

THESIS

MEASUREMENTS OF MANTLE ATTENUATION  
AROUND THE YELLOWSTONE HOTSPOT

Submitted by

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## ABSTRACT

### MEASUREMENTS OF MANTLE ATTENUATION AROUND THE YELLOWSTONE HOTSPOT

Estimation of the seismic attenuation  $t^*$  was performed using teleseismic  $P$ -wave spectra recorded by 174 broadband seismic stations around the Yellowstone hotspot, WY, US.  $P$ -wave spectra used were generated by earthquakes with a moment magnitude ( $M_W$ ) greater than 6.4 and with epicentral distances ranging from  $30^\circ$  to  $180^\circ$ , with focal depths greater than 200 km, within a time frame from 1995 to 2009. Multi-channel cross-correlation was used to align all waveforms, then the Futterman operator was applied to estimate the variations in  $t^*$ .  $t^*$  residuals vary from -0.5 to 0.5 s. Most  $dt^*/d[\text{travel time}]$  values were found to be in the negative domain, which contradicts expected values. This could imply that the absorption or dissipation of energy and the frequency dependence of seismic velocities are not due to intrinsic attenuation but rather due to scattering in the mantle and/or water content in the vicinity of the Yellowstone plume.



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## Chapter 1

### INTRODUCTION

#### Purpose of the Study

In this study measurements of variations in the frequency content of teleseismic waves observed in the vicinity of the Yellowstone hotspot have been explored as a way to constrain the mantle temperature. Frequency variations in seismograms from a common event are thought to be caused by spatial variations in seismic wave attenuation caused primarily by anelastic loss of seismic wave energy. Characterization of this effect can be used to infer temperature in two ways. First, it constrains otherwise free parameters that affect the mapping between seismic velocity and temperature, such as rock activation energy, partial melting, water content, and the frequency dependence of  $Q$ , that define the mapping between seismic velocity and temperature; and secondly, since attenuation is temperature dependent, it can be used to get an indirect temperature estimate [Faul, 2005]. However, poorly known parameters such as the mantle's grain size, and activation volume make this challenging.

At the conditions within the Earth's mantle a variety of temperature dependent grain-scale processes cause seismic waves to lose energy, including: stresses that induce migration of defects, frictional sliding on crystal grain boundaries, vibration of dislocations, and (potentially) movement of melt--“melt squirt”--within pores. A way to characterize the sum of these effects is through the quality factor,  $Q$ , which is defined as



the multiplicative inverse of the energy loss per cycle.  $Q$  is relatively sensitive to small degrees of partial melt or rock composition, unlike seismic wave velocities [Schutt, 2006]. By solving for  $Q$ , or attenuation,  $Q^{-1}$ , insights can be gained into temperature variations in the mantle [Stachnick, 2004].

### Yellowstone and its history

The Yellowstone volcanic trend is an age-transgressive 700 km long silicic volcanic province caused by a mantle hotspot of unknown source. The trend seems to start at 17 Ma around the Oregon-Idaho-Nevada border, although the exact location is a matter of debate [Pierce, 2009]. Around 10-12 Ma, the trend becomes much more distinct, and is marked by a series of rhyolite caldera complexes that gradually get younger to the northeast, culminating in the current caldera in Yellowstone National Park (Figure 1). This caldera has an active magma chamber under it [Pierce, 2009; Smith, 2009] (Figure 2).

At the surface, passage of the hotspot is marked by two modes of volcanism. The first stage is marked by rhyolite flows and huge ignimbrite eruptions; these have produced five of the forty seven largest known explosive eruptions since the Ordovician [Mason, 2004]. The rhyolite is thought to be produced by crustal melting due to massive gabbroic intrusion into the mid-crust. This ~10 km mid-crustal sill complex is denser than the surrounding country rock, causing isostatic depression of the lithosphere and forming the Snake River Plain (SRP) depression (Figure 1) [McQuarrie, 1998; Stachnick, 2008]. The second stage of volcanism occurs as basalt flows about 2 Myr after the earliest rhyolite eruptions [Christiansen, 2002; Pierce, 1992]. These may occur

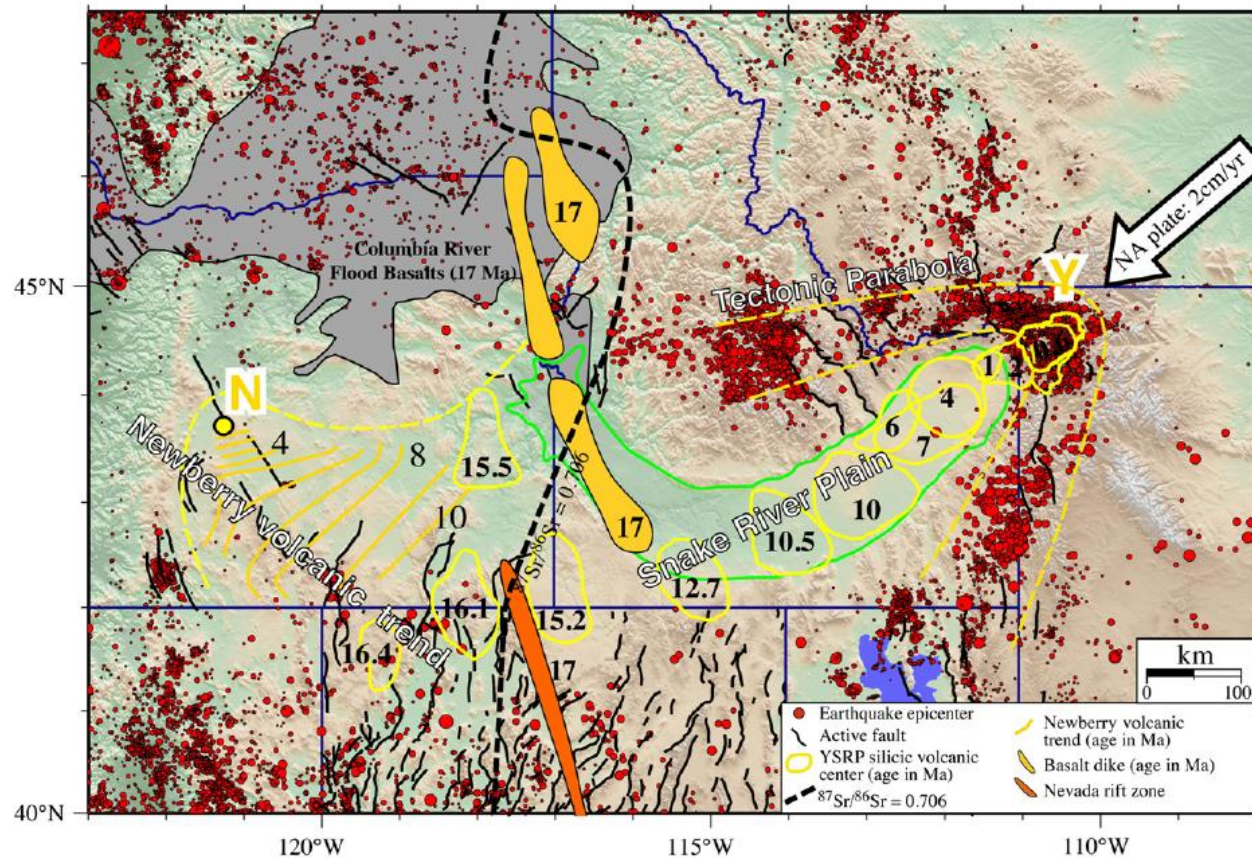


Figure 1. Yellowstone hotspot track. Relative motion (with respect to the hotspot) of the age-transgressive Snake River Plain (SRP--encircled by green line). The silicic volcanic centers with their relative age (in Ma) are depicted as yellow ovals. Earthquake epicenters are shown as red dots. The yellow near-parabolic dashed lines show a region of heightened uplift, faulting, and seismicity thought to be due to the mantle structure of the hotspot. To the west, the yellow dashed line shows the extent of the counter-propagating Newberry volcanic trend in Oregon. North of this, the Columbia River flood basalt is shown in gray [Smith, 2009].

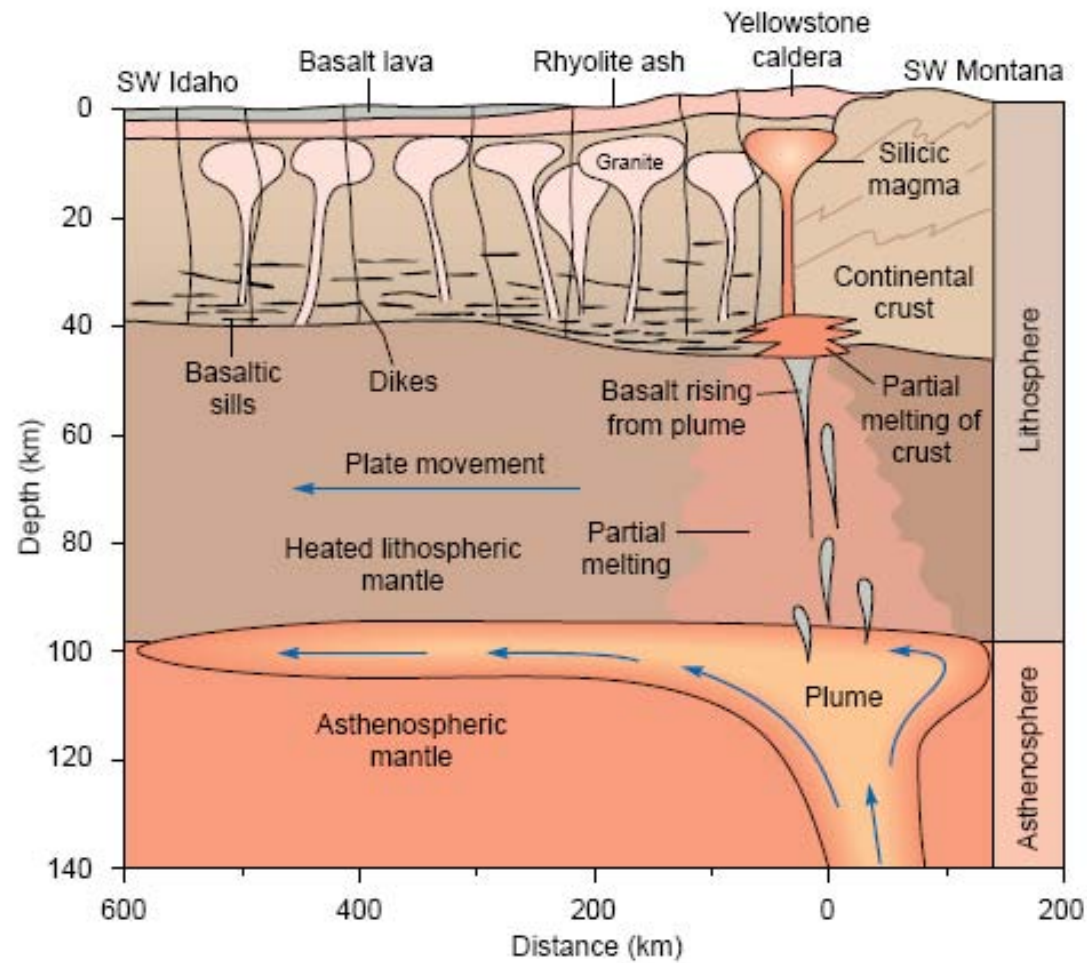


Figure 2. Schematic depiction of magma chamber underneath the Yellowstone caldera and structure beneath the *SRP*, from SW Idaho to SW Montana [Hamblin, 2004].

because the initial mid-crustal mafic magmatism makes the crust more dense, allowing mafic magmas to reach the surface [Annen, 2009].

Broadly speaking, two hypotheses have been put forward for Yellowstone: the hotspot has been characterized as being either a shallow lithospheric/asthenospheric melting anomaly, or a plume sourced in the deep mantle. Currently evidence is in favor of a deep mantle plume source, as recent seismic tomography has shown a cylindrical low-velocity feature to a depth of at least 500 - 600 km inclined to the northwest from Yellowstone [Smith, 2009; Waite, 2006; Yuan, 2005] (Figures 3 and 4). Other evidence includes: a high  $^3\text{He}/^4\text{He}$  anomaly [Graham, 2009], thermal models that need plume-like temperatures to fit the observed surface wave phase velocities associated with the hotspot track [Schutt, 2008], and a southwest-widening topographic swell that also seems to have heightened seismicity and faulting--this feature is thought to be produced by upwelling material interacting with the moving North America lithosphere [Ribe, 1999]. On the other hand, there is no clear tomographic evidence for a lower mantle component to the plume [Yuan, 2005]. Some researchers have produced tomographic images that suggest the hotspot is solely an upper mantle feature [Christiansen, 2002], and ongoing studies presented at a recent conference [Obrebski, 2010] have shown the interpretation of the deep structure of Yellowstone is subject to debate.

Researchers that favor an upper mantle origin to Yellowstone suggest it could be caused by a regional mid-Miocene tectonic reorganization in which extensional deformation that began in the southwestern U.S. propagated northward over time, in response to the northward migration of the Mendocino triple junction, and generated the hotspot track through decompression [Leeman, 2009] Furthermore, basalt geochemistry

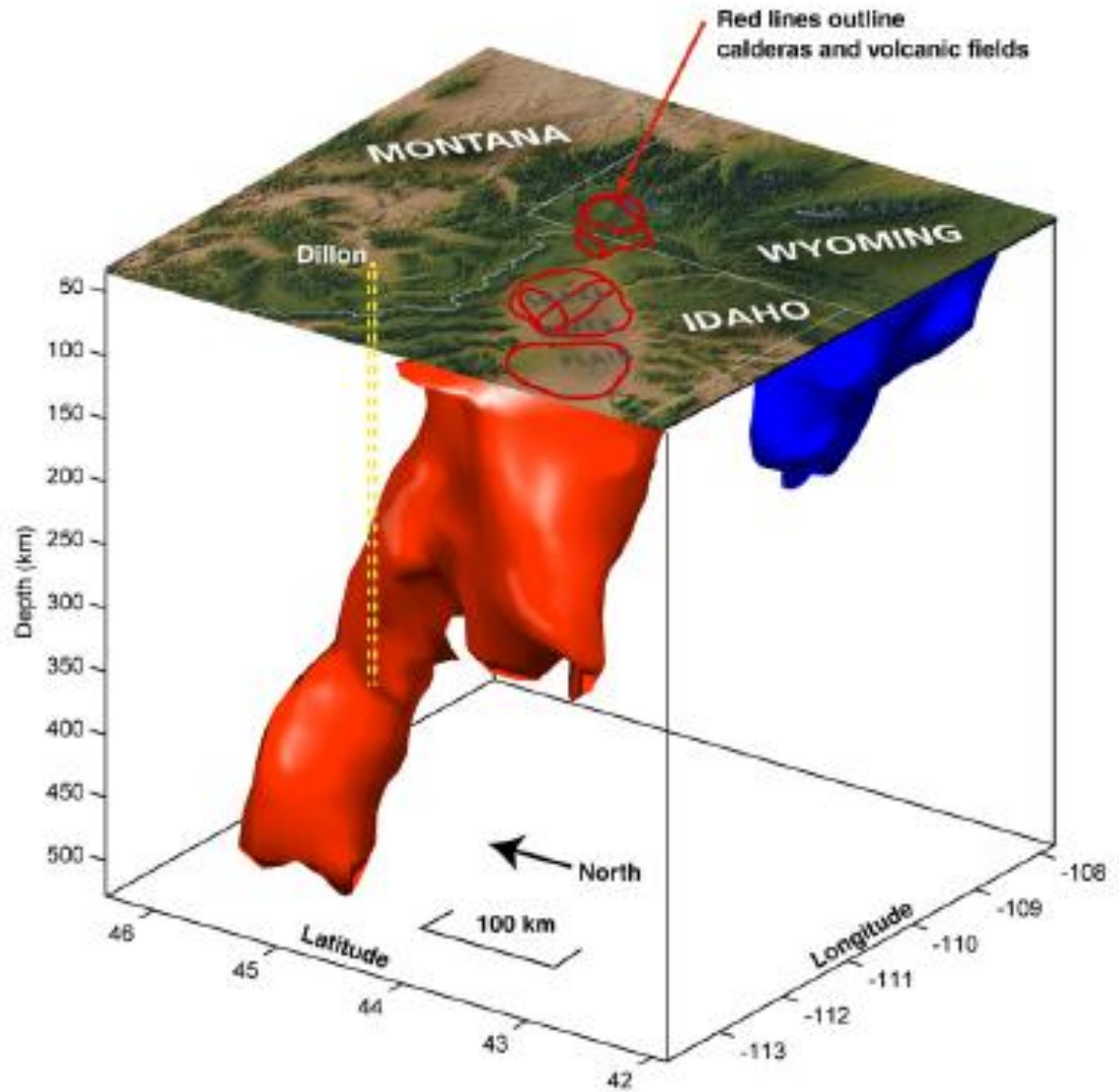


Figure 3. Seismic tomography model showing a northwest dipping pipe of low velocity mantle beneath Yellowstone (red isosurface) [Yuan, 2005].



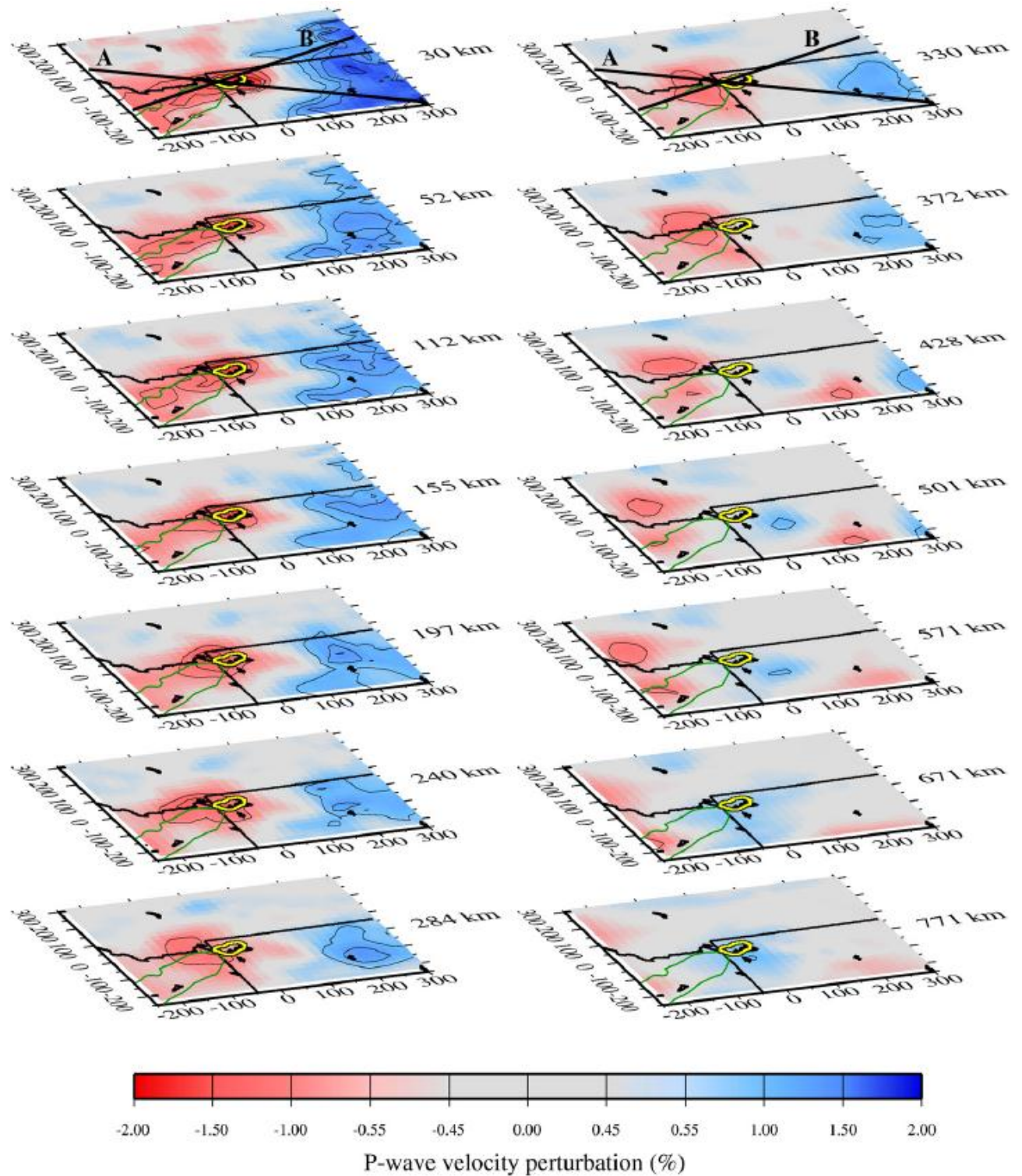


Figure 4. Slices through a P-wave Yellowstone tomographic model from 30 km to 771 km depth. Red and blue colors refer to low and high relative velocity variations, respectively. Yellow outline refers to the Yellowstone caldera [Smith, 2009].

shows a signature of ancient depleted mantle, suggesting melting of the Wyoming Craton lithosphere rather than young plume material [Doe, 1982; Leeman, 1985].

To further address the cause of Yellowstone magmatism, it is helpful to review the nature of hotspots and plumes. Hotspots are defined by time-transgressive volcanism over hundreds of kilometers, with geochemically distinct lavas; they are generally considered to be surface manifestations of partially molten mantle. The cause of the melting is not addressed: a “hotspot” is a surface observation. A plume is a buoyant thermal (and potentially chemical) upwelling from a deep thermal boundary layer. Typically it is considered to consist of upwelling of chemically primitive mantle from the core-mantle boundary [Adams, 2010; Ritsema, 2003]. Plume models generally have a mushroom-like head (Figure 5) and a tail. As this material ascends into the upper mantle it crosses the solidus and melts (Figure 6). This process is thought to be responsible for flood basalts [Jordan, 2004; Hamblin, 2004]. Behind the head, the tail that comes up causes the time-transgressive magmas that create the hotspot track as the North American plate moves (Figures 1 and 2).

A plume origin for many hotspots is supported by the relative fixedness of hotspots, the need for an anomalous heat source, and elevated  $^3\text{He}/^4\text{He}^1$  values thought to represent long-isolated “primordial” mantle [Courtillot, 2003; Humphreys, 2000]. Since mantle plumes nucleate at deep thermal boundary layers, they will have temperatures

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<sup>1</sup>  $^3\text{He}/^4\text{He}$  ratios of 7 to 9  $R_A$  (where  $R_A$  is the atmospheric ratio =  $1.38 \times 10^{-6}$ ) are typical of Mid-ocean ridges basalts. They are considered representative of sources within the convecting asthenospheric upper mantle. Lower  $R_A$  values reflect additional contributions from lithospheric mantle or the crust. Values above 10  $R_A$  indicate derivation from a region with higher time-integrated  $^3\text{He}/(\text{U}+\text{Th})$ , which is taken to be from the deep mantle by a thermochemical plume [Graham, 2009].

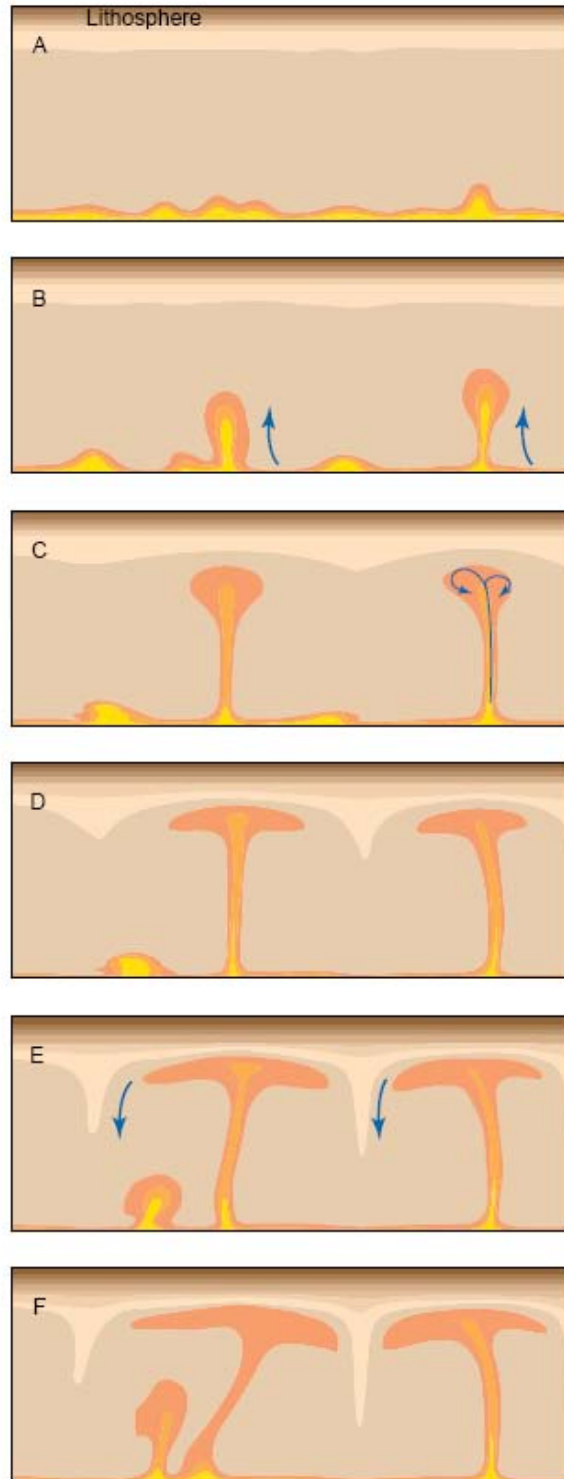
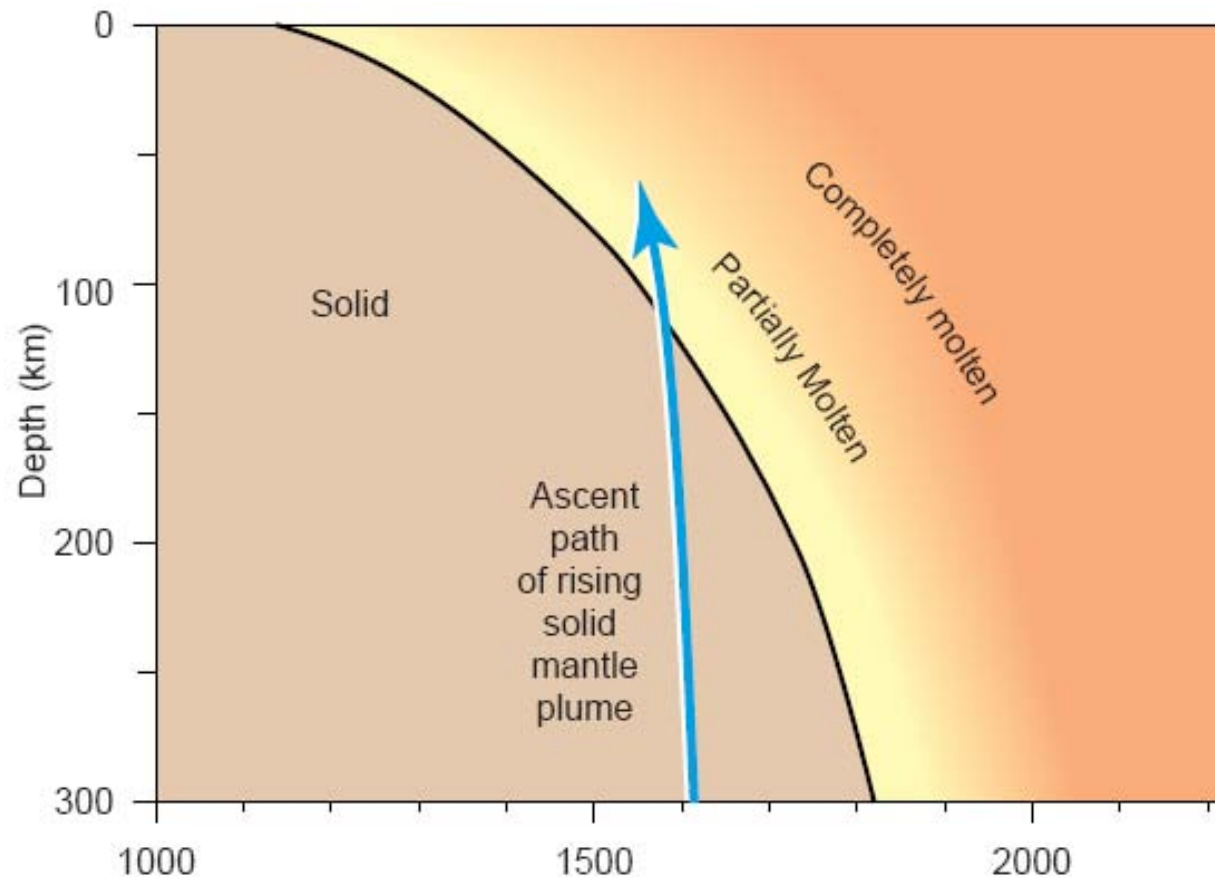


Figure 5. Subfigures A through F shows the development of a mantle plume. The mantle plume mushroom-like head and tail can be seen. Yellow and orange colors refer to higher temperatures, beige grey represents background mantle temperature of 1300°C-1400°C [*Hamblin, 2004*].





& \* +) , ' - . ) ! \$ "

Figure 6. Magma is produced as a result of decompression melting in a mantle plume (schematic diagram). Black line refers to the temperature at which melting begins for mantle peridotite. The blue arrow denotes the pressure and temperature path followed by the rising plume. If conditions in the plume cross the melting curve at shallow depths, basaltic magma is produced [Hamblin, 2004].

higher (200°C-300°C) than average convecting mantle, which is typically thought to have a potential temperature of around 1300°C-1400°C [Courtier, 2007].

### Anelasticity and attenuation

Seismic velocity models (tomograms) of regions in the Earth provide important clues to the processes occurring therein. However, an important challenge is to map seismic velocity into more fundamental parameters, such as temperature, melting and composition. While general relations are known, such as that increasing temperature monotonically decreases seismic velocities, putting tight constraints on aspects such as temperature has remained elusive. The physics of rock properties at high temperatures and pressures is not well-understood, and laboratory measurements are extremely difficult [e.g. *Faul*, 2005]. What is clear, however, is on the time scale of seismic wave propagation, two types of deformation are important: anharmonic and anelastic.

Anharmonic deformation is elastic. In this mode of deformation, strain is recoverable (material returns to its original shape after the stress that deforms it is removed), and the relationship between rock elastic properties and aspects such as temperature and composition is relatively well-known [Schutt, 2006]. At higher temperatures, especially as mantle rocks approach their solidus (Figure 6), anelasticity becomes an important mode of deformation. During anelastic deformation some of the seismic wave energy is converted to heat through irreversible changes in the microstructures within and among the mineral constituents of rocks. Its deformation depends on the time rate of stress change as well as on the stress itself, causing internal

damping. The causes of anelastic dissipation are: stresses that induce migration of defects in mineral structures, the frictional sliding on crystal grain boundaries, the vibration of dislocations, and the flow of hydrous fluids or magma along grain boundaries within the minerals [Stein, 2003].

Different wavelengths of energy excite different anelastic processes. Thus, the elastic energy loss per wave cycle, attenuation ( $A$ ), has a frequency-dependent nature (Figure 7 (from [Stein, 2003] – modified with hatchings)):

$$A(\omega) = \frac{1}{Q(\omega)} = \frac{\Delta E(\omega)}{2\pi E_{max}} \quad (1)$$

where  $\omega$  is angular frequency ( $\omega=2\pi f$ ),  $\Delta E(\omega)$  is the energy lost per cycle and  $E_{max}$  is the maximum elastic energy contained in a cycle. However, for teleseismic seismograms which have dominant energy at 1-100 s periods, attenuation per cycle is near constant as discussed below.  $Q$  can be characterized as having a weak or non-existent frequency dependence when teleseisms are used:

$$Q \sim \omega^\alpha \quad (2)$$

where  $\alpha \sim 0.1 - 0.3$ , and  $\omega$  is angular frequency over the range of  $\sim 10^{-8}$  to 1 Hz [Karato, 1993]. The weak frequency dependence is generally consistent with long-period

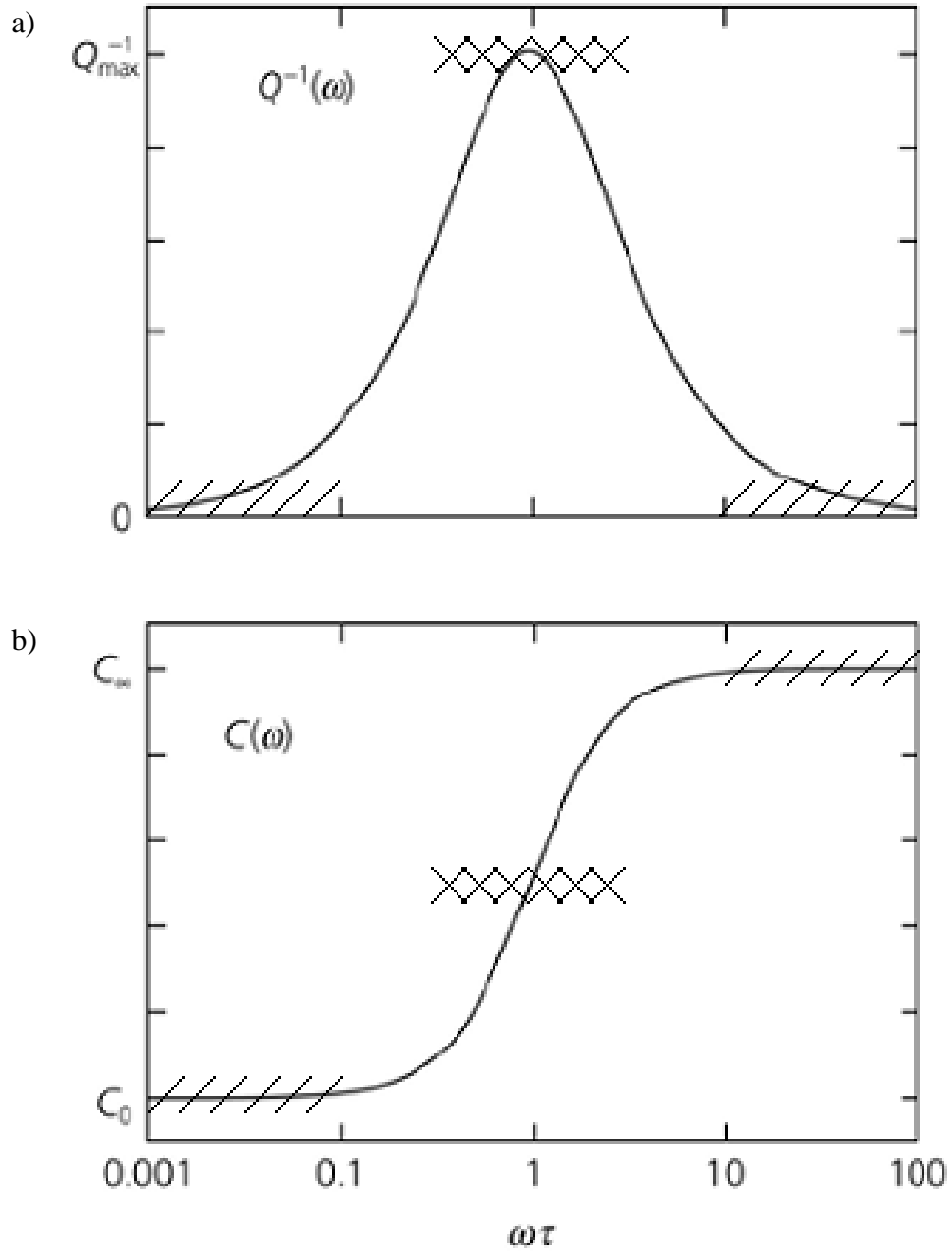


Figure 7. Frequency-dependence of attenuation. (a) Seismic attenuation  $Q(\omega)$  as a function of angular frequency  $(\omega)$ ; and (b) phase velocity,  $c(\omega)$ , as a function of angular frequency for a linear viscoelastic solid with a single relaxation time  $\tau$ .  $Q = Q^{-1}$ , or  $Q = 1$  [Stein, 2003].

variations in  $Q$  at mantle depths (explained below, see Figures 7 and 9). A simple analogue for anelasticity in the Earth is the *viscoelastic system* or *standard linear solid* model [Stein, 2003]. This model consists of a dashpot in series with a spring, and these are connected in parallel to another spring (Figure 8).

In this model, the springs model the anharmonic response, and the dashpot models the anelastic response of the Earth. Below, I will explore the properties of this system and then explain similarities and differences with the real Earth. The force with which a spring resists deformation,  $F$ , is proportional to the displacement of the spring ( $x$ ) times the strength of the spring ( $k$ ):

$$F = kx \quad (3)$$

the dashpot dissipates energy viscously (and unrecoverably). In it, the resistance to deformation ( $F$ ) is proportional to the rate of deformation (velocity,  $v$ ) multiplied by its viscosity ( $\eta$ ):

$$F = \eta v \quad (4)$$

If the process of deformation takes place fast enough, the dashpot will be glued to

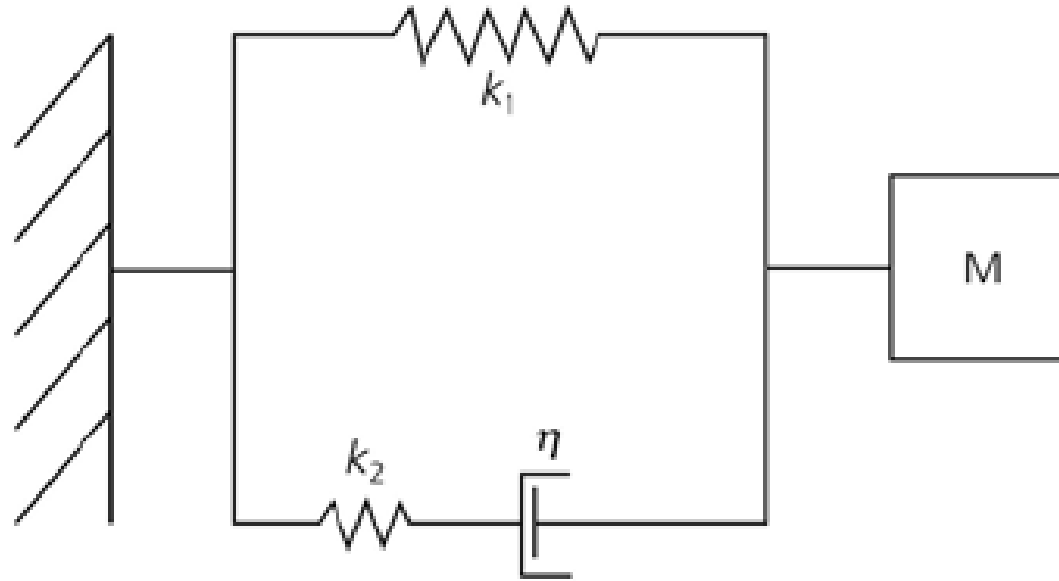


Figure 8. The *standard linear solid* model (also called the *viscoelastic system*). This is a simple analogue way to explain Earth's response to deformation. It consists of a dashpot connected in series with a spring that is connected in parallel with another spring.  $k_1$ , and  $k_2$  are the spring constant,  $\eta$  refers to the dashpot, and  $M$  the mass attached to the system [Stein, 2003].

the system, such as in response to an infinite frequency sine wave of amplitude  $A$ ; the displacement of the spring then is,

$$x(t) = A \sin(\omega t) \quad (5)$$

as  $\omega \rightarrow \infty$ , then the rate of deformation (velocity) is,

$$v(t) = A \cos(\omega t) \quad (6)$$

will approach infinity. Thus, the resistive force of the dashpot will approach infinity, acting as if it is fixed into the system and the system will respond as two springs in parallel. The effective spring constant of the system is then,

$$K_{eff} = k_1 + k_2 \quad (7)$$

Conversely, if the process of deformation takes place very slowly,  $\omega \rightarrow 0$  and  $v(t) \rightarrow 0$ . In this case the dashpot will present no resistance and it will behave as a break in the system. In this case, this is equivalent as having only one spring  $k_1$ , and an effective spring constant:

$$K_{eff} = k_1 \quad (8)$$

For  $\omega = 0$ , the effective spring constant is less than the effective spring constant for  $\omega = \infty$ . In the case of the Earth, the harmonic input force is caused by seismic waves. Very long period waves approach the  $\omega \rightarrow 0$  end-member, and high frequency seismic waves approach the  $\omega = \infty$  case. Thus for low frequencies the Earth's elastic response ( $K_{eff}$ ) is less stiff than for high frequencies. Because of this, the terms *unrelaxed* and *relaxed* are used to refer to the moduli and velocities at  $\omega = \infty$  and  $\omega = 0$  respectively. In neither of these cases is the dashpot absorbing energy, which implies that attenuation is 0. For finite frequencies, the viscous processes represented by the idealized dashpot will absorb energy, and the energy lost will be maximized at a frequency that is dependent upon the viscosity of the dashpot. Mathematically, attenuation is described by

$$Q^{-1}(\omega) = \frac{k_2}{k_1} \left[ \frac{\omega\tau}{1+(\omega\tau)^2} \right] \quad (9)$$

where  $\tau$  is the relaxation time constant,  $\tau = \left(\frac{\eta}{k_2}\right)$ , in which  $\eta$  is the viscosity of the dashpot, and  $k_1$  and  $k_2$  the spring constants [Anderson, 1989]. Attenuation is maximized at  $\omega\tau = \omega \left(\frac{\eta}{k_2}\right) = 1$  or  $\omega = \frac{1}{\tau}$  (called the “absorption peak” and indicated by cross-hatching



in Figure 7a), and  $Q^{-1} = Q_{max}^{-1} = \frac{k_2}{2k_1}$  (Figure 7a). Thus,  $Q$  for the system can be expressed as

$$Q^{-1}(\omega) = 2Q_{max}^{-1} \left[ \frac{\omega\tau}{1+(\omega\tau)^2} \right] \quad (10)$$

and the velocity of the system is,

$$c(\omega) = c_0 \left\{ 1 + Q_{max}^{-1} \left[ \frac{(\omega\tau)^2}{1+(\omega\tau)^2} \right] \right\} \quad (11)$$

where  $c_0$  represents the relaxed velocity or low-frequency limit of the system which is known as,

$$c_0 = c(\omega = 0) = \sqrt{\left(\frac{k_1}{\rho}\right)} \quad (12)$$

and the unrelaxed velocity (elastic velocity) or high-frequency limit is (Figure 7b)

$$c_\infty = c(\omega = \infty) = c_0 \left[ 1 + \left( \frac{k_2}{2k_1} \right) \right] = c_0(1 + Q_{max}^{-1}) \quad (13)$$

[Anderson, 1989]. It can be seen that far away from the absorption peak (hatching in Figure 7a) in these two limits, velocity is nearly independent of frequency, but  $Q$  varies as  $\omega$  or  $\omega^{-1}$  [Anderson, 1989].

In this model, where  $Q^{-1}$  is nearly constant (cross-hatching in Figure 7a) the system approaches the Earth's mantle's conditions. *Kanamori and Anderson* [1977] and *Minster and Anderson* [1981] have shown that Earth's attenuation is best modeled not as a single characteristic frequency but rather as an absorption band (Figure 9a), which can be modeled as a superposition of the relaxation peaks (such as the one shown in Figure 7a). If the superposition of relaxation peaks is distributed as  $\tau^{-1}$  continuously between two relaxation times,  $\tau_1$  and  $\tau_2$  then,

$$Q^{-1}(\omega) = \frac{2Q_{max}^{-1}}{\pi} \cdot \tan^{-1} \left[ \frac{\omega(\tau_1 - \tau_2)}{(1 + \omega^2 \tau_1 \tau_2)} \right] \quad (14)$$

and the velocity of the system (Figure 9b) then can be expressed as

$$c(\omega) = c_0 \left\{ 1 + \frac{Q_{max}^{-1}}{2\pi} \cdot \ln \left[ \frac{(1 + \omega^2 \tau_1^2)}{(1 + \omega^2 \tau_2^2)} \right] \right\} \quad (15)$$

For  $\tau_1 \ll \omega^{-1} \ll \tau_2$ , then  $Q^{-1}(\omega) \sim Q_{max}^{-1} = \text{const.}$  and thus the total dispersion

is,

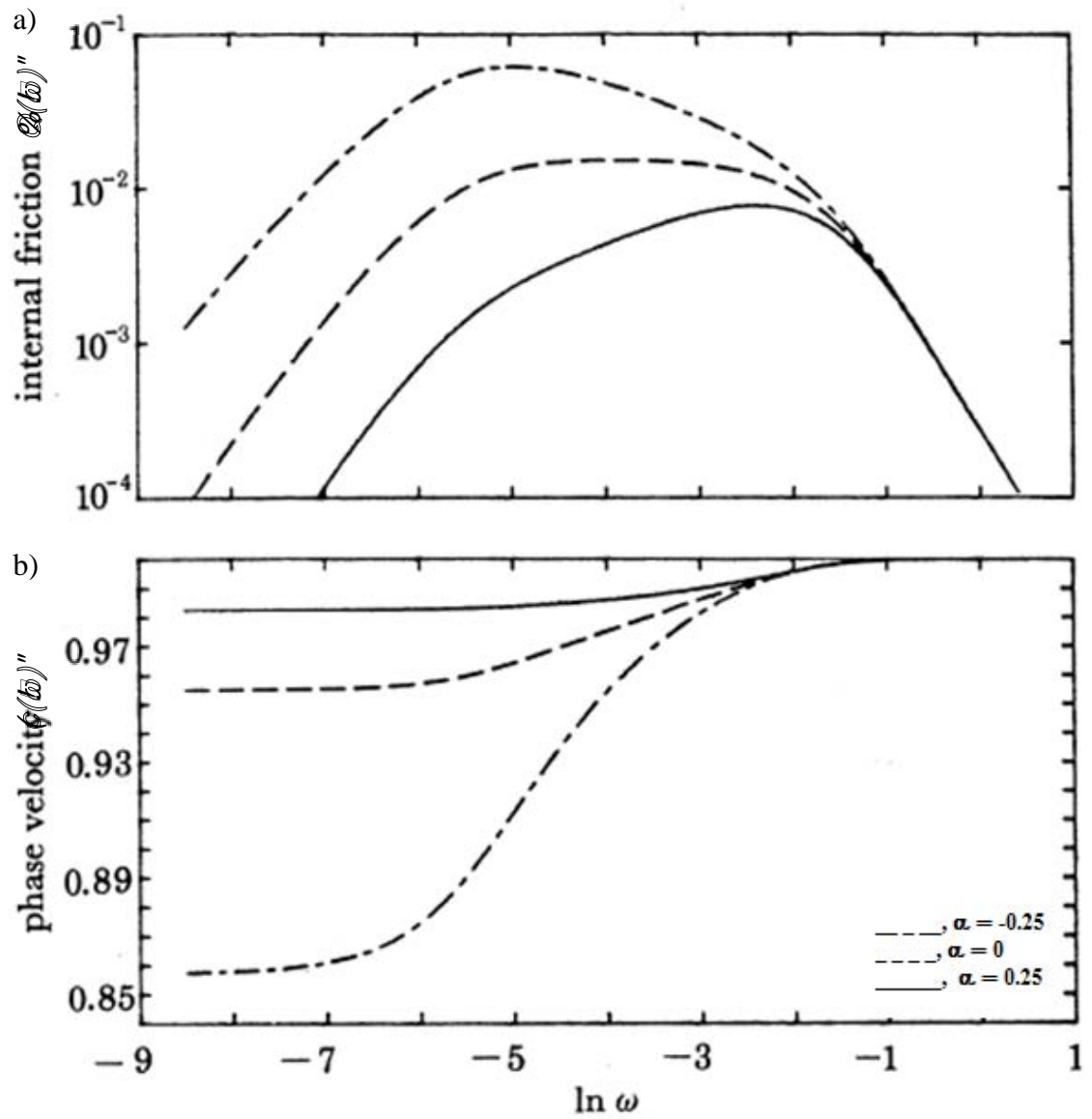


Figure 9 shows a weak frequency dependence of  $\mathcal{Q}(\omega)^{-1}$  for  $\alpha = -0.25, 0$ , and  $0.25$ , respectively. Relaxation spectra have been adjusted to yield identical high-frequency behavior [Minster, 1981].

$$\left(\frac{\Delta c}{c_0}\right) = \left(\frac{c_\infty - c_0}{c_0}\right) = \left(\frac{Q_{max}^{-1}}{\pi}\right) \ln\left(\frac{\tau_1}{\tau_2}\right) \quad (16)$$

which is dependent upon the ratio of relaxation times  $\left(\frac{\tau_1}{\tau_2}\right)$ , which indicates the width of the absorption band. Relaxation time is related to temperature as:

$$\tau(T) = \tau_0 e^{\left(\frac{E^*}{RT}\right)} \quad (17)$$

in which  $\tau_0$  is a pre-exponential factor,  $E^*$  is the activation energy,  $R$  the gas constant, and  $T$  the absolute temperature [Karato, 1993]. *Minster* and *Anderson* [1981] showed how the relaxation peak depends upon temperature (Figure 10a). So, for a frequency independent  $Q$  (absorption band – Figure 9a) the seismic wave velocity is dependent on frequency and temperature as

$$V(\omega, T) = V_0(T) \left\{ 1 + \frac{Q_{max}^{-1}}{\pi} \cdot \ln[\omega \tau(T)] \right\} \quad (18)$$

where  $V_0$  is known as a reference velocity that corresponds to an unrelaxed – high-

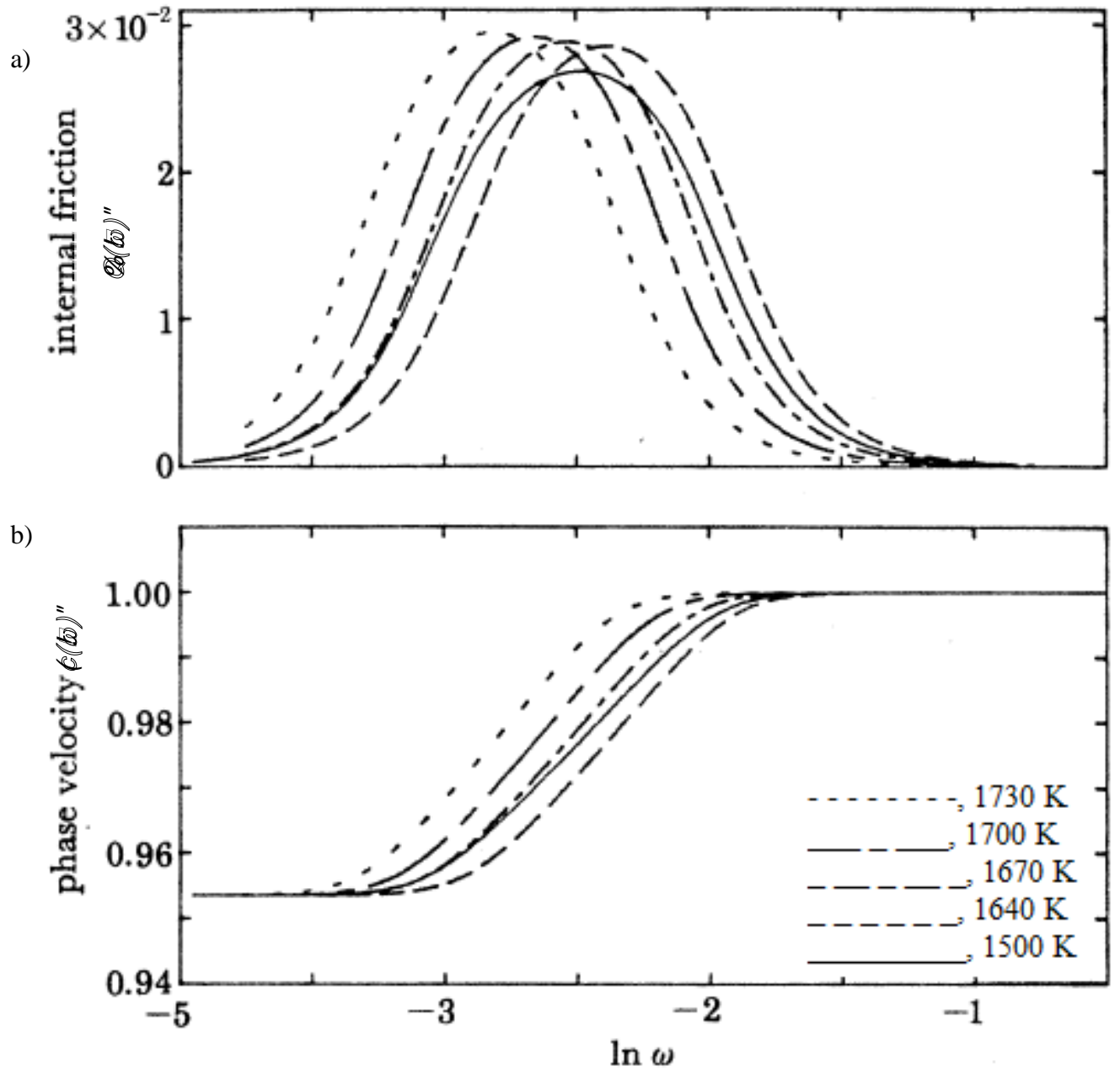


Figure 10. Effects of temperature on dispersive properties of attenuation. Differing temperatures produce differing relaxation times (eq. 16)[Minster, 1981]. Legend: various line styles show the response of the system for different temperatures.

frequency state, and  $\tau(T)$  the relaxation time – the temperature dependent characteristic time at which the wave amplitude decays by  $e^{-1}$  [Kanamori, 1977; Minster, 1981].

### Q to Temperature

In order for temperature to be inferred from  $Q$ , P-wave attenuation combined with P-wave velocity anomalies from seismic tomography are used. By taking the derivative of equation (18) with respect to temperature, and assuming  $Q^{-1} \ll 1$ , equation 18 becomes:

$$\frac{\partial \ln(V)}{\partial T} = \frac{\partial \ln(V_0)}{\partial T} - \left( \frac{Q^{-1}}{\pi} \right) \left( \frac{H^*}{R T^2} \right) \quad (19)$$

However, if  $Q$  is weakly frequency dependent ( $Q \sim \omega^\alpha$ ,  $0 < \alpha < 1$ ), then seismic wave velocity depends on frequency as [Minster, 1981],

$$V(\omega, T) = V_0(T) \left\{ 1 - \left( \frac{1}{2} \right) \cot \left( \frac{\pi \alpha}{2} \right) Q^{-1}(\omega, T) \right\} \quad (20)$$

thus, for  $Q^{-1} \ll 1$ ,

$$\frac{\partial \ln(V)}{\partial T} = \frac{\partial \ln(V_0)}{\partial T} - F(\alpha) \left( \frac{Q^{-1}(\omega, T)}{\pi} \right) \left( \frac{H^*}{R T^2} \right) \quad (21)$$

where,

$$F(\alpha) = \left( \frac{\pi \alpha}{2} \right) \cot \left( \frac{\pi \alpha}{2} \right) \quad (22)$$

describes the effect of frequency on anelasticity. The first terms of equation (19) and (21) represent the temperature derivative due to anharmonic effects, and the second term of the equations represents the anelastic effects. By considering equations (19) and (21) it can be seen that the anelastic effect,  $F(\alpha) \left( \frac{Q^{-1}(\omega, T)}{\pi} \right) \left( \frac{H^*}{RT^2} \right)$ , is proportional to the energy loss,  $Q^{-1}$ ; anelasticity is also dependant upon the activation enthalpy,  $H^*$ , and the frequency dependence of  $Q$ ,  $\alpha$  [Karato, 1993]. These effects can depend upon depth [Karato, 1993]. Karato [1993] showed plots of temperature derivatives of seismic wave velocities in the mantle as a function of depth (Figure 11).

### Measuring attenuation

As stated in page 1,  $Q$  is the multiplicative inverse of the energy loss per cycle. This implies that attenuation ( $Q^{-1}$ ) causes an exponential decay in energy as a function of frequency. Amplitude effects of attenuation are:

$$A(\omega) = e^{\left( \frac{-\omega t^*}{2} \right)} \quad (23)$$

where  $A$  is the amplitude,  $\omega$  is angular frequency ( $2\pi f$ ) in Hz; and:

$$t^* = \int_{path} \frac{dt}{Q} \quad (24)$$

is the integrated attenuation along the ray path, where  $dt$  is the travel time along a segment of the ray path. For constant velocity and attenuation along the ray path (24) reduces to:

$$t^* = \frac{tt}{Q} \quad (25)$$

where  $tt$  is the travel time and  $Q$  is the quality factor.

The observed spectrum of a seismogram at a station  $O(\omega)$  can be written as a product of the source spectrum,  $S(\omega)$ , the instrument response of the seismometer,  $I(\omega)$ , and the effects of attenuation,  $A(\omega)$ .

$$O(\omega) = S(\omega)I(\omega)A(\omega) \quad (26)$$



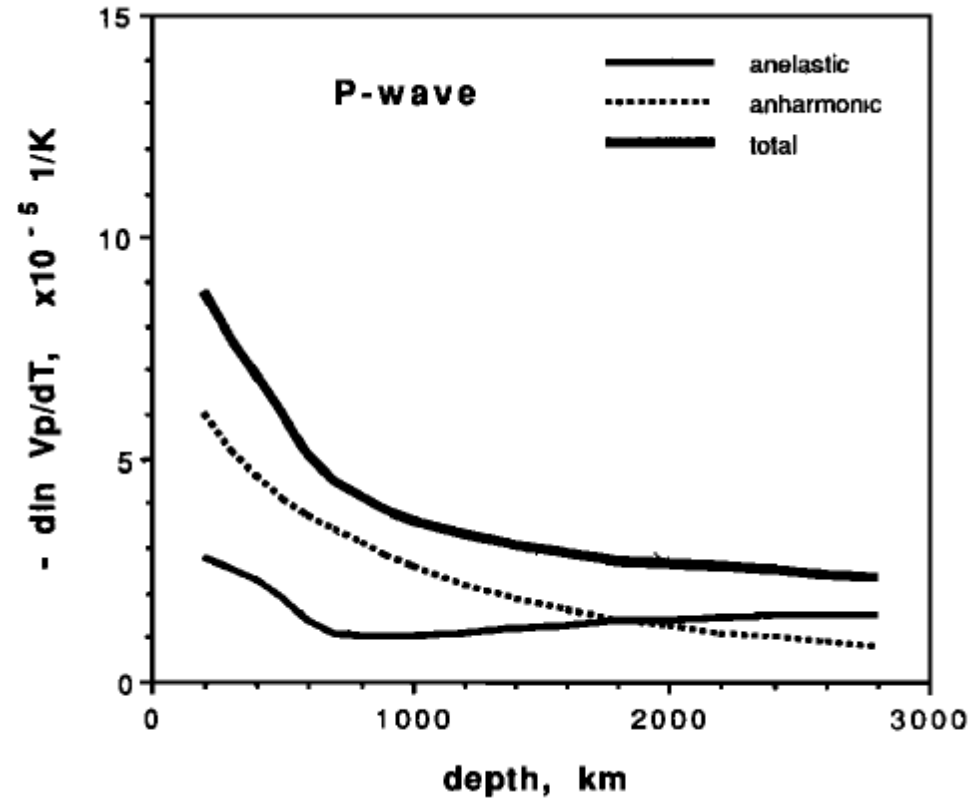


Figure 11. Temperature derivatives of seismic wave velocities plotted vs depth. Anelastic effects, anharmonic effects and total temperature derivatives – which are the sum of anharmonic effects and anelastic effects – are shown in the plot. Anelastic effects are calculated from seismologically inferred  $Q$  for shear modulus.  $Q$  for compressional waves is calculated assuming  $Q$  for bulk modulus, infinite. Adiabatic temperature gradients are assumed [Karato, 1993].

Since  $S(\omega)$  is constant for a given event, and  $I(\omega)$  is constant for broadband seismometers over the range of frequencies in a teleseismic P-wave, for a given event observed at an array of seismometers:

$$O(\omega) = kA(\omega) = ke^{\left(\frac{-\omega t^*}{2}\right)} \quad (27)$$

where  $k$  is a proportionality constant. Although  $A(\omega)$  is described above as being caused by anelasticity, there is a complication. Impedance contrasts along the path of propagation of the seismic energy can cause energy to scatter off of the ray path through reflections and refractions. If these impedance contrasts are small in size with respect to the dominant wavelength, this will cause a loss in high-frequency energy called extrinsic attenuation [Stein, 2003] that can be difficult to distinguish from attenuation caused by anelasticity (intrinsic attenuation). However, studies suggest that scattering effects tend to average out to zero, as maps of estimated  $t^*$  correlate with mantle velocity structure as would be expected if  $t^*$  was reflecting intrinsic attenuation [Hwang, 2009].

### Expected $Q$

Although there are few  $Q$  data on mantle hotspots, it is worth reviewing other studies to get an idea of what range of  $Q$  values might be found. Beneath central Alaska, an active subduction zone with absent arc volcanism,  $Q$  was measured for S-wave

frequencies between 0.5 – 20 Hz. This study found a low  $Q$  (high attenuation) wedge, with  $Q_S < 150$  at 1 Hz, and a low-attenuation slab, with  $Q_S > 500$  (assuming frequency-dependence). This implies temperatures for the wedge that exceed  $1200^{\circ}\text{C}$  [Stachnick, 2004]. In the Tanzania craton and the eastern branch of the East African Rift, the upper mantle  $Q$  was found to be  $Q_P \sim 175$  beneath the cratonic lithosphere, and  $Q_P \sim 80$  beneath the rifted lithosphere. This variation in  $Q$  was ascribed to temperatures 140-280 K higher than ambient mantle temperatures beneath the eastern rift region [Vemkatamaran, 2004].

In Yellowstone,  $Q_S$  has been predicted from a study that attempted to estimate the temperature of low velocity mantle beneath the eastern Snake River Plain [Schutt, 2008]. In this study, temperature and grain size were varied in an attempt to match extremely low fundamental mode Rayleigh wave phase velocity measurements. As part of the research  $Q_S$  predictions were made by estimating parameters in two differing equations for the effects of temperature on  $Q$  [Goes, 2000; Jackson, 2006]. These  $Q_S$  predictions ranged from 15 to 25, and 25 to 40 (Figure 12) depending on whether the grain size was predicted to be important (the former  $Q_S$  values [Jackson, 2006]) or unimportant (the latter  $Q_S$  values [Goes, 2000]) [Schutt, 2008]. A global attenuation study of the upper mantle found variations in Rayleigh wave  $dQ_S^{-1}/Q_S^{-1}$  of  $\pm 60\%$  to  $\pm 100\%$  exhibiting a strong agreement with tectonic features at depth of 200 km [Dalton, 2008]. Low  $Q_S$ , as low as 100, dominates greater depths in the southeastern Pacific and eastern Africa, and higher attenuation (high  $Q_S^{-1}$ ) in many subduction zones in the western Pacific (Figure 13). Young oceanic regions are those most attenuated, and it has been found that in

general attenuation decreases with seafloor age (Figure 14), at shallow depths ( $< 200$  km) [Dalton, 2008].

In continents orogenic zones and magmatic belts have higher lithospheric attenuation than Precambrian shields and platforms. At greater depths ( $\sim 200$ - $250$  km), there does not seem to be a clear correlation between tectonic regime and attenuation. All in all, it seems that the range of  $Q$  depicted by Schutt [2008] is lower than most studies, although Yellowstone and the Snake River Plain also have some of the most lowest velocities ever found in the uppermost mantle [Schutt, 2008]. If  $Q_S$  values range from 15 to 25 and 25 to 40 depending on the grain size (as depicted above), values for  $Q_P$  can be obtained by [Stein, 2003],

$$Q_P \approx \left(\frac{9}{4}\right)Q_S \quad (28)$$

then, our expected values for  $Q_P$  would range from 33 to 56 and 56 to 90. Since both seismic velocity decreases and attenuation increases as temperature increases, a useful way to examine data is to look at the relationship between travel time and  $t^*$  for a given event. For the *SRP* a simple back-of-the-envelope calculation was performed to compare our seismological intuition with actual results. This is done assuming that the *SRP* has a 100 km deep low velocity structure with a  $\sim 5\%$   $V_P$ , which is an approximation of tomographic results [Waite, 2006; Schutt, 2008] to a decrease and a change in  $Q_S$  from 20

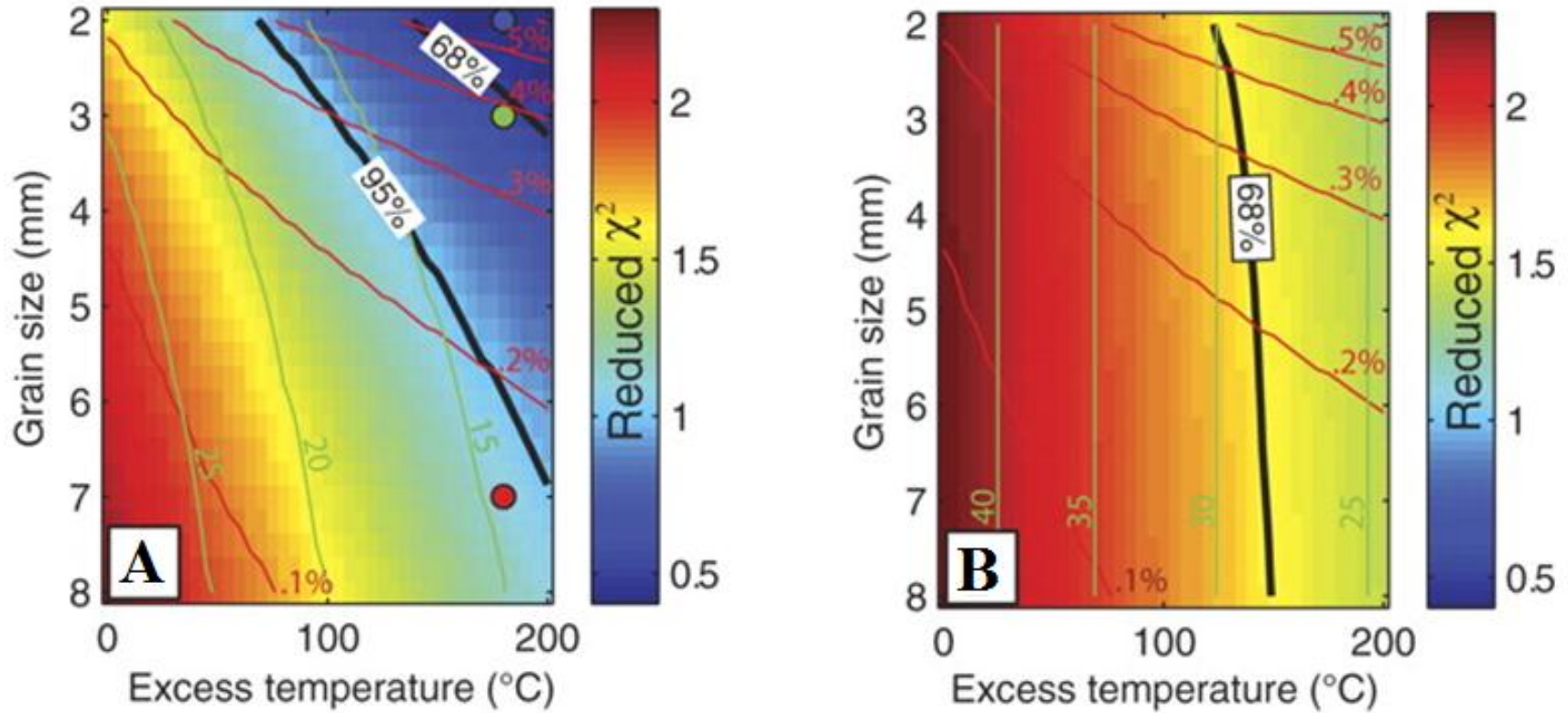


Figure 12. Plume layer temperature, melt porosity (red counters), and  $Q_s$  (green counters) beneath Yellowstone. A) reduced  $\chi^2$  (chi-squared distribution) as the error surface for grain-size-sensitive anelastic model. Quantities are contoured on the  $\chi^2_n$  misfit surface: Black lines represent the confidence levels from F-test, red lines the melt porosity at top of plume layer, and the green lines the predicted shear wave attenuation. Colored dots refer to specific grain size within the temperature shown (its importance refers for other description not shown here). B) Same plot as A, but using the non-grain size anelastic model (based on [Karato, 1993]) [Schutt, 2008].

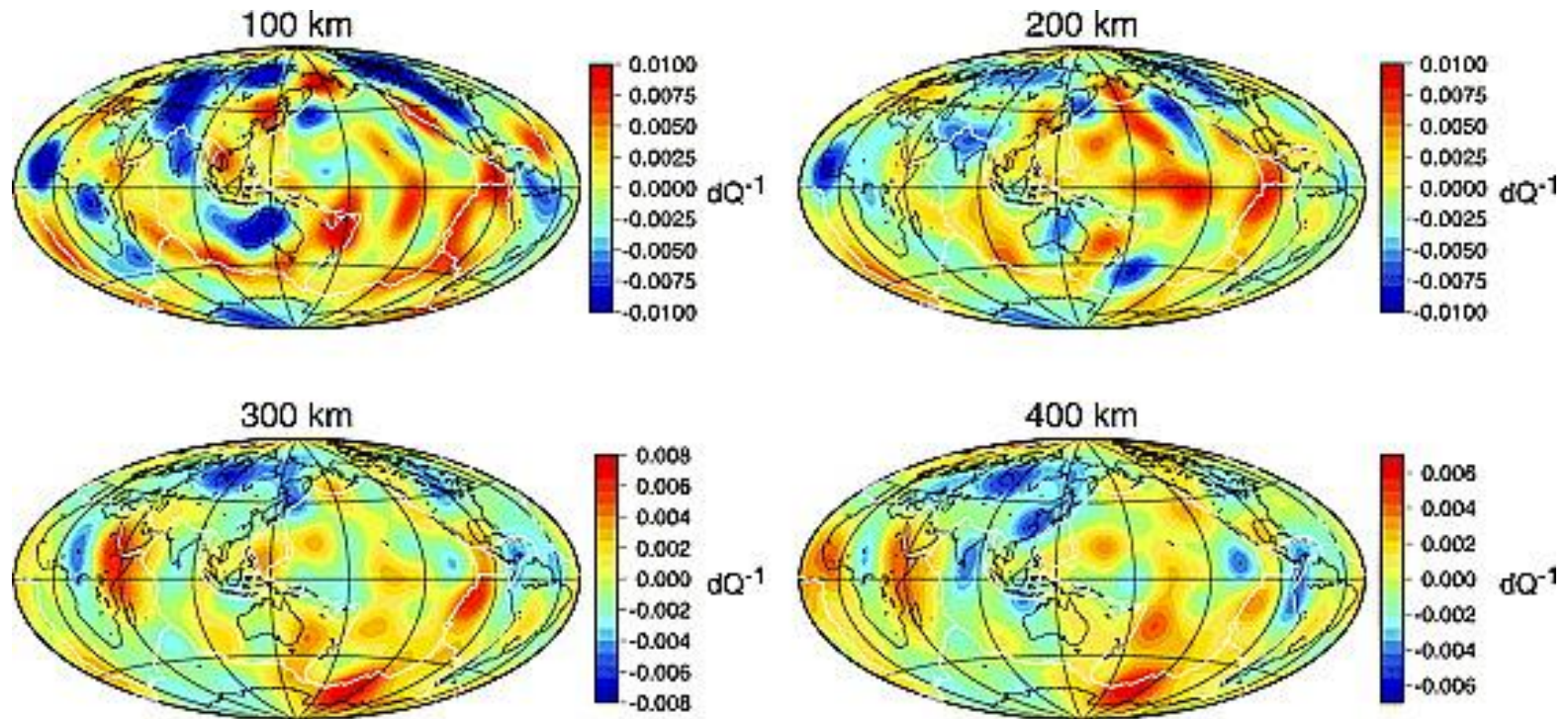


Figure 13. 3D shear attenuation ( $Q_s^{-1}$ ) model QRFSI12, where  $Q^{-1}$ , deviation away from the globally averaged, is plotted as the at each depth, 100 km, 200 km, 300 km, and 400 km. Variations correspond to 1% faster to 1% slower than global average for all depths [Dalton, 2008].

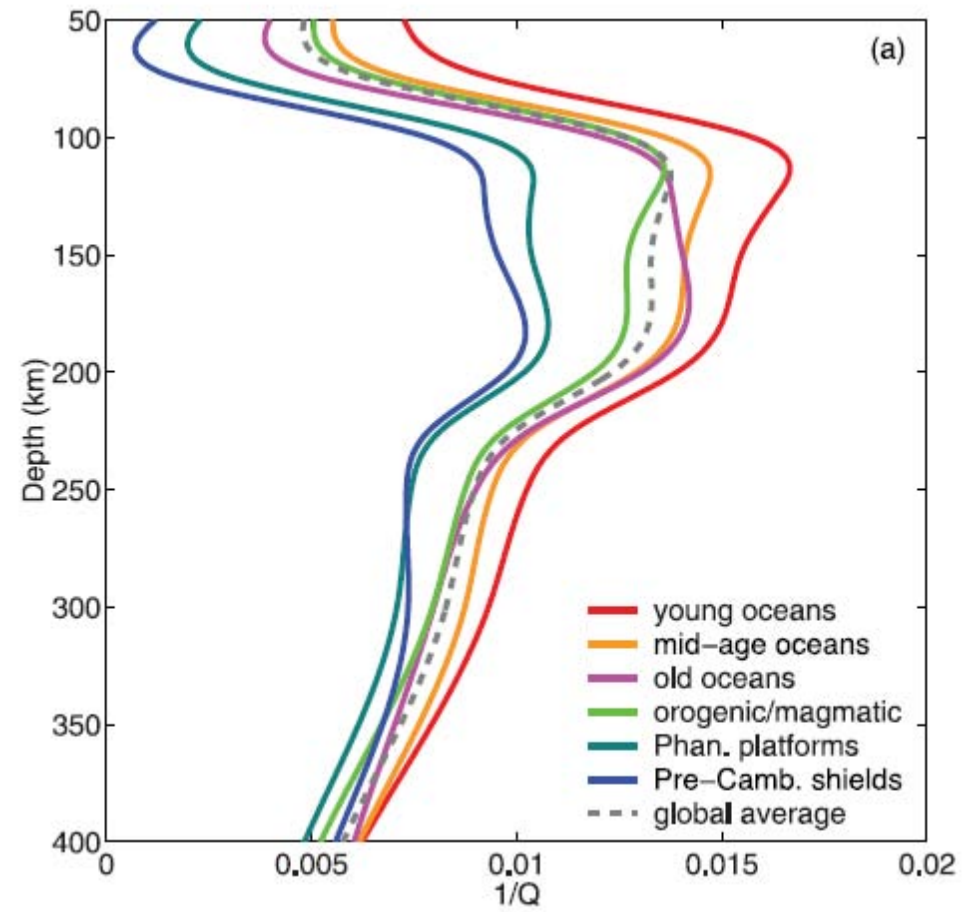


Figure 14. Shear attenuation variation for six different tectonic regions [*Dalton, 2008*].

within *SRP* to 100 outside of the *SRP* (*OSRP*) with an infinite  $Q_S$  for a deeper structure (100 km) inside that same region.

First, equation (28) is used to calculate  $Q_P$ ,

$$Q_P = \left(\frac{9}{5}\right)(20) = 45 \quad (SRP)$$

$$Q_P = \left(\frac{9}{5}\right)(100) = 225 \quad (OSRP)$$

The travel time variation can be calculated since the velocity variations from *SRP* to outside the *SRP* (*OSRP*) is known,

$$t = \frac{d}{v} \quad (29)$$

in which  $t$  refers to time,  $d$  the distance and  $v$  the velocity. This relation can be used to estimate the travel time for a ray path that travels through the 100 km deep low velocity structure. A more general equation for equation (29) is,

$$T(s, r) = \int_s^r \frac{dx}{v(x)} \quad (30)$$



where  $v(x)$  refers to the velocity, and  $dx$  to a segment of the ray path between the source ( $s$ ) and the receiver ( $r$ ). For this calculation, velocities of  $(0.93)*V_P$  for *SRP* and  $(0.98)*V_P$  for *OSRP* will be assumed, where  $V_P$  refers to the P-wave velocity of the radially-averaged Earth model *PREM*. The velocity at 100 km depth in region from *SRP* to *OSRP* is,

$$(0.93)V_P|_{100km} = 0.93(8.06 \text{ km/s}) = 7.50 \text{ km/s} \quad (\text{SRP})$$

$$(0.98)V_P|_{100km} = 0.98(8.06 \text{ km/s}) = 7.90 \text{ km/s} \quad (\text{OSRP})$$

then the  $tt$  will be,

$$tt = \frac{d}{v}|_{100km} = \frac{100 \text{ km}}{7.50 \text{ km/s}} = 13.3 \text{ s} \quad (\text{SRP})$$

$$tt = \frac{d}{v}|_{100km} = \frac{100 \text{ km}}{7.90 \text{ km/s}} = 12.7 \text{ s} \quad (\text{OSRP})$$

The  $tt$  variation ( $\Delta tt$ ) will be,

$$\Delta tt = tt_{SRP} - tt_{OSRP} = 13.3 \text{ s} - 12.7 \text{ s} = 0.6 \text{ s}$$

Then, equation (24) is used to infer the integrated path attenuation ( $t^*$ ),

$$t^* = \frac{tt}{Q} \Big|_{13.3s} = \frac{13.3s}{45} = 0.30s \quad (SRP)$$

$$t^* = \frac{tt}{Q} \Big|_{12.7s} = \frac{12.7s}{225} = 0.056s \quad (OSRP)$$

where the  $tt$  refers to the travel times calculated above. Here  $t^*$  variations below 100 km depth have been ignored, as they are assumed to be the same for the two regions.  $\Delta t^*$  is then used to estimate how  $t^*$  varies from the SRP to the OSRP ( $\Delta t^*$ ).

$$\Delta t^* = t^*_{SRP} - t^*_{OSRP} = 0.30s - 0.056s = 0.244s$$

Knowing these values a  $\left(\frac{\Delta t^*}{\Delta tt}\right)$  expected value can be estimated.

$$\frac{\Delta t^*}{\Delta tt} = \frac{0.244s}{0.6s} = 0.407$$

In this study, the  $t^*$  values are derived from the observed spectrum at the seismometers, and the  $t$  values are derived from estimating relative differences in P-wave travel time.

## Chapter 2

### EARTHQUAKE DATA

#### Type of Data

The data used are from all broadband stations operating between 1995 and 2009 within a latitude/longitude box centered on Yellowstone. The box ranges from 42°N to 47°N, and from 115°W to 107°W giving a total of 174 stations used (Figure 15; Table II.1). Notable arrays within this box include the 46 stations Yellowstone array (2000-2001), the 31 stations Billings array (2000-2001), and the Earthscope Transportable Array (~2008-2010). For comparison, data from two cratonic stations (stations under cratonic lithosphere) were also used (Figure 15): Cathedral Cave, Missouri (CCM), and Flin Flon, Canada (FFC). All seismometers used are CMG-3T, CMG-40T, STS-1, or STS-2 3-component broadband sensors.

A utility available to the seismic community called Standing Ordering for Data was used to gather the waveform data with specific parameters [Owens, 2004]: Teleseismic P-waves generated by earthquakes with a moment magnitude ( $M_W$ ) > 6.4 at distances > 30° (distance range from 30° to 180°) at a depth > 200 km. The distance range is chosen because nearer events present two difficulties: the radiation pattern of the source will cause substantial variability in observations, and the shallower ray path of the nearer events will not sample the region of interest in the uppermost mantle as well. The depth range is chosen because deeper events have simpler source functions.

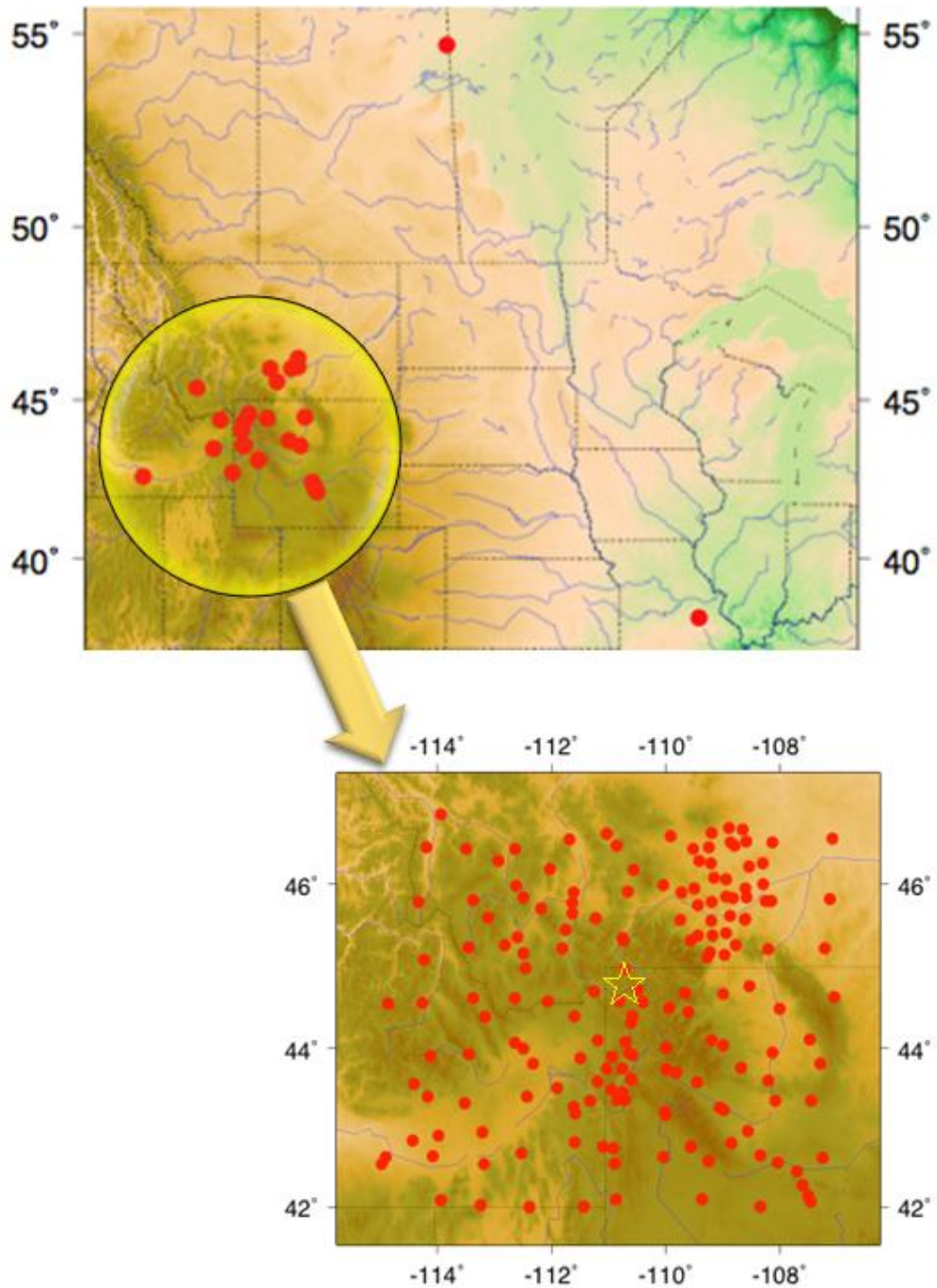


Figure 15. Stations locations. Two cratonic seismic stations FFC and CCM, used for comparison, as described in the Discussion. Close up shows the 46 stations from the Yellowstone array, 31 stations from the Billings array, and other stations within a the study area of 42° to 47°N, and 115° to 107°W, giving a total of 176 stations used. The yellow star refers to the position of the Yellowstone caldera [Figure created using <http://woodshole.er.usgs.gov/mapit/>].

## Chapter 3

### METHOD

#### Criteria used for picking events

The waveform data were downloaded as Seismic Analysis Code files (SAC) [Goldstein, 2003; 2005]. 657 initial events were gathered and subjected to quality control. For an event to be considered usable, it had to have been recorded at at least five stations, and have an average cross-correlation value of  $> 0.6$ . Cross-correlation is a method to identify the similarity of waveforms. For time series A and B, it involves shifting trace B by a time amount, and then multiplying the shifted B trace times trace A. The total value is typically normalized so identical waveforms that are perfectly lined up have a cross-correlation value of 1, and perfectly dissimilar waveforms would have a value of 0. Cross-correlation produces the value of the multiplied traces for all possible time shifts of trace B, and thus itself is a time-series. In our case, we take the maximum cross-correlation value within a range of time shifts that can reasonably be considered to be due to variations in velocity structure along the ray paths (-6 to +6 s). A more mathematical description of cross-correlation is presented below. This cross-correlation cut-off value of 0.6 that is used was empirically determined as providing data of sufficient quality, and is high enough to remove events in which the waveform is barely

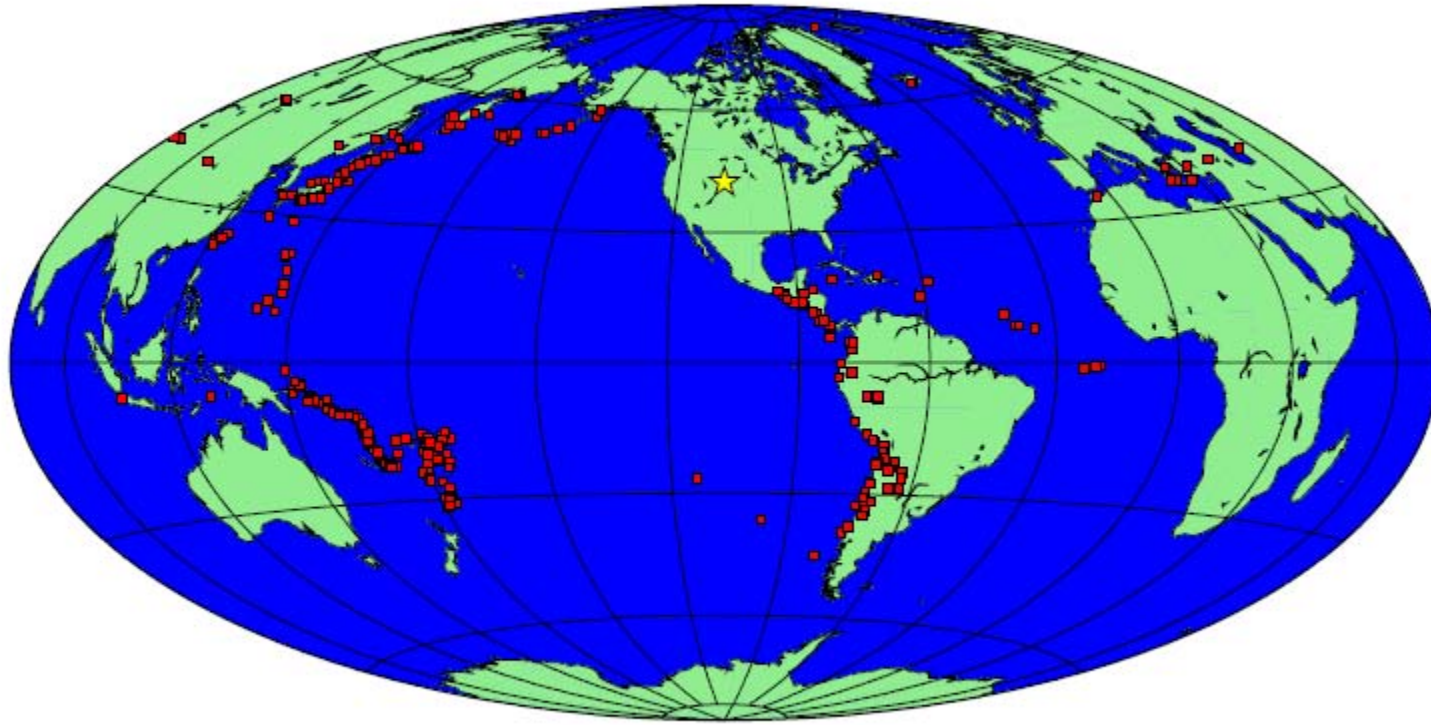


Figure 16. Event locations. Red squares show the 297 events used to estimate the  $t^*$  parameter. Yellow star represents the study area.

observed. Further, individual stations that had an average cross-correlation value of  $< 0.6$  were culled. This removed seismograms of poorly operating stations, or where local noise was overwriting the event of interest.

### Seismometer response

Figure 16 shows the global distribution of the 297 events used in the initial study, after the cratonic stations were added (the reason for adding cratonic stations is discussed in the end of this section). Since the goal of this project is to measure differential frequency response of event data observed at various seismometers, it is worth considering whether the seismometers may alter the spectrum of the data. A way to examine this is by looking at the corner period, which denotes the longest wave period at which instrument response effects do not significantly alter the data. Of the seismometers used, the CMG-3T, CMG-40TG, STS-1, and STS-2, have corner frequencies of 0.0083, 0.033, 0.0027, and 0.0083 Hz respectively, implying that instrument response is not a significant issue for the dominant 1 Hz P-wave energy (teleseismic P-waves have a dominant wave frequency of 0.1 to 1.0 Hz [Futian, 2001]) that is under investigation. Thus no corrections are made for the type of seismometer sensor used.

### Multi-channel cross-correlation

To improve the signal-to-noise ratio in the data, SAC [Goldstein, 2003; 2005] was used to apply a bandpass Butterworth filter with corner frequencies of 0.05 and 1 Hz. This bandpass filter should not significantly affect the P-wave signal, and improves the



resulting cross-correlation estimates of P-wave arrival time. However, to be careful, a later analysis of the data was done without this initial noise removal. To align the P arrivals at each seismic station for a given event, the multi-channel cross-correlation<sup>2</sup> method was used. This allows us to quantitatively estimate the uncertainty in relative arrival times, as well as to determine the relative time lag between traces observed from a given earthquake (which we refer to as an “event”). The alignment of seismograms (also referred to as “traces”) is performed by comparing each trace to each other via cross-correlation and aligning them to their position of maximum equivalence. To improve estimates of the relative time lag between seismograms (caused by velocity variations among the respective ray paths), ensemble cross-correlation was used, which allows for least-squares minimization of the errors in time lag estimates for all seismograms in a given event [VanDecar, 1990] (Figure 17). Thus for each event, the relative travel times, with errors, was determined.

### $t^*$ estimates

Approximately the same process is used to estimate the relative ray path integrated attenuation,  $t^*$  for each event. Seismic waves are variably attenuated when

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<sup>2</sup> If we designate two traces being compared as  $T_1$  and  $T_2$  and define  $d$  as the number of overlapped position between the two traces, the cross-correlation at their point of maximum equivalence ( $\Delta$ ) is

$$r_{\Delta} = \frac{d \sum T_1 T_2 - \sum T_1 \sum T_2}{\sqrt{\left[ d \sum T_1^2 - (\sum T_1)^2 \right] \left[ d \sum T_2^2 - (\sum T_2)^2 \right]}} = \frac{\text{cov}_{1,2}}{s_1 s_2},$$

where  $\text{cov}_{1,2}$  is the covariance between the overlapped portions of the traces  $T_1$  and  $T_2$  and  $s_1$  and  $s_2$  are the corresponding standard deviations [David, 2002].



they arrive at seismometers. For each event, the variation in  $t^*$  between stations,  $\Delta t$  was estimated between every combination of seismograms, allowing for least-squares minimization of errors. By calculating only relative  $t^*$  changes within an event, the effects of earthquake source function and structure along the ray path but outside Yellowstone, where the ray paths from the event to each station overlap, are removed. To better understand the analysis process, consider three seismograms, 1, 2 and 3, observed at three seismic stations for a given event. First,  $\Delta t^*$  between seismograms 1 and 2 is determined by variably attenuating seismogram 1 until it best matches seismogram 2. This is done by looping through a range of reasonable  $\Delta t^*$  values, and for each possible  $\Delta t^*$  value, applying the Futterman operator (described below) to approximate the effects of  $\Delta t^*$  on the seismic waveform. The  $\Delta t^*$  that makes seismogram 1 look most like seismogram 2 was then determined by cross-correlation. Since seismogram 1 may be more attenuated than seismogram 2, this procedure is also performed by variable attenuating seismogram 2 until it matches seismogram 1. From this process,  $\Delta t^*_{12}$  was determined. Similarly,  $\Delta t^*_{13}$  and  $\Delta t^*_{23}$  were calculated (example Figure 18).

Thus, for this example case, three different  $\Delta t^*$  values were estimated:  $\Delta t^*_{12}$ ,  $\Delta t^*_{13}$  and  $\Delta t^*_{23}$ . Using the constraint equation

$$\sum_{i=1}^n t_i^* = 0 \quad (31)$$

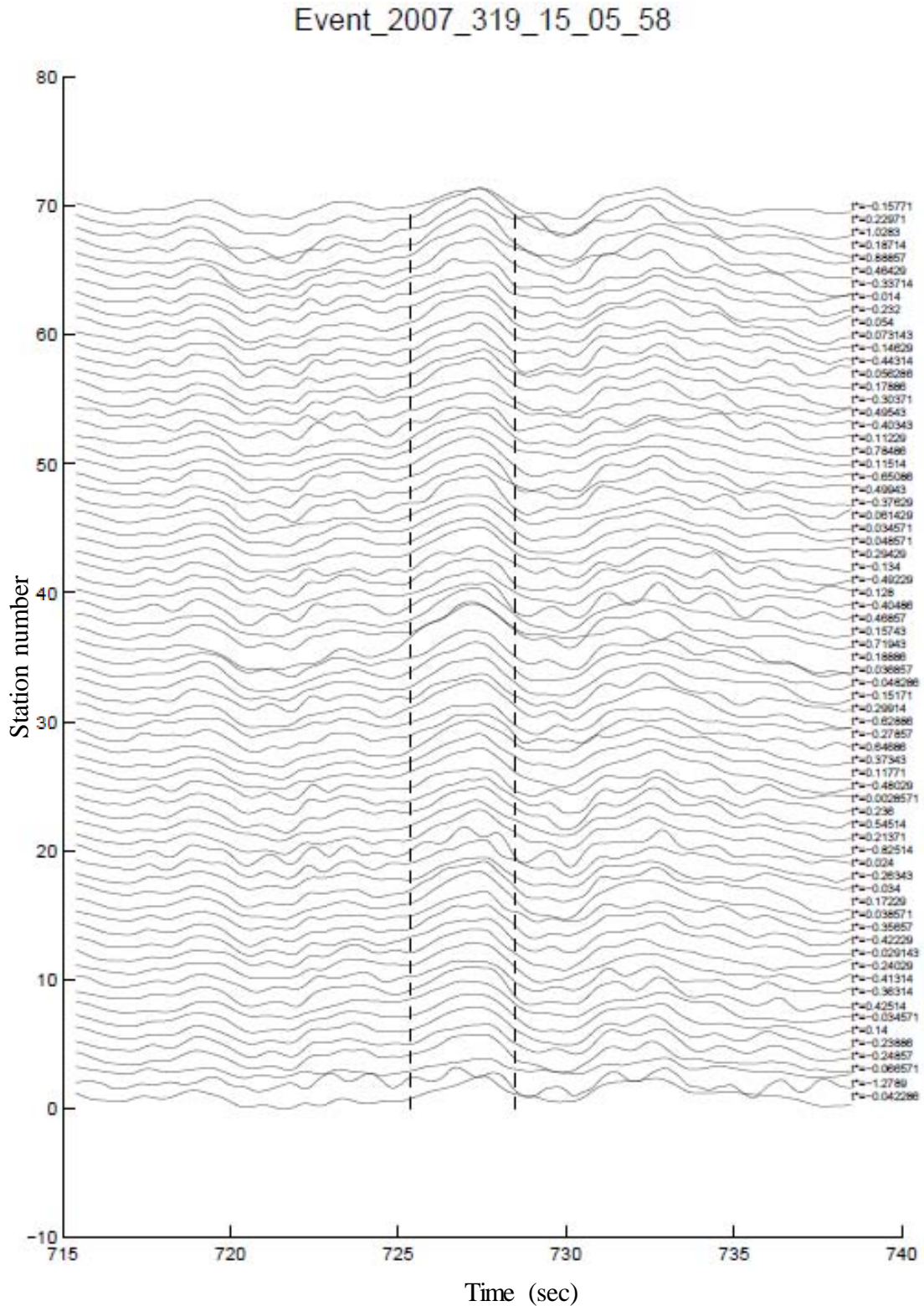


Figure 18. Example of a  $t^*$  estimate for Event 2007-05:58.  $t^*$  estimates are shown to the right of the plot. All  $t^*$  values are shown in the right side of figure. Dashed line indicates the portion of the wave picked.

where  $t_i^*$  is the ray path integrated attenuation of trace  $i$  sets the mean  $t^*$  to zero and results in four equations for two unknowns, allowing for least squares minimization of errors and formal error assessment [VanDecar, 1990].

### Futterman operator

As used in this project, the Futterman operator is defined as such:

$$A(\omega) = e^{i \left\{ -t^* \frac{|\omega|}{2} + \omega \left( \frac{t^*}{\pi} \cdot \log \left[ \frac{(|\omega| + 2^{-52}) \omega_0}{2} \cdot \frac{\omega_0}{\pi} \right] \right) \right\}} \quad (32)$$

This operator works like a filter that cuts off high frequencies from the waveform. An example of how the Futterman operator affects a waveform is shown in Figure 19. Note the smoothing and shifting of the attenuated (blue) waveform as  $t^*$  changes from 0.5s to 5.0s. After the shift, all traces were aligned to their position of maximum equivalence. Figure 20 shows the frequency response of the Futterman filter and how it varies with  $t^*$ .

### Order of Data Analysis

Initial data analysis was performed only on stations within the box centered at Yellowstone. However, as discussed below, results suggested a robust  $t^*$  signal was not

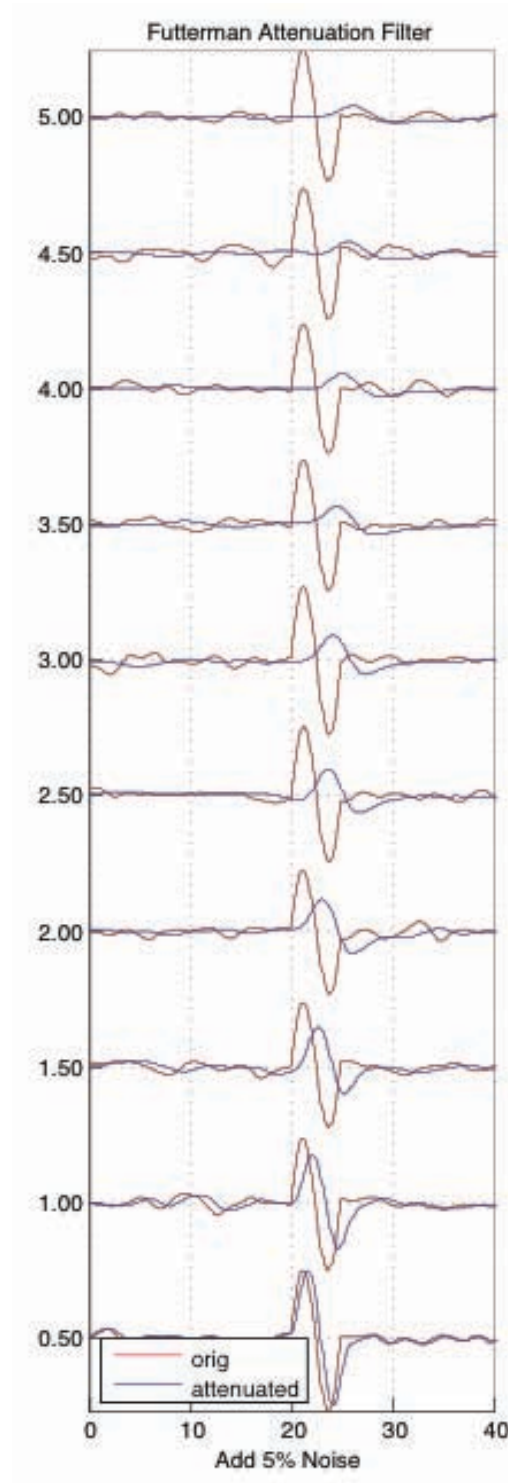


Figure 19. Example of effects of the Futterman attenuation filter on an input pulse, for  $t^*$  varying from 0.5  $\square$  5.0 s in 0.5 s increments (y-axis). Red trace shows the original synthetic trace, blue trace show the attenuated trace.

being found. To examine if our data processing method was faulty, tests of various processing aspects were performed.

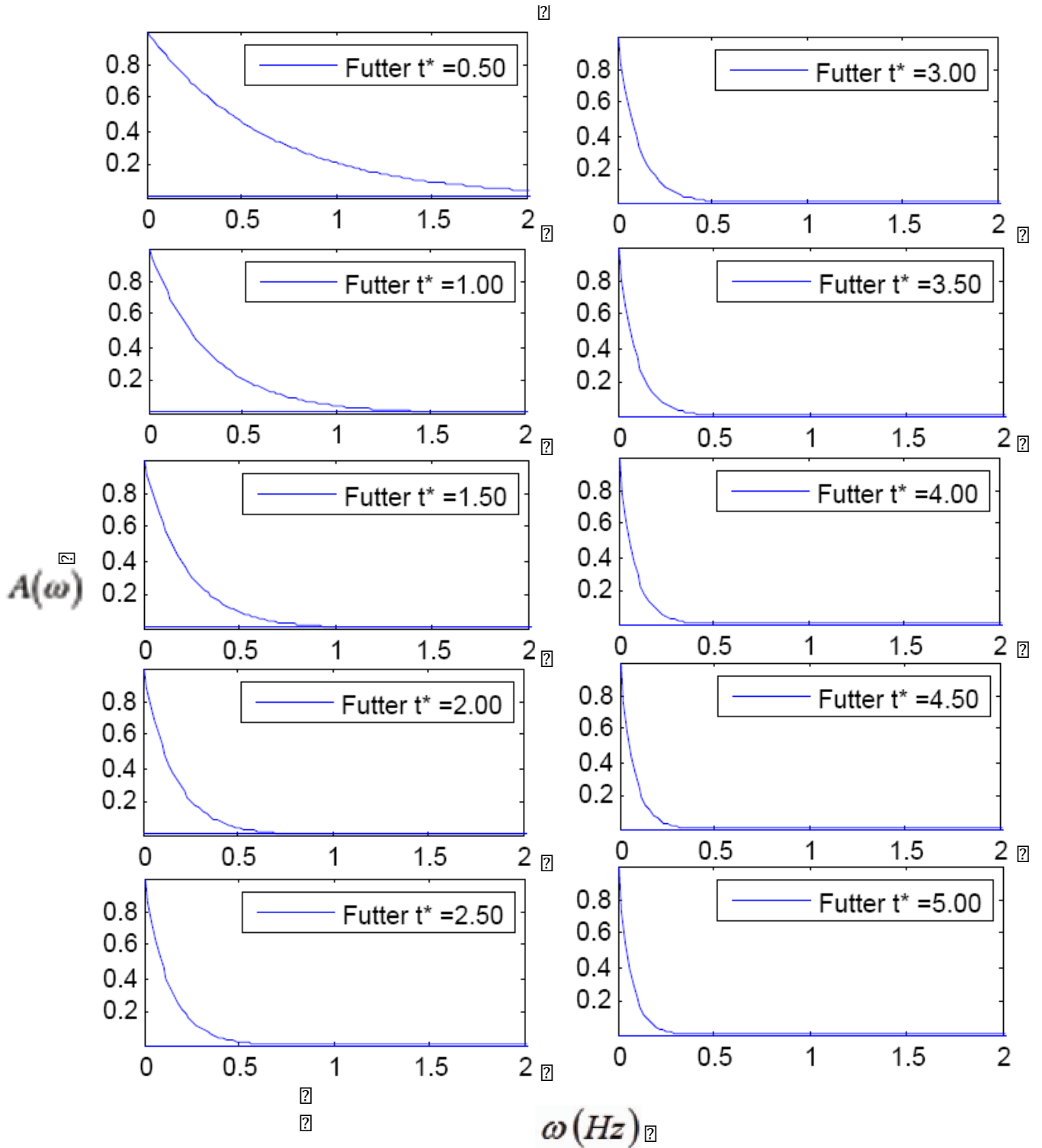
#### Other tests performed

Three tests were performed and their effect on our resulting  $t^*$  measurements analyzed. We explored varying the part of the waveform analyzed, removing the initial bandpass Butterworth filter, and incorporating data from cratonic stations (where  $t^*$  is expected to be much lower).

The first test was based on the observation that occasionally the onset of the P-wave was subtle, and it might be useful to pick a more impulsive peak behind the initial arrival or use more of the waveform. On a subset of 10 events, three criteria for waveform picking were tested: 1) the first pulse in the waveform was selected; 2) the most impulsive pulse in the waveform was selected, even if it was after the initial P-onset; and 3), a larger portion of the waveform was analyzed. As discussed in the Results, these experiments suggested that most effective technique involved picking a larger part of the P-wave that included the most impulsive peak.

After running the tests, the initial bandpass filtering of the data was turned off, in case this was somehow altering the frequency content of the P-wave signal. In addition, we added data from two cratonic stations. For cratonic regions the temperature-attenuation relationships [Faul, 1995] suggest cold, high-velocity mantle should have high  $Q$  and low attenuation. For this reason, stations FFC and CCM on on relatively

$$A(\omega) = e^{i \left\{ -t^* \cdot \frac{|\omega|}{2} + \omega \left( \frac{t^*}{\pi} \cdot \log \left[ \frac{(|\omega| + 2^{-52}) \cdot \omega_0}{2 \cdot \pi} \right] \right) \right\}}$$



$$\omega = 2\pi f_{vector}; \quad \omega_0 = (f_{vector})_{\max}$$

Figure 20. Fetterman filter spectral response at different  $t^*$  values. Y-axis shows amplitude, and x-axis shows angular frequency.



cold mantle were picked for comparison. The cross-correlation of the waveforms and  $t^*$  analysis was done by the same method.

## Chapter 4

### RESULTS

After the initial data culling 297 events remained and were analyzed for  $t^*$  and travel time variations. These initial  $t^*$  results, as described below, look almost random, and the mean slope:  $dt^*/dt$  is  $-0.081 \pm 0.009$  (see Figures 24, and 25). This negative value is distinctly different from the  $\sim 0.4$  value expected. Hence, the effects of picking different parts of the initial P waveform was tested to see if this affected  $t^*$  measurements significantly.

Reported below, are results of the: 1) initial  $t^*$  analysis, 2) waveform picking tests, and 3) reanalysis taking into account the waveform picking results and including two cratonic stations.

#### Initial $t^*$ results

Measurements of intra-event variations in  $tt$  as well as the estimated integrated path attenuation ( $t^*$ ) were made for all 297 good events observed at stations in the region around Yellowstone. An example result for Event 2007 05:43 is shown in Figure 21. All events and their respective parameters are presented in Table III.1 in Appendix III

and Figure 16. The example event (Figures 21, and 22) is considered an ideal event, as it has a clear impulsive initial P-wave arrival that is well above the noise level. Travel time residuals, when plotted on a map, correlate well with hotspot features (Figure 22e). The event comes in from an azimuth of  $236^\circ$ , so if the mantle anomaly is at roughly 80 km depth [e.g. *Schutt*, 2008], the stations that record the most delayed rays will not be directly over the anomaly, but will be offset by  $56^\circ$  from the anomaly that caused the delays. These travel time anomalies, varying roughly from -0.5 to 0.5 s, fit existing tomographic results that show a distinct uppermost mantle low velocity zone under the Snake River Plain well.

The  $t^*$  variations are from about -1 to 1 s, and visual inspection of Figure 22 suggests they do not correlate tightly with the tomographically imaged low velocity feature, nor with the travel time residuals. However, they seem to show a spatial correlation trending from high in the southeast to lower in the northwest (Figure 22f). The relationship between  $t^*$  and  $tt$  can be investigated by plotting  $t^*$  vs  $tt$  residuals on a graph (Figure 22d). If  $t^*$  residuals are thermally controlled,  $dt^*/dtt$  should be positive, and probably close to our predicted value of 0.4 as discussed in the Introduction. No correlation between  $t^*$  and  $tt$  is found. Other events show similar patterns, in which  $tt$  and  $t^*$  show spatial patterns, but a clear correlation between  $tt$  and  $t^*$  does not seem to exist (Figure 23). When all events are considered (Figures 24 and 25), no spatial patterns are obvious in the  $t^*$  values. Nor are they apparent for station averages of  $t^*$ .  $dt^*/dtt$  when results are plotted for all events and stations is  $-0.08 \pm 0.009$ .

While this figure is robust, many events had large uncertainties in their slopes because of the scatter in the data (Table 1). Of all the events, only 104 of 297 showed

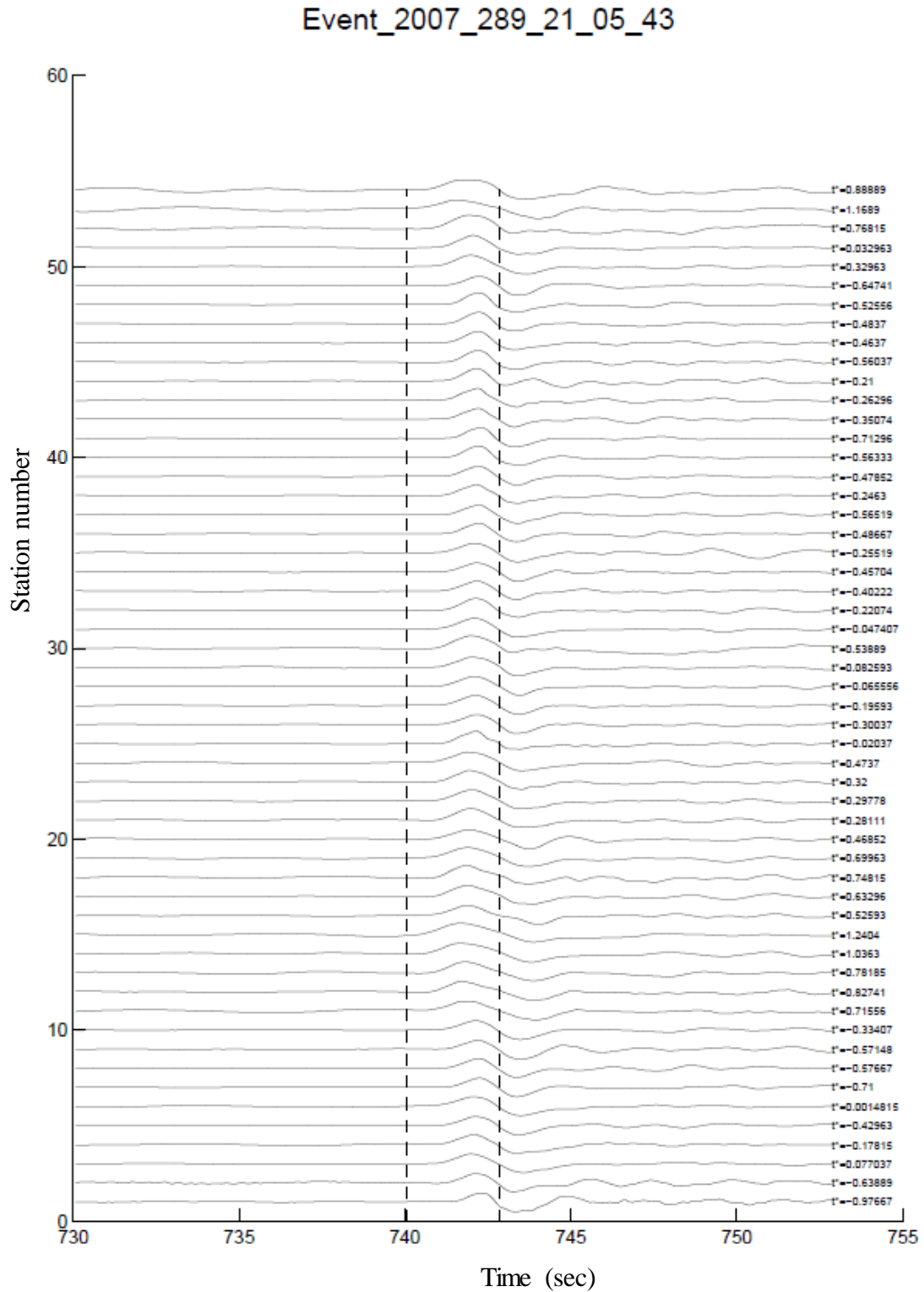


Figure 21.  $t^*$  values for all stations within Event 2007-05:43. The broadening of the pulse increases with increasing values of  $t^*$  (with increasing attenuation). Dashed line indicates the portion of the wave picked. Station number has been given arbitrarily.

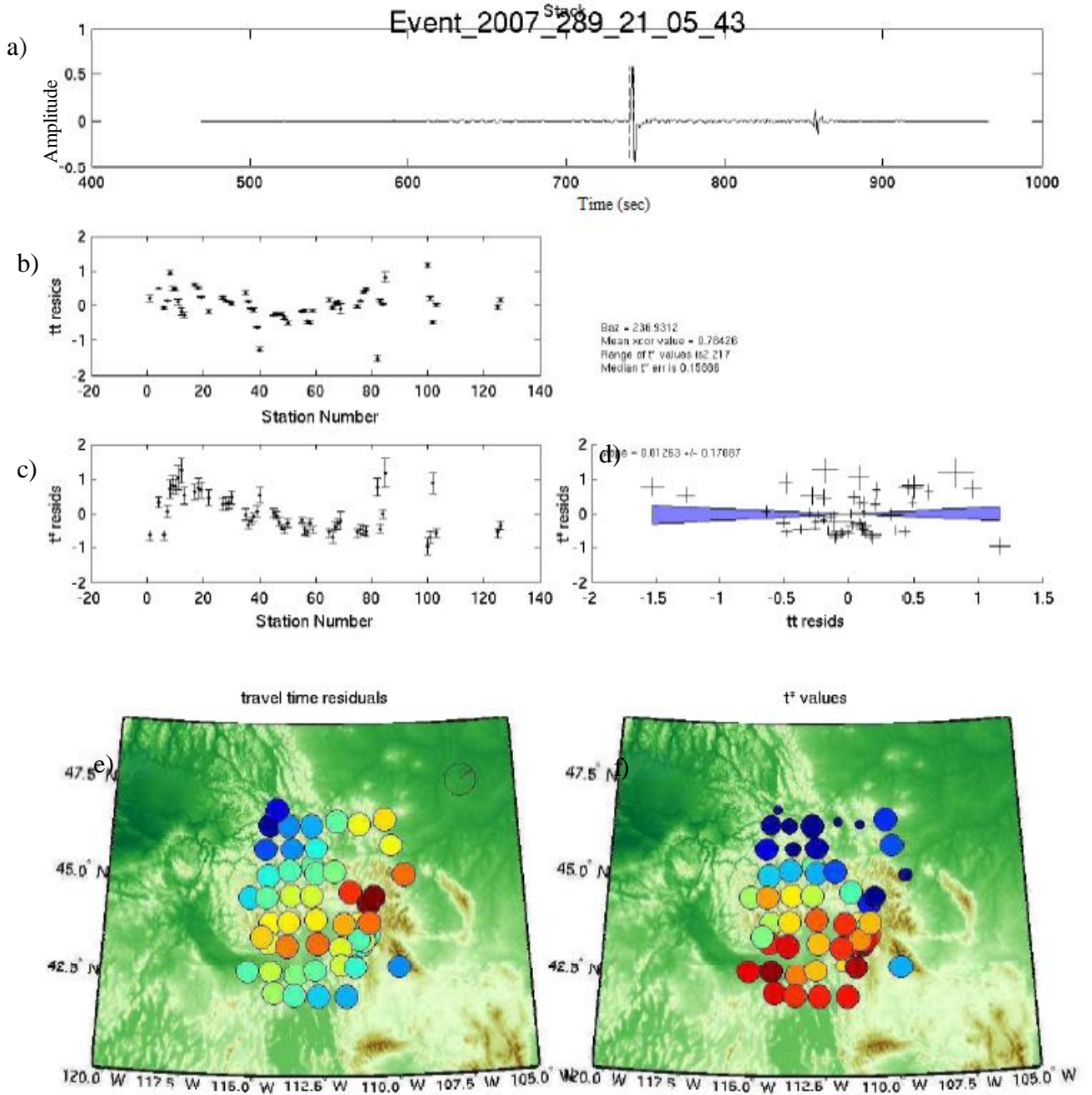


Figure 22. Measurements of  $t^*$  and travel time estimates. Results for Event 2007-05:43: a) waveform stack, b) travel time residuals as a function of station number, c)  $t^*$  residuals as a function of station number, d)  $t^*$  residuals as a function of travel time residuals, e) travel time residuals mapped, and f)  $t^*$  values mapped. In this and subsequent figures, size of circle is inversely proportional to the estimated error in the measurement. Circles represent the stations, warm colors refers to high values of  $t^*$  and  $tt$ , and size of the circles represent the measurement error which is inversely proportional to its size. The total range of color variation from deep red to deep blue represents  $tt$  variation from -1 to 1 s (e) and  $t^*$  variation from -0.75 to 0.75 s (f).

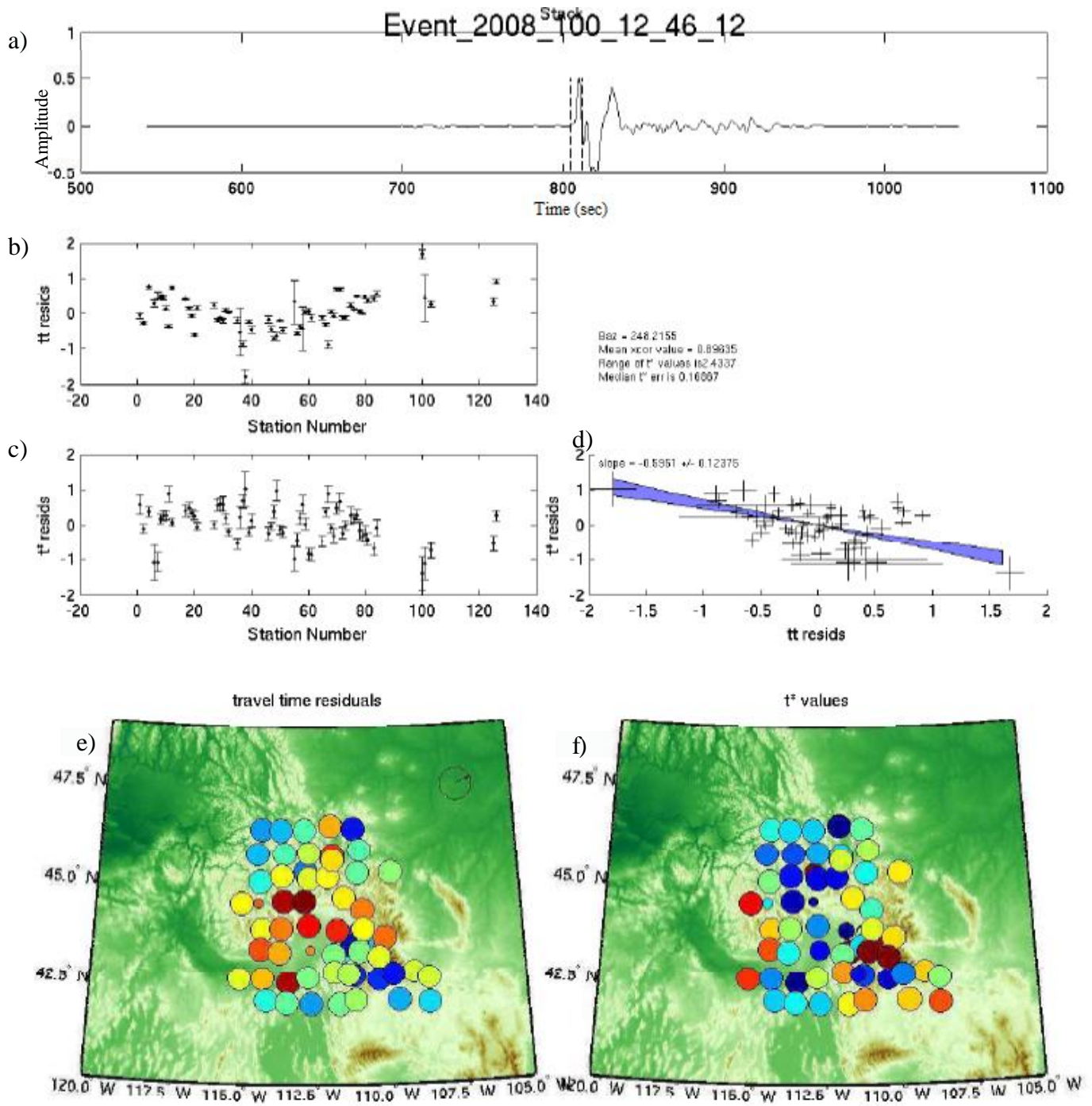


Figure 23. Measurements of  $t^*$  and travel time estimates. Results for Event 2008-46:12: Details are as in Figure 22.

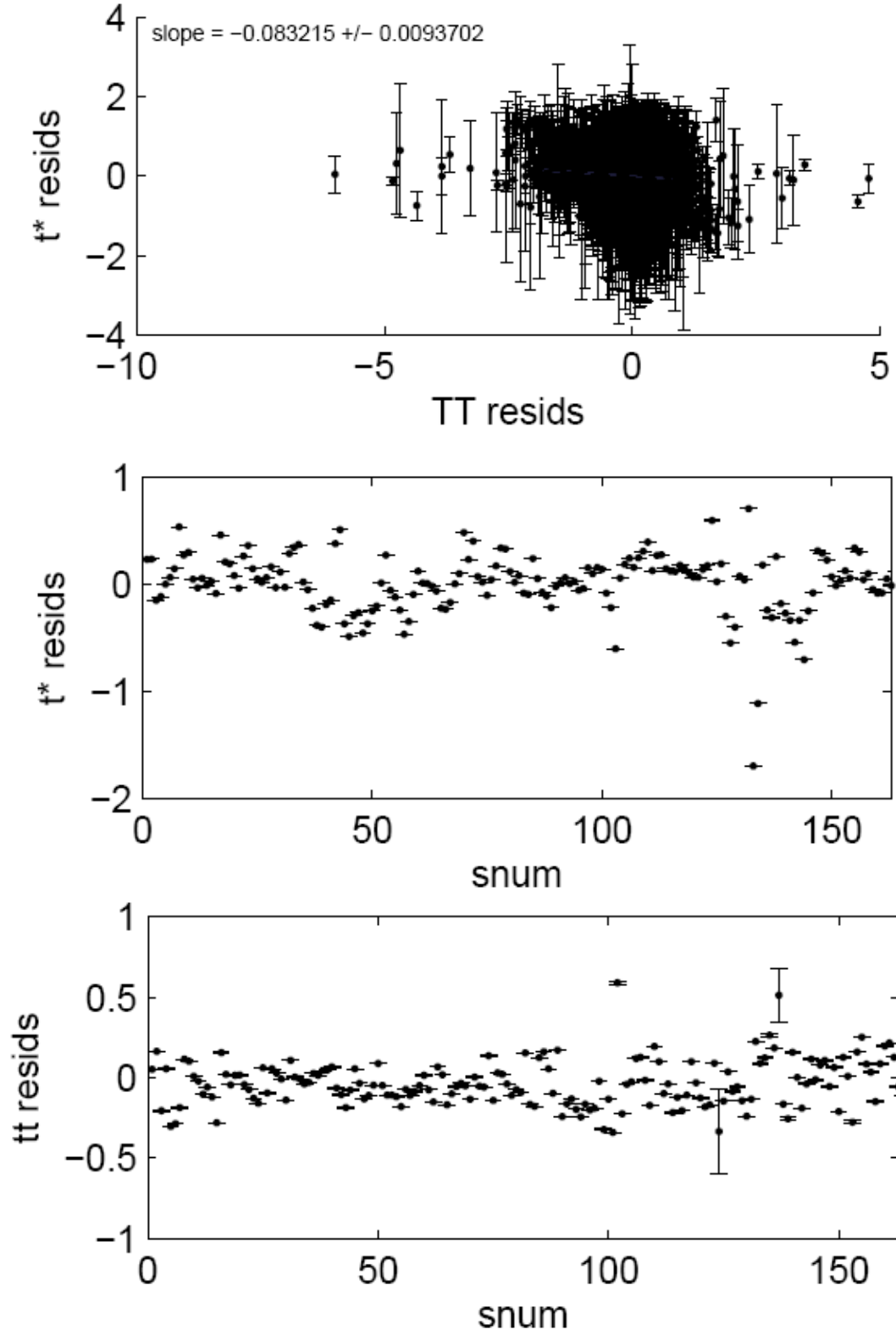


Figure 24. Slope results,  $t^*$  residuals and  $tt$  residuals for all 297 events. Note that most of the slope events fall into the negative region of the plot. Snum refers to station number, which was given arbitrarily.



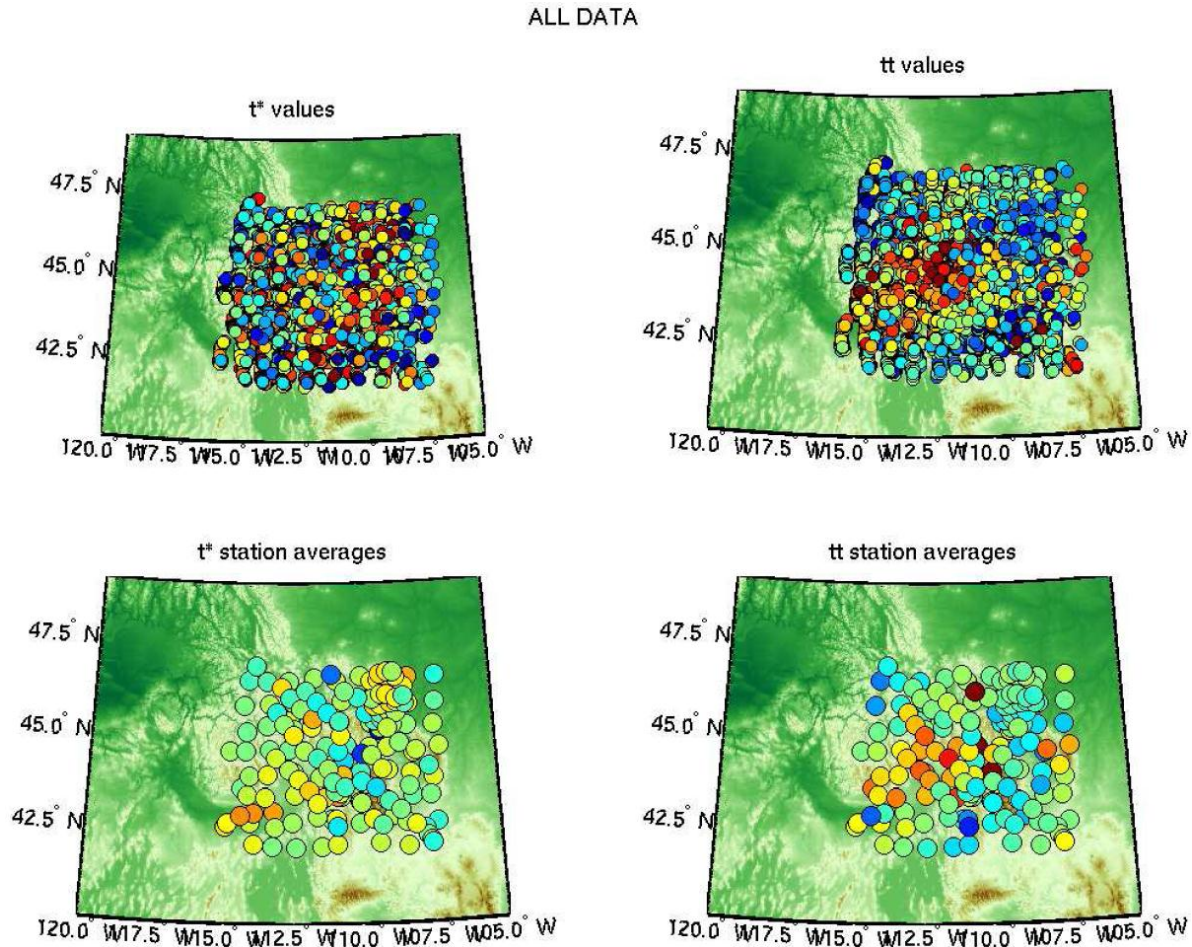


Figure 25. Map of  $t^*$  and  $tt$  residuals for all 297 events. Top row of figures shows all data plotted by the location of the ray piercing point at 80 km depth. Bottom row shows station-averaged residuals. Details of the colors and circle size are as in Figure 22.



the expected positive correlation, and only 9 of these were close to the expected 0.4 value. Total variation in  $tt$  and  $t^*$  are similar to the example event:  $tt$  is from about -0.5 to 0.5s and  $t^*$  varies from -1.0 to 1.0s. A full output of our results and a table with their respected  $t^*$  and slope values (including negative slope values) are given in Appendix IV.

#### Testing for $t^*$ Robustness

The lack of a clear pattern in the initial results motivated a test of waveform picking parameters to see if variations in the part of the P-wave picked affected the robustness of the results. Three tests were performed on the same ten events selected as representative of the whole set of data. In the first test (c1) only the first up and down swing of the P-wave was selected, whether or not it was impulsive or clearly above the noise (Figure 26a). For the second test (c2), the most impulsive waveform was selected, even if it came in a little after the arrival of the first P-wave energy (Figure 26b). In the third test (c3), a longer segment of the waveform was selected (Figure 26c). Results for all three tests are presented in Table 2.

Results for Event 2009-17:40 are shown for all three tests (Figure 27, 28, and 29). The travel time residuals map shows a well defined correlation with the low velocity features which lie directly under the Snake River Plain depression (even though that some variation can be seen -- Figure 27e). For all three tests the  $tt$  spatial correlation is the same (Figure 27e, 28e, and 29e). However, the  $t^*$  residual maps do not show a spatial pattern that correlates with what is expected. They seem to show a spatial

Table 1. Initial  $t^*$  results for all events.

Event Name (year-hour:min)	Range of $t^*$ (s)	Slope <sup>4</sup>	Slope error
1999 14:16	0.72286	0.011275	0.19557
1999 33:40	-	-	- <sup>5</sup>
1999 21:15	1.7072	1.5066	0.17697
1999 01:53	0.56	-0.2473	0.059825
1999 12:33	1.3389	0.11644	0.27916
1999 19:49	1.3131	0.10423	0.2152
1999 29:49	1.3064	-0.24231	0.22144
1999 38:30	1.8436	-0.8183	0.38687
1999 29:19	0.94	0.27329	0.44894
2000 19:46	-	-	-
2000 59:21	1.2881	-0.84987	0.25305
2000 47:20	0.52647	0.03473	0.093246
2000 26:50	1.2949	-0.17536	0.26167
2000 21:07	1.0405	-0.16396	0.10911
2000 43:58	1.4817	-0.18022	0.23824
2000 00:22	1.1549	-0.27557	0.17879
2000 27:23	1.036	-0.09865	0.078932
2000 36:32	1.0107	0.073241	0.12643
2000 43:18	1.221	-0.31684	0.10718
2000 57:02	1.4767	-0.084813	0.14574
2000 23:29	-	-	-
2000 55:35	1.5108	-0.51605	0.12648
2000 40:41	1.7754	-0.11983	0.18206
2000 51:46	1.4555	-0.15973	0.13762
2000 53:35	1.8405	-0.081253	0.047022
2000 25:45	1.69	-0.058911	0.057322
2000 09:38	2.4026	-0.91075	0.12782
2000 13:02	1.8789	-0.30671	0.07917
2000 27:12	1.7119	-0.0604	0.05179
2000 08:41	-	-	-
2000 55:59	1.69	-0.21801	0.1148
2000 17:52	1.3486	0.093649	0.078525
2000 23:43	-	-	-
2000 58:44	2.6614	-0.45228	0.17848
2000 32:24	-	-	-
2000 11:06	1.6225	-0.099148	0.061312

<sup>4</sup> Slope refers to the correlation within the  $tt$  and  $t^*$  values (correlates low velocity with high attenuation).

<sup>5</sup> Event classified as bad event. Event with cross-correlation value lower than 0.6.

2000	23:54	1.4124	-0.11362	0.072742
2001	49:28	2.7078	-0.035211	0.13381
2001	33:32	1.3903	-0.081936	0.11904
2001	10:14	-	-	-
2001	22:05	1.29	-0.082713	0.088035
2001	27:53	1.3703	0.064447	0.06034
2001	00:57	2.0547	-0.15102	0.10927
2001	49:53	1.5518	0.0015217	0.088714
2001	40:50	2.0915	0.13788	0.26209
2001	57:26	1.2	-0.047407	0.1946
2001	41:57	1.1311	-0.44035	0.20883
2001	48:47	0.9025	-0.40808	0.26949
2001	33:14	1.75	-0.58977	0.29922
2001	18:31	2.0467	-0.43594	0.3565
2001	10:42	0.985	0.14675	0.16765
2001	06:31	1.165	0.13024	0.29587
2001	38:43	1.9725	-0.4017	0.42734
2001	21:36	1	0.23717	0.24745
2001	32:43	-	-	-
2001	11:23	0.228	0.098502	0.07179
2001	48:37	1.805	1.45	0.60426
2001	40:07	-	-	-
2001	14:26	1.67	2.7807	0.63945
2001	20:38	-	-	-
2001	24:47	1.6767	-0.70566	0.801
2001	32:32	0.868	0.17318	0.31947
2001	01:53	0.375	-0.33661	0.32285
2001	32:29	-	-	-
2001	02:58	0.99333	0.14667	0.13198
2001	52:54	1.9	-0.32074	0.55087
2002	09:52	1.092	0.17086	0.41455
2002	11:28	-	-	-
2002	56:22	0.74	0.23157	0.20802
2002	52:50	1.71	-0.20717	0.32388
2002	59:32	1.075	1.4665	0.89448
2002	08:36	0.716	-0.12321	0.22442
2002	16:44	0.688	0.36856	0.062105
2002	57:52	0.51	-0.018405	0.10865
2002	08:24	-	-	-
2002	39:32	0.196	0.36149	0.086096
2002	57:22	0.47	-0.13906	0.17738

2002	01:28	1.0767	0.15326	0.48514
2002	09:11	0.34333	0.057308	0.10156
2002	23:55	-	-	-
2002	09:05	1.29	-143.3475	101.3577
2002	37:42	1.0267	0.22443	0.22431
2002	14:06	1.54	-1.3296	0.68435
2002	53:53	0.304	-0.12538	0.27304
2002	30:42	-	-	-
2003	15:03	-	-	-
2003	43:06	2.19	-0.79341	0.36433
2003	46:47	0.95	0.033227	0.25658
2003	32:36	1.5567	-0.13374	0.28402
2003	03:41	1.16	0.38101	0.40997
2003	27:32	-	-	-
2003	54:12	-	-	-
2003	36:17	2.3767	0.12728	0.69031
2003	48:38	1.0857	-0.21902	0.15643
2003	27:04	-	-	-
2003	15:18	1.44	-7.5311	3.7481
2003	08:46	1.256	-0.016565	0.3496
2003	21:14	-	-	-
2003	03:35	0.556	-0.3675	0.10722
2003	24:33	0.48667	0.099965	0.11693
2003	24:33	1.888	3.2444	3.9757
2003	08:02	0.87667	0.040032	0.24849
2003	19:38	0.268	0.12958	0.1277
2003	30:41	1.1333	0.11073	0.44216
2003	12:34	0.66667	0.06902	0.25299
2003	46:38	-	-	-
2003	37:45	-	-	-
2003	04:11	1.26	0.3198	0.59558
2003	25:31	0.77333	-0.051479	0.18232
2003	28:00	1.7367	0.10694	0.68101
2003	19:20	-	-	-
2003	45:36	1.7057	0.2148	0.69459
2003	50:06	1.0057	-0.017881	0.20357
2003	08:00	-	-	-
2003	33:25	1.3925	-0.040112	0.33284
2003	52:47	1.0543	0.0052494	0.28219
2003	36:53	0.65	-0.30895	0.29515
2003	08:37	2.0275	-0.11433	0.2924

2003	03:25	1.4867	0.027768	0.92754
2003	06:55	0.4	-0.5456	0.33638
2003	06:28	1.5433	-0.77127	0.50807
2003	38:04	1.008	0.24173	0.6344
2003	52:36	-	-	-
2003	43:06	1.468	1.0067	0.70231
2003	26:09	0.68333	-0.031808	0.41306
2003	38:11	-	-	-
2003	40:45	-	-	-
2003	11:11	0.96	-0.39601	0.85209
2003	42:33	-	-	-
2003	00:59	2.2633	-1.5901	0.5124
2003	38:01	2.41	-0.62782	0.28115
2004	43:11	1.2	-0.15772	0.61201
2004	27:46	-	-	-
2004	23:35	-	-	-
2004	36:50	1.085	0.77063	0.98815
2004	41:27	1.588	0.39731	0.718868
2004	07:07	1.8514	-0.58587	0.34513
2004	57:18	1.6571	-0.60421	0.2813
2004	29:35	0.77667	-0.023575	0.29786
2004	53:06	0.7	0.16619	0.4179
2004	27:53	1.6714	-0.17259	0.24032
2004	26:53	1.8867	-0.22954	0.5173
2004	08:50	1.6457	0.26453	0.31618
2004	34:52	1.7457	-0.35488	0.19821
2004	06:56	1.5971	-0.84121	0.16927
2004	09:13	-	-	-
2004	07:22	1.912	1.6502	0.92783
2004	35:13	-	-	-
2004	32:14	1.3714	-0.18188	0.33194
2004	15:11	1.3086	-0.062997	0.27017
2004	20:13	1.4433	0.37617	0.43374
2005	17:52	0.64	-0.18452	0.16453
2005	11:36	2.07	-0.77853	1.012
2005	30:17	1.96	-0.12562	0.34268
2005	34:25	1.1175	-0.035044	0.16456
2005	48:22	2.04	-0.48449	0.22225
2005	42:12	-	-	-
2005	53:41	1.6143	-0.27026	0.27706
2005	23:54	0.94	0.74347	0.36252

2005	43:12	-	-	-
2005	08:53	2.0314	-0.49524	0.13074
2005	12:20	1.784	-0.33679	1.4409
2005	11:35	0.95	-0.19757	0.20246
2005	44:33	2.0875	-0.55665	0.14917
2005	10:16	0.53667	-0.044852	0.15909
2005	52:24	-	-	-
2005	16:43	0.78	0.59241	0.94086
2005	03:15	1.1825	0.051462	0.23481
2005	46:28	1.464	0.80178	0.7095
2005	26:43	-	-	-
2005	51:07	0.88	-0.34946	0.13721
2005	44:42	1.6982	-0.32079	0.18309
2005	38:51	0.836	0.026111	0.1376
2005	26:56	1.8291	-0.54187	0.23114
2005	13:09	1.7022	-0.17982	0.32053
2005	32:51	-	-	-
2005	16:06	2.4273	-0.55892	0.19997
2006	13:40	1.6514	-0.18954	0.31997
2006	34:55	0.86	0.082424	0.12144
2006	02:59	1.052	0.16591	0.28323
2006	48:43	0.94857	0.37845	0.23393
2006	08:27	1.4743	0.9656	0.49211
2006	21:00	0.96545	-0.2369	0.11272
2006	30:45	1.998	-0.74403	0.19054
2006	25:02	1.3511	-0.22889	0.3105
2006	58:06	0.75143	0.22248	0.31401
2006	17:17	1.8911	-0.63203	0.1888
2006	40:58	1.5425	-0.46047	0.29952
2006	26:40	1.5956	-0.25488	0.1377
2006	42:51	0.652	-0.31927	0.77119
2006	39:23	1.8933	1.2019	1.2408
2006	12:00	0.9475	0.099528	0.50366
2006	18:42	1.5667	-0.89215	0.35923
2006	40:01	-	-	-
2006	18:54	2.3723	-0.38557	0.19688
2006	50:36	1.0436	0.062242	0.19152
2006	44:46	1.4473	0.24098	0.55519
2006	18:51	2.2327	-0.74324	0.20362
2006	22:09	1.7657	-0.029329	0.075795
2006	50:23	0.67667	0.060914	0.14238

2006 06:02	1.5743	-0.11884	0.092344
2006 05:58	1.5183	0.10597	0.11119
2006 48:56	2.4275	-0.55056	0.22945
2006 38:33	-	-	-
2006 26:34	1.9067	0.29397	0.58216
2006 14:13	2.0916	-0.23007	0.14974
2006 40:55	1.3764	-0.0692	0.050189
2007 23:21	1.91136	4.5993	0.96533
2007 15:52	1.3936	-2.1735	0.48218
2007 11:05	1.8486	-0.72977	0.19797
2007 40:01	0.92308	0.079108	0.0955
2007 41:57	1.355	0.029459	0.14186
2007 08:19	-	-	-
2007 39:56	2.4303	-1.5031	0.34062
2007 47:31	-	-	-
2007 34:38	1.7778	0.22347	0.14563
2007 00:27	2.0662	0.14018	0.19162
2007 02:29	2.4464	0.021717	0.21438
2007 11:52	0.94	0.14157	0.082508
2007 22:12	1.4222	0.21822	0.10139
2007 29:40	1.5471	-0.188009	0.13564
2007 52:09	-	-	-
2007 13:22	2.2477	0.13131	0.11987
2007 17:37	0.6112	0.02807	0.057368
2007 34:52	1.097	0.033732	0.15373
2007 08:51	2.6686	-0.60648	0.16309
2007 21:42	-	-	-
2007 22:11	1.5888	-0.089367	0.14524
2007 40:57	2.2937	-0.719	0.1648
2007 39:27	1.977	0.019423	0.1248
2007 42:29	1.5063	-0.26727	0.14467
2007 05:18	2.1642	-0.44815	0.15809
2007 49:14	2.3395	-0.67347	0.18652
2007 36:26	-	-	-
2007 01:48	-	-	-
2007 35:52	-	-	-
2007 38:59	1.6636	0.27314	0.096958
2007 08:30	1.8408	0.1107	0.099964
2007 17:52	1.9078	0.48292	0.17893
2007 05:43	2.217	0.01263	0.17087
2007 30:17	1.4013	0.10756	0.073877

2007	40:50	1.4868	-0.27336	0.084185
2007	05:58	1.4465	-0.15468	0.096107
2007	13:00	1.2943	-0.082319	0.13901
2007	49:58	2.629	-0.248248	0.11728
2007	00:19	1.6038	-0.62391	0.11001
2007	28:20	1.5579	0.036136	0.080666
2007	09:17	1.5113	-0.098835	0.083267
2007	30:27	1.4283	-0.012342	0.089246
2007	04:56	1.7089	-0.081647	0.14187
2008	52:15	-	-	-
2008	38:14	2.2306	-0.33168	0.11885
2008	50:18	1.9551	-0.23811	0.12415
2008	09:22	1.8653	-0.080217	0.10369
2008	31:02	2.0827	0.12345	0.11876
2008	23:34	2.0394	0.050827	0.078354
2008	13:17	2.2175	0.016976	0.13083
2008	46:12	2.4337	-0.5951	0.12375
2008	59:51	1.5758	0.30812	0.091206
2008	54:19	2.4634	0.50479	0.15132
2008	14:49	-	-	-
2008	33:34	1.7037	-0.16095	0.090967
2008	33:37	1.3519	0.14498	0.061067
2008	45:20	-	-	-
2008	51:29	1.9379	0.21451	0.083865
2008	35:34	2.4379	-0.22779	0.21064
2008	43:45	2.4039	0.059873	0.082298
2008	12:04	1.5268	0.16427	0.071238
2008	26:34	-	-	-
2008	39:28	1.8318	0.11366	0.078772
2008	27:01	2.5776	-0.37779	0.076102
2008	39:52	0.79909	0.15803	0.051095
2008	26:19	1.7303	0.14678	0.070048
2008	00:36	0.90636	-0.14539	0.060968
2008	52:07	2.6451	-0.32857	0.11251
2008	08:14	2.1927	-0.16183	0.099793
2008	19:31	2.0515	0.04675	0.12149
2008	52:49	2.3423	-0.071127	0.094742
2008	41:25	2.2324	0.10585	0.086322
2008	10:33	1.8217	-0.098328	0.08468
2008	55:57	1.1785	0.25249	0.10188
2008	19:35	2.592	-0.14984	0.13106



2008 22:02	-	-	-
2008 02:58	1.7409	0.061052	0.076617
2008 23:59	-	-	-
2009 27:20	2.2983	0.0094418	0.10859
2009 49:39	2.4884	-0.022907	0.11583
2009 11:48	-	-	-
2009 35:18	2.3892	-0.00012155	0.12681
2009 53:45	2.1543	-0.096081	0.1009
2009 50:29	1.413	-0.036863	0.075965
2009 17:40	1.4981	-1.339	0.14864
2009 23:33	1.5405	0.08251	0.078769
2009 17:58	1.8118	0.083178	0.077586
2009 53:52	2.1914	-0.18755	0.13221
2009 24:45	2.4125	-0.35968	0.15106
2009 30:33	1.5732	0.15159	0.073513

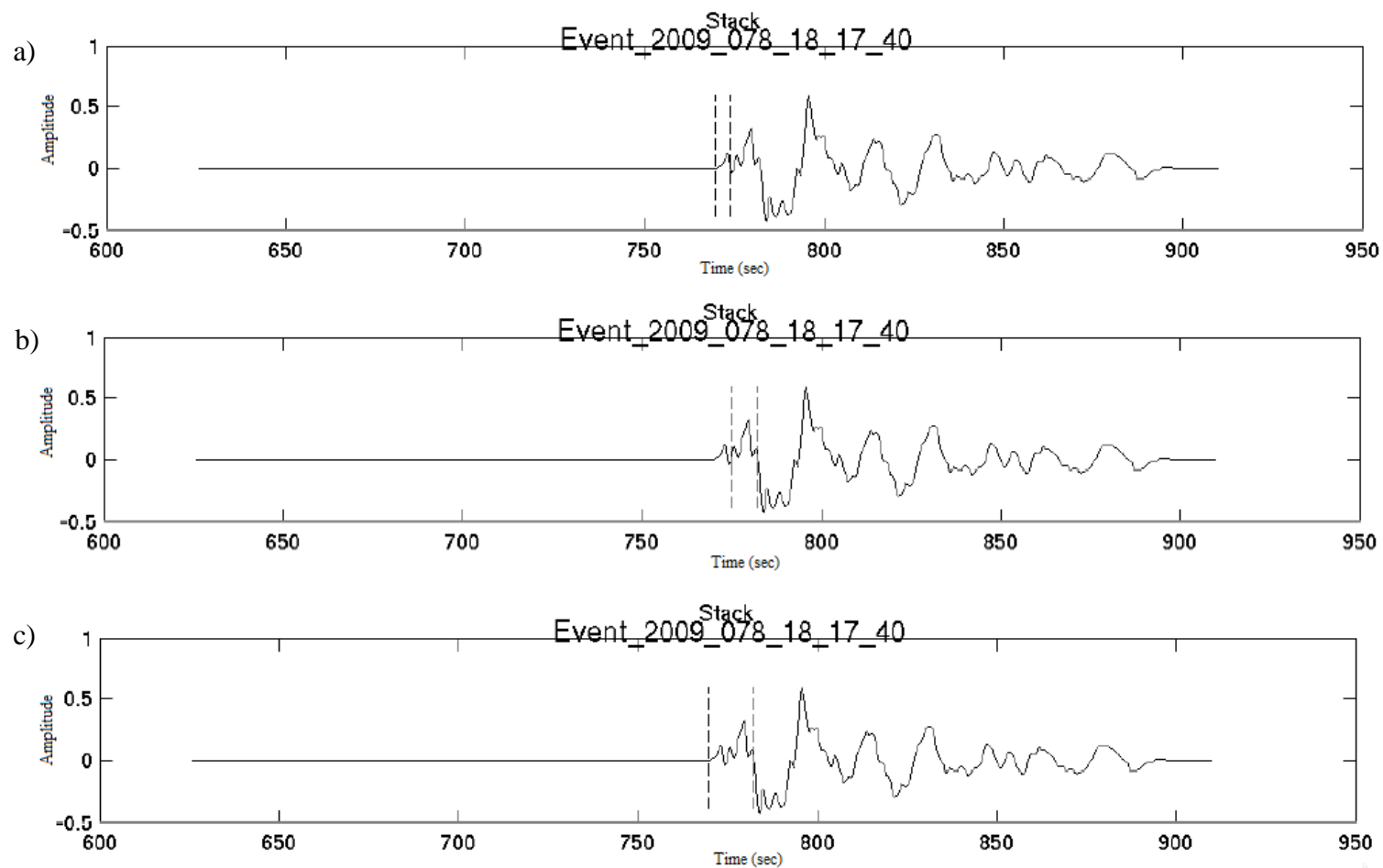


Figure 26. Example of the different waveform picking criteria tried. The selection of the pulse can be seen for (a) category 1, (b) category 2, and (c) category 3. Results for Event 2009-17:40. Dashed line indicates the portion of the wave picked.

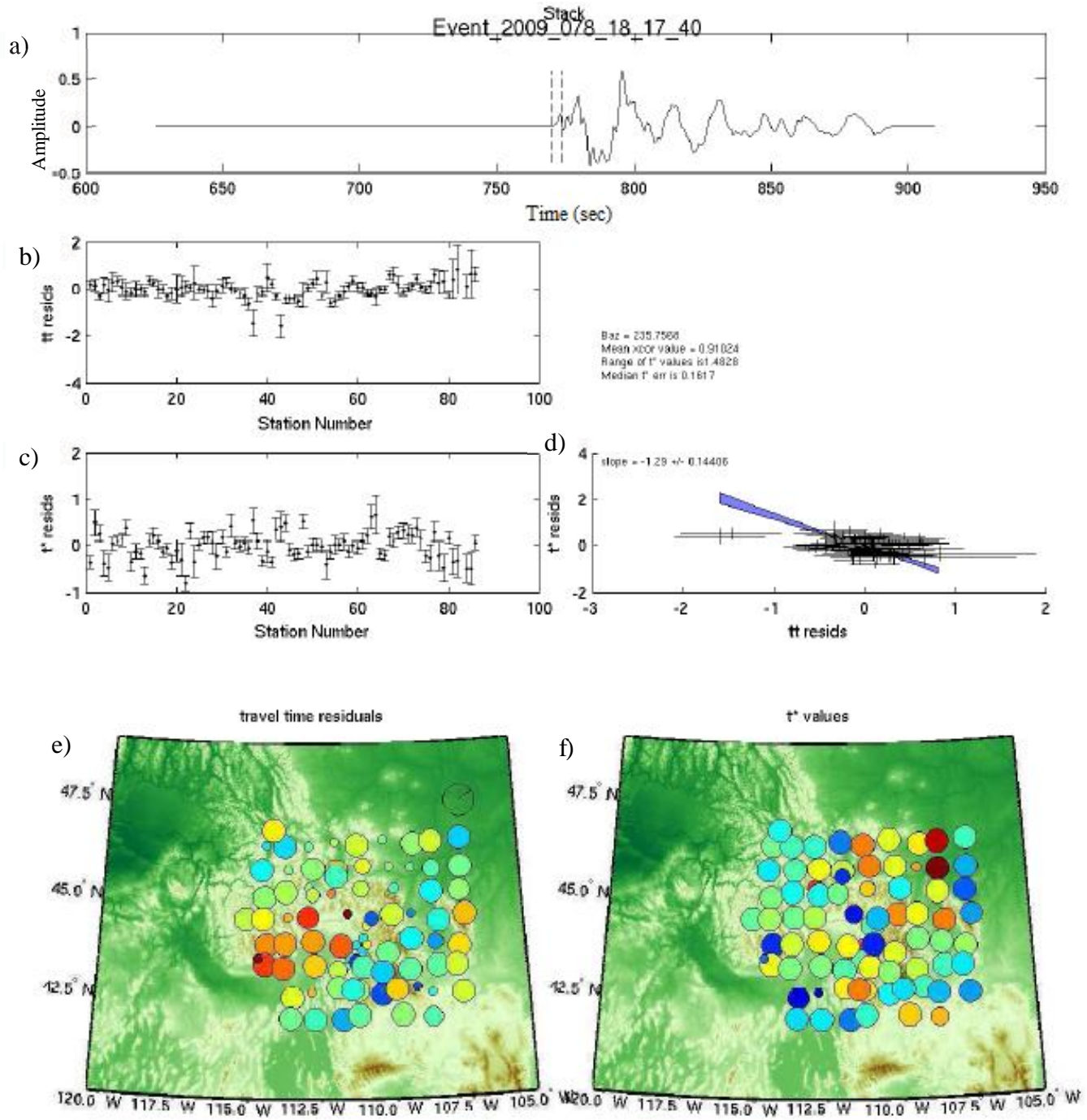


Figure 27. Measurements of  $t^*$  and travel time estimates for c1. Results for Event 2009-17:40. Details are as in Figure 22.

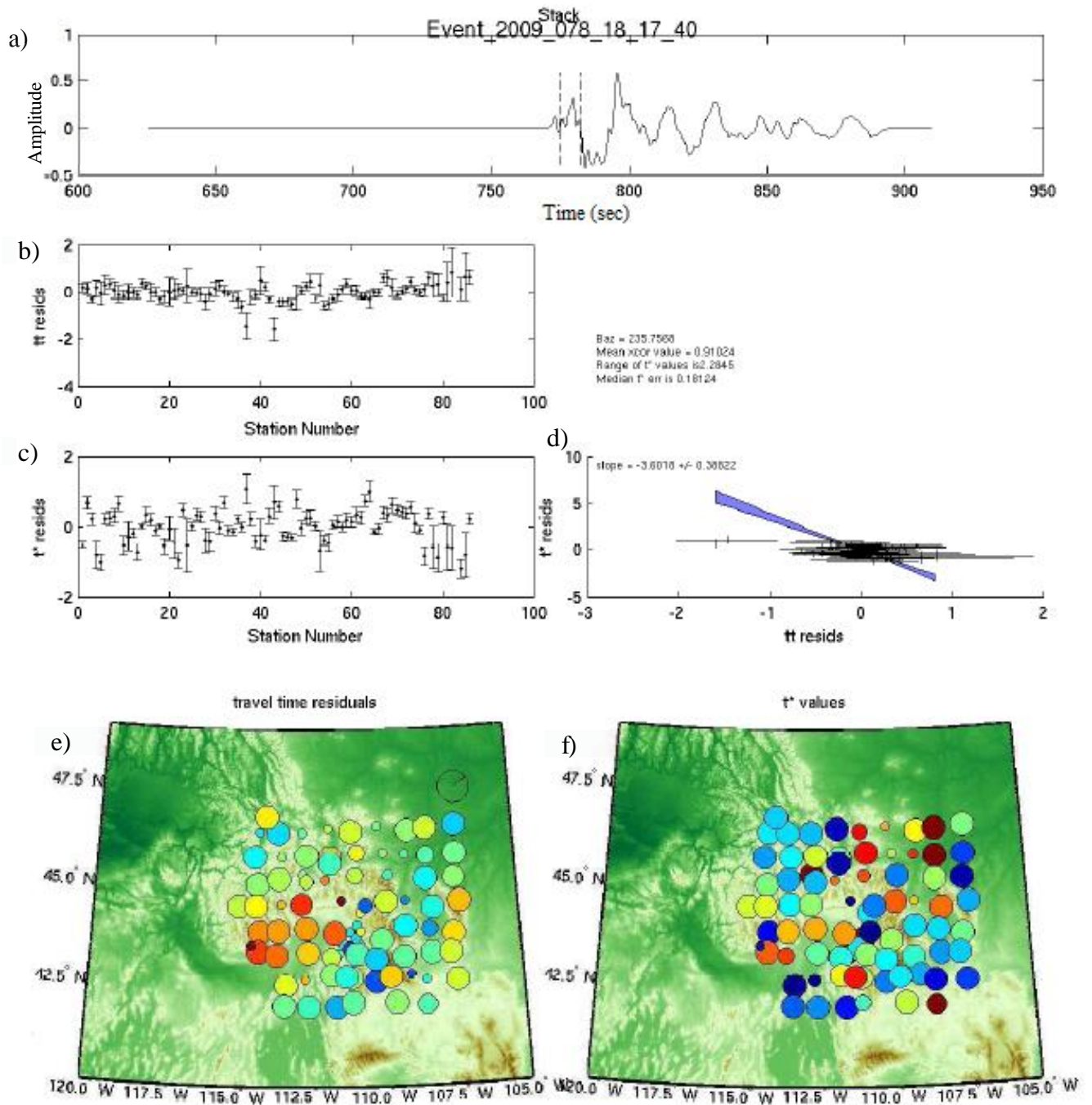


Figure 28. Measurements of  $t^*$  and travel time estimates for c2. Results for Event 2009-17:40.: Details are as in Figure 22.

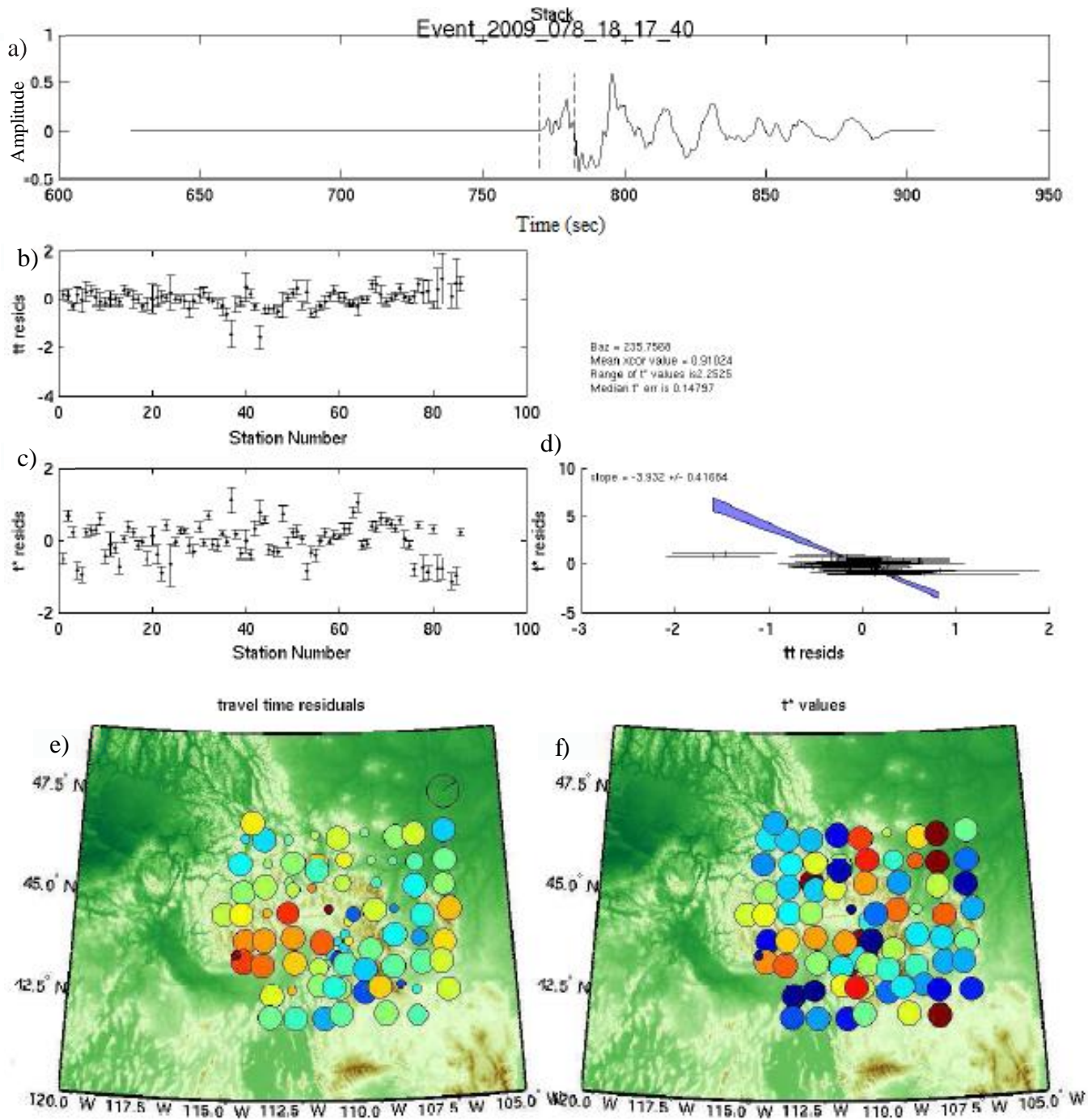


Figure 29. Measurements of  $t^*$  and travel time estimates for c3. Results for Event 2009-17:40. Details are as in Figure 22.

pattern trending from low in the northwest to a high attenuation in the central region and again to a low attenuation in the southeast region. For all three tests these spatial patterns are similar, but for c2 and c3 attenuation increases in the central region, and to the northwest and southeast attenuation decreases (see Figure 27f, 28f, and 29f). Compared to c1, c2 and c3 show a clearer spatial pattern c2 and c3 are not clearly different for this event.  $dt^*/dtt$  for all three tests is negative (see Table 2), contrary to expectations (Figure 30). Most of the events showed this type of pattern. When all events are considered, no spatial patterns are obvious in the  $t^*$  values (Figures 31, 32, and 33). Nor are they apparent for station averages of  $t^*$ . However  $tt$  spatial patterns seem to show the velocity variation within the *SRP* region (as expected).

All three tests find the same range of  $t^*$  variations, from about -0.5 to 0.5 s (Figure 34). These show little correlation with travel time variations, nor any clear spatial correlation when all 10 representative events are considered. The range of  $tt$  values found for the three tests are  $\sim -0.55$  to  $\sim 0.45$ s for c1 (Figure 35a);  $\sim -0.55$  to  $\sim 0.45$  with an outlier in  $\sim 0.53$ s for c2 (Figure 35b), and c3 give a range of  $\sim -0.50$  to  $\sim 0.57$ s for c3 (Figure 35c). The  $tt$  fit well with existing tomographic models for the region (see Figure 4).

Of the three tests, the second one (c2) produced the most consistent results. Scatter in  $t^*$  results seems less, and more of a spatial correlation was found in the results. This method was used for the subsequent  $t^*$  analysis including cratonic stations. All in



Table 2. Results of all three tests.

Test 1: The selection of the first pulse of the waveform.			
Event name (year-hour:min)	Range of $t^*$ (s)	Slope	Slope error
2009-49:39	2.5003	-0.021072	0.11616
2009-35:18	2.439	-0.012336	0.12687
2009-53:45	2.6219	-0.12565	0.11169
2009-50:29	1.4123	-0.036631	0.076026
2009-17:40	1.4828	-1.29	0.14406
2009-23:33	1.7274	0.05154	0.087921
2009-17:58	1.8251	0.082904	0.078064
2009-53:52	2.2359	-0.18881	0.13403
2009-24:45	2.4188	-0.36401	0.15175
2009-30:33	1.7782	0.20124	0.078852

Test 2: The selection of the most prominent pulse of the waveform.			
Event name (year-hour:min)	Range of $t^*$ (s)	Slope	Slope error
2009-49:39	-	-	-
2009-35:18	2.4746	-0.0091871	0.12714
2009-53:45	2.62	-0.12741	0.11117
2009-50:29	2.1528	0.10092	0.093267
2009-17:40	2.2845	-3.6018	0.38822
2009-23:33	1.7274	0.05154	0.087921
2009-17:58	1.8251	0.082904	0.078064
2009-53:52	2.2351	-0.1899	0.1345
2009-24:45	1.813	0.095855	0.11773
2009-30:33	2.2031	0.0207	0.12429

Test 3: The selection of a larger unit of the P-wave.			
Event name (year-hour:min)	Range of $t^*$ (s)	Slope	Slope error
2009-49:39	2.4724	-0.052025	0.10845
2009-35:18	2.5641	-0.19321	0.13703
2009-53:45	2.8771	-0.27889	0.11344
2009-50:29	1.9827	0.17635	0.10205
2009-17:40	2.2525	-3.932	0.41684
2009-23:33	2.3119	0.29424	0.12193
2009-17:58	1.9973	0.11301	0.10803
2009-53:52	2.7147	-0.29112	0.13214
2009-24:45	2.5835	-0.26562	0.1526
2009-30:33	2.0252	0.17362	0.11818

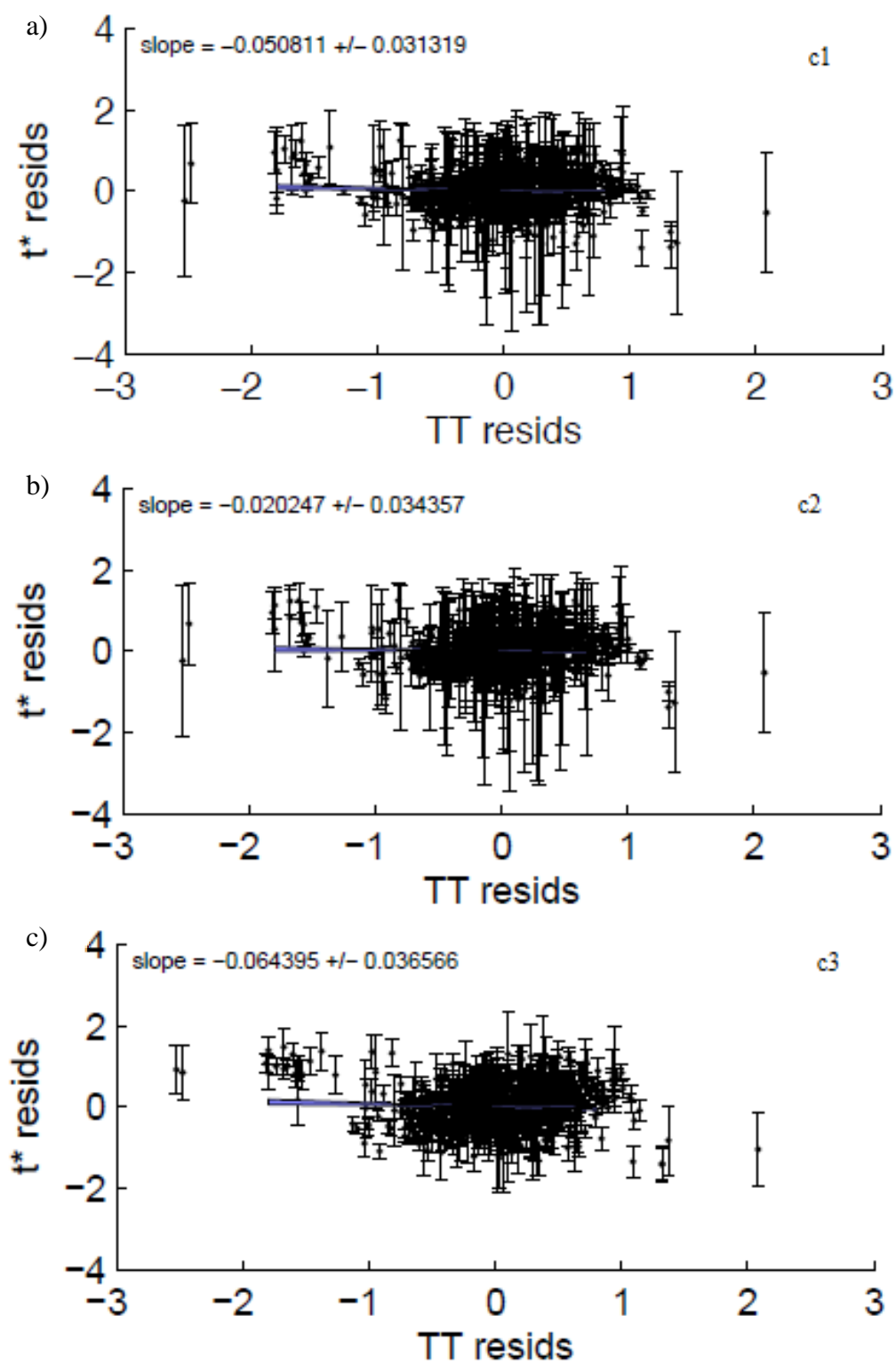


Figure 30. Slope results for the different waveform picking criteria tried, (a) category 1, (b) category 2, and (c) category 3.



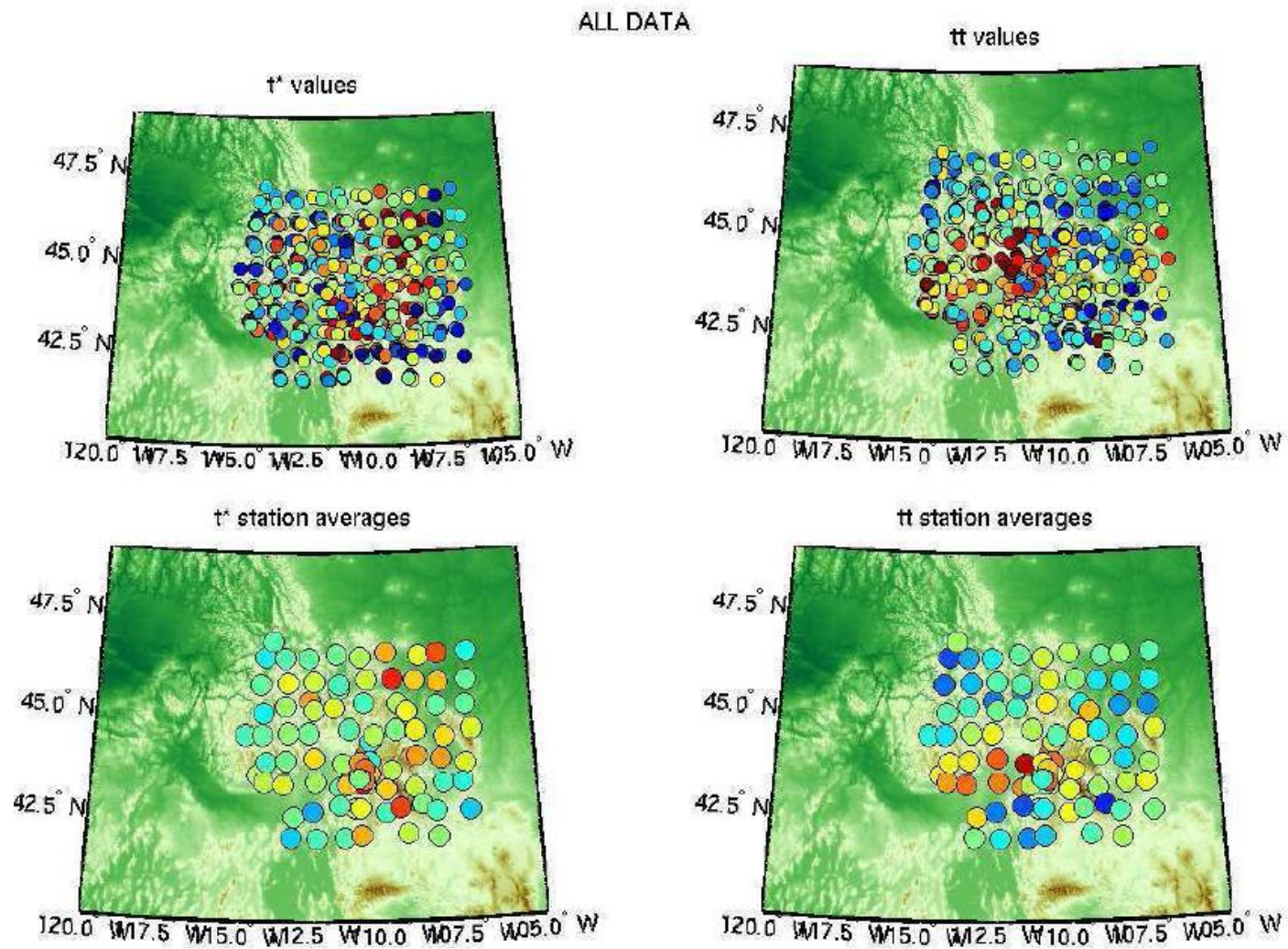


Figure 31. Station averages map for all 10 events within c1. Details of the colors are as in Figure 22.

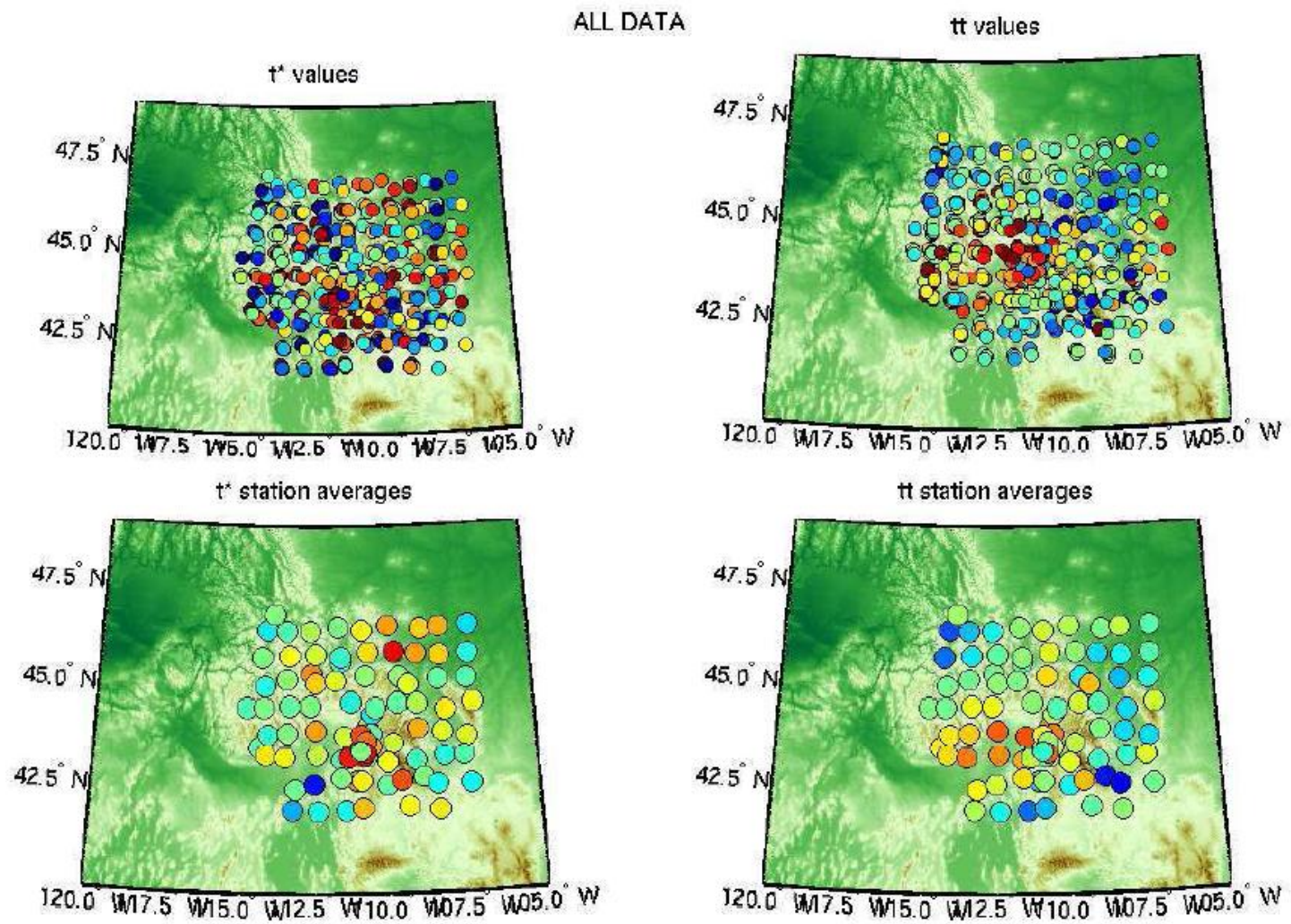


Figure 32. Station averages map for all 10 events within c2. Details of the colors are as in Figure 22.



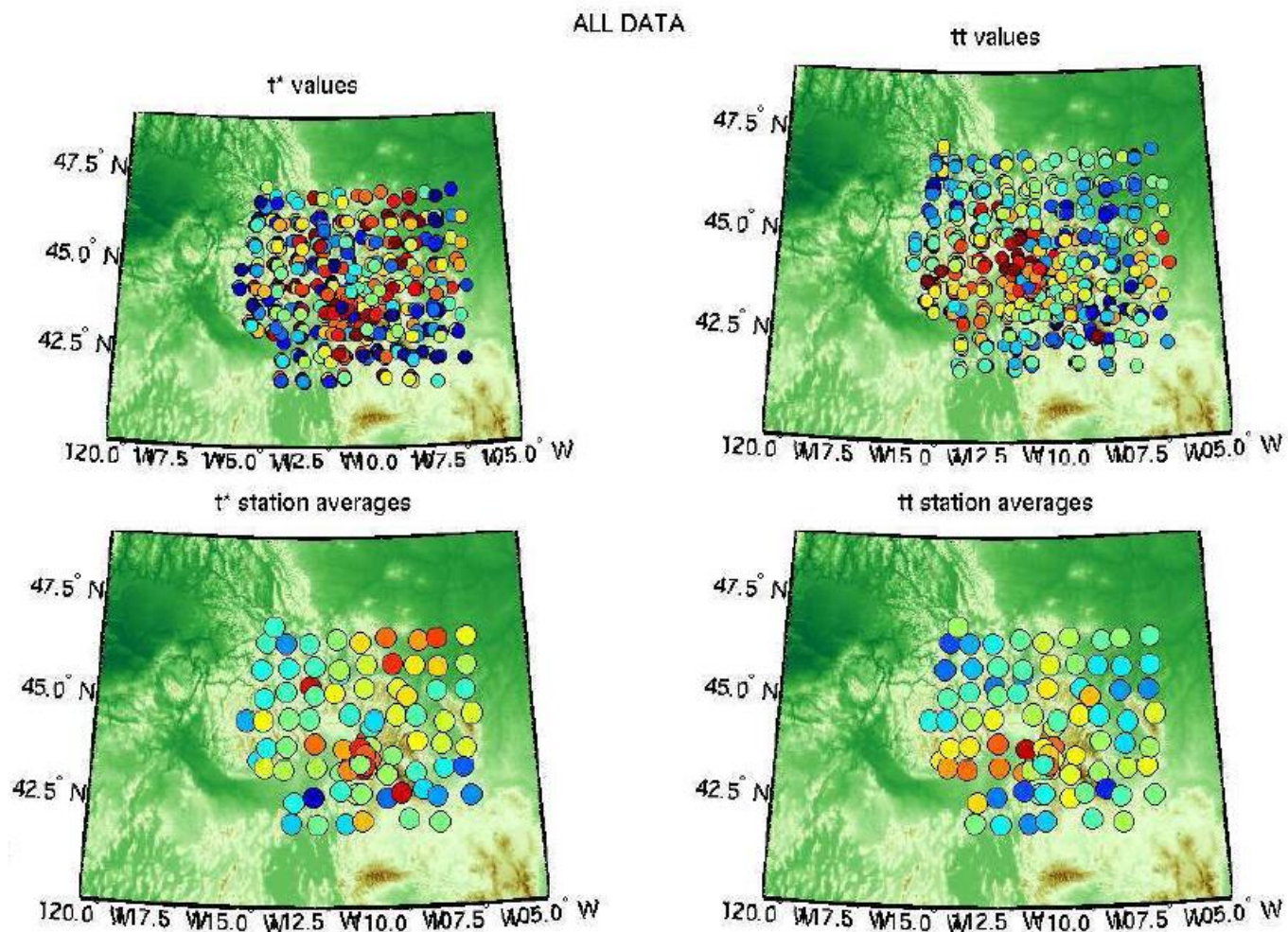


Figure 33. Station averages map for all 10 events within c3. Details of the colors are as in Figure 22.

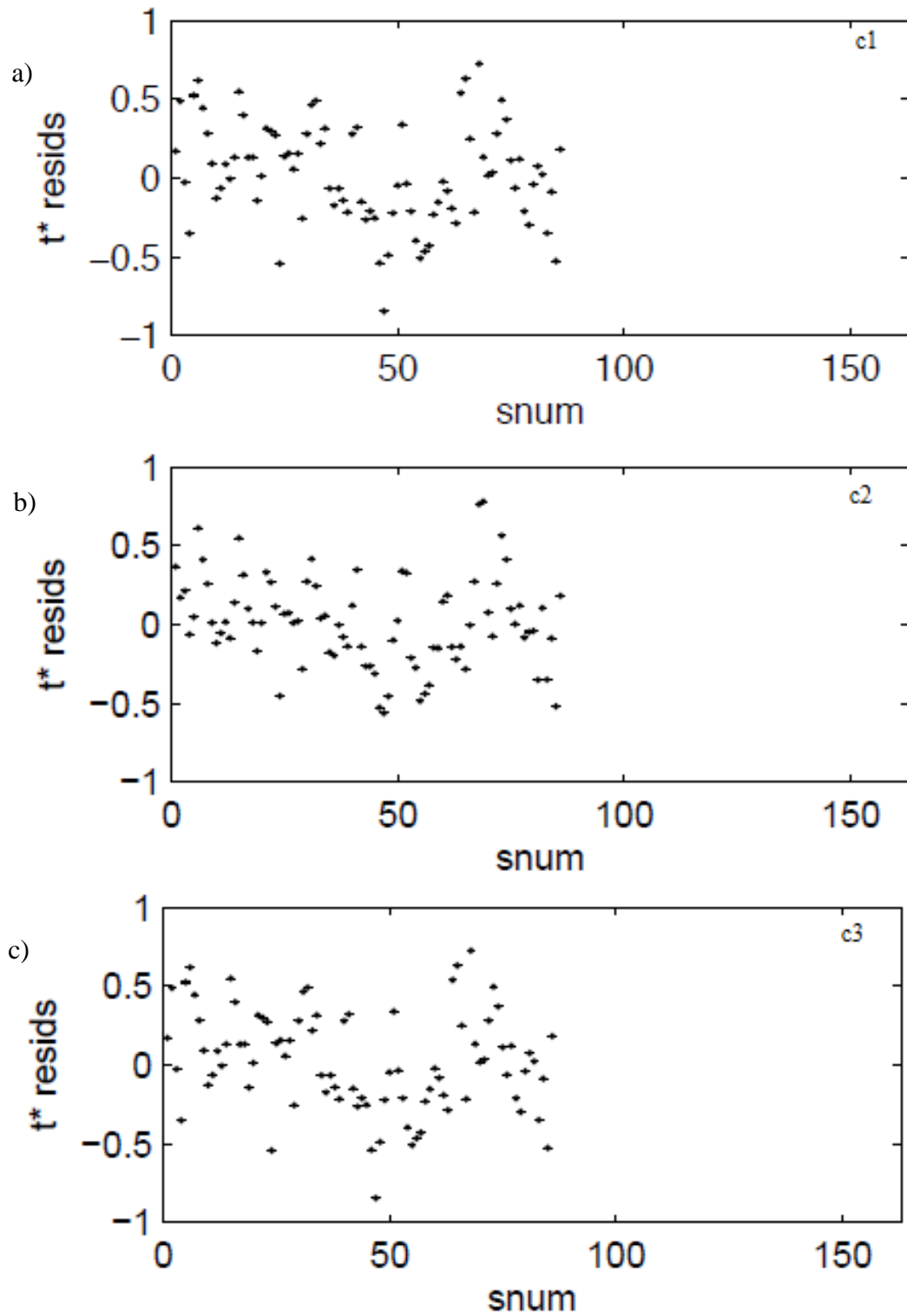


Figure 34.  $t^*$  results for the different waveform picking criteria tried, (a) category 1, (b) category 2, and (c) category 3. Snum refers to station number, which was given arbitrarily.

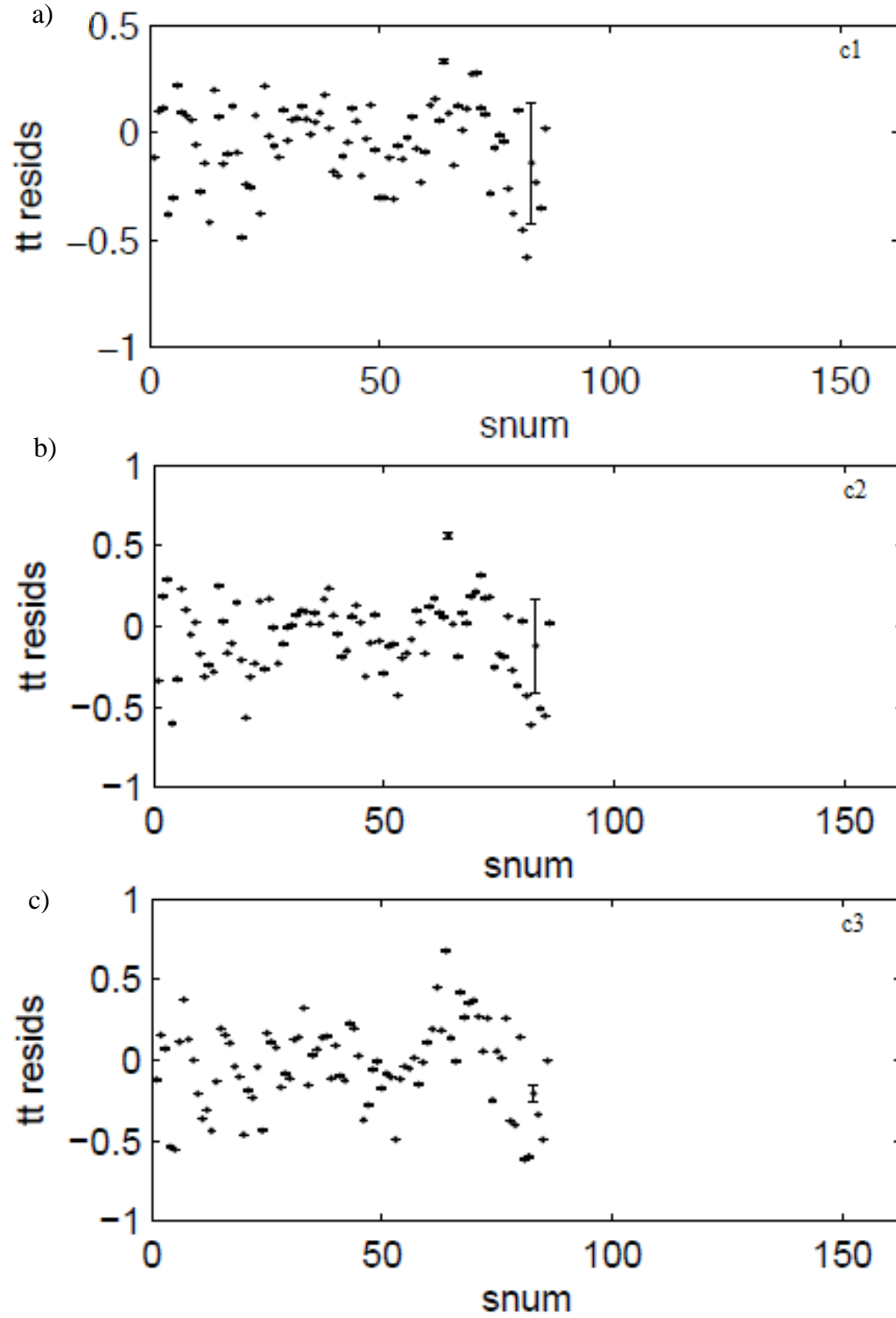


Figure 36.  $tt$  results for the different waveform picking criteria tried, (a) category 1, (b) category 2, and (c) category 3. Snum refers to station number, which was given arbitrarily.

all, however, varying the part of the waveform picked did not have a large effect on the results (Figures 31-33).

#### Inclusion of cratonic stations FFC and CCM

Using the new waveform picking method (c2 -- as explained above), measurements of  $tt$  and  $t^*$  were performed on the same data augmented with cratonic stations FFC and CCM. This data set has a total of 235 events (with the two cratonic stations, more events were classified as bad events, reducing the number of events from 297 to 235). Figures 36, 37, and 38 shows the  $t^*$  values estimated for different stations sorted by parameters like: delta (time lag),  $t^*$ , and  $tt$  for Event 2008-33:37, and Figure 39 summarizes the results for the same event. In this event, there is a rough spatial correlation in  $t^*$  values (Figure 39e), and there is even a correlation between  $tt$  and  $t^*$ . Interestingly, the cratonic stations were expected to have the lowest  $tt$  and  $t^*$  values of all the stations analyzed; however, this generally was not the case, especially for station CCM (see Figure 39e and f).

Other events also show the rough pattern of low  $t^*$  in the south to higher  $t^*$  in the north, for example Event 2007-22:11 (Figure 40). Two interesting events to examine are Event 1999-12:33 and Event 2000-00:22 (Figures 41 and 42). In these events, a tightly spaced array in Montana, the Billings Array, was operational. This array, over a smaller spatial scale than the full Yellowstone region being examined, has a clear change in mantle velocity structure under it, but not nearly the mantle velocity variations found around the Yellowstone hotspot track [Schutt, 2008]. Thus is it worthwhile to check if  $t^*$

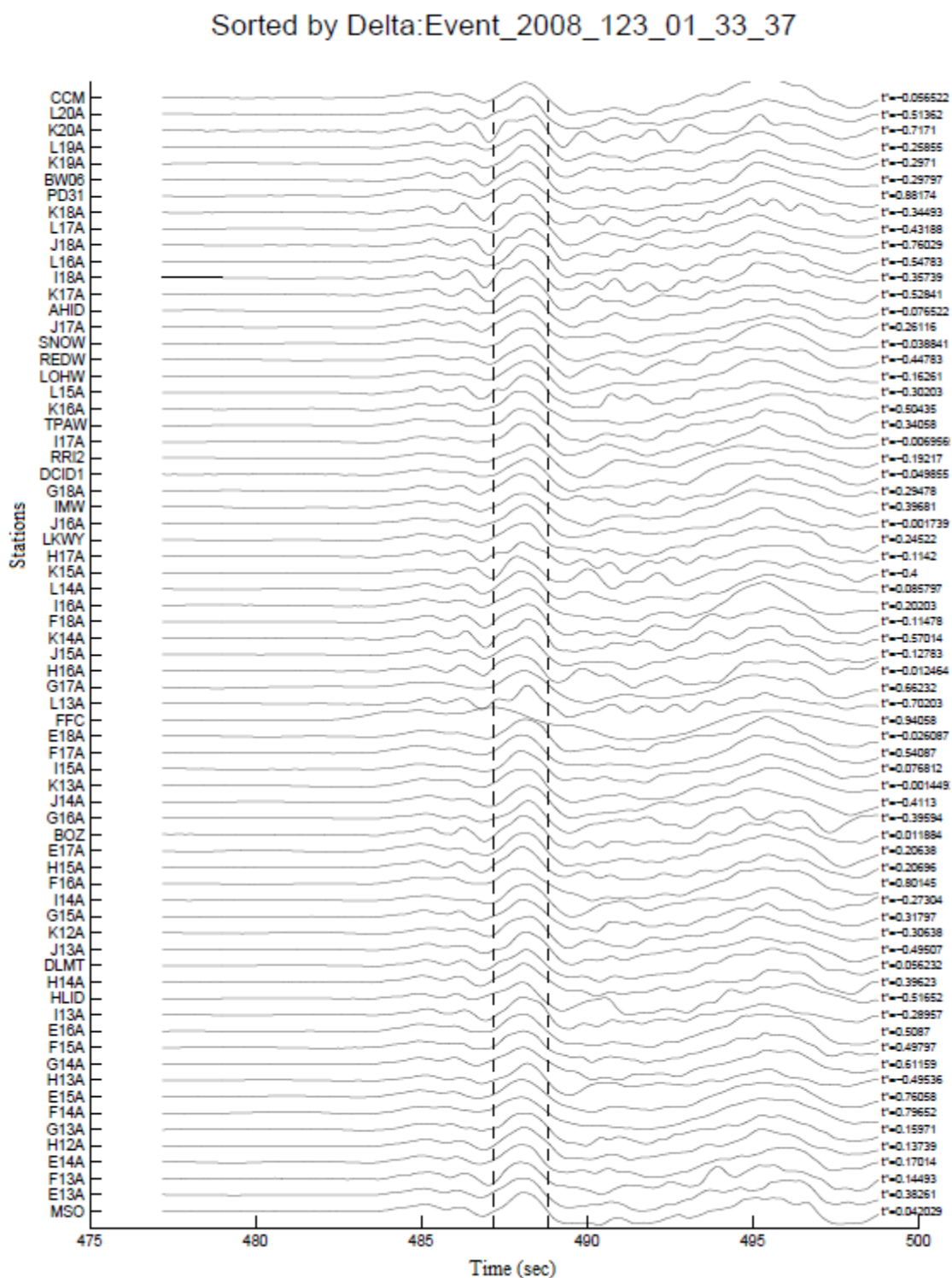


Figure 36.  $t^*$  estimated sorted by delta (time lag). Dashed line indicates the portion of the wave picked.

Sorted by  $t^*$ :Event\_2008\_123\_01\_33\_37

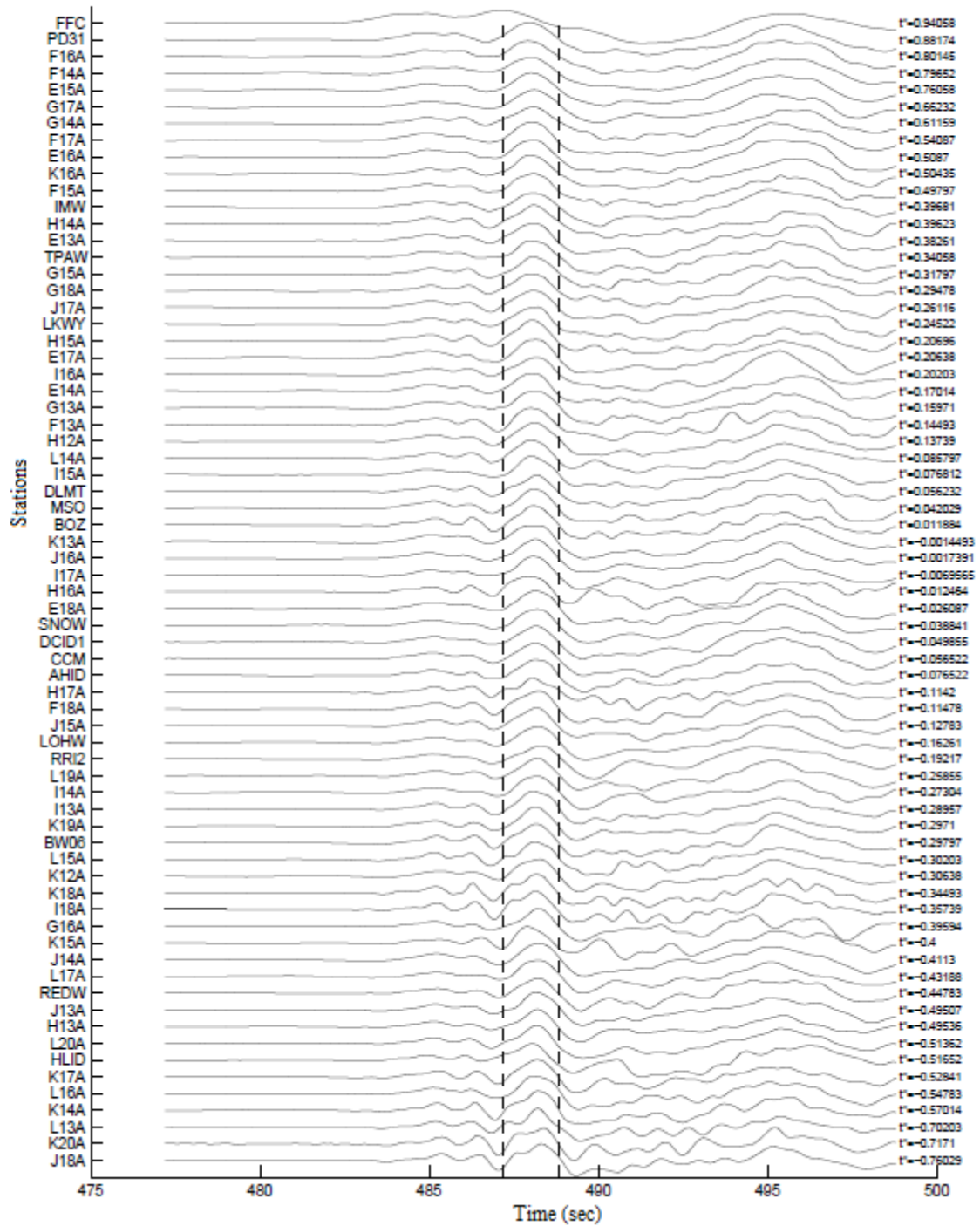


Figure 37.  $t^*$  estimated sorted by  $t^*$  value. Dashed line indicates the portion of the wave picked.



# Sorted by travel time: Event\_2008\_123\_01\_33\_37

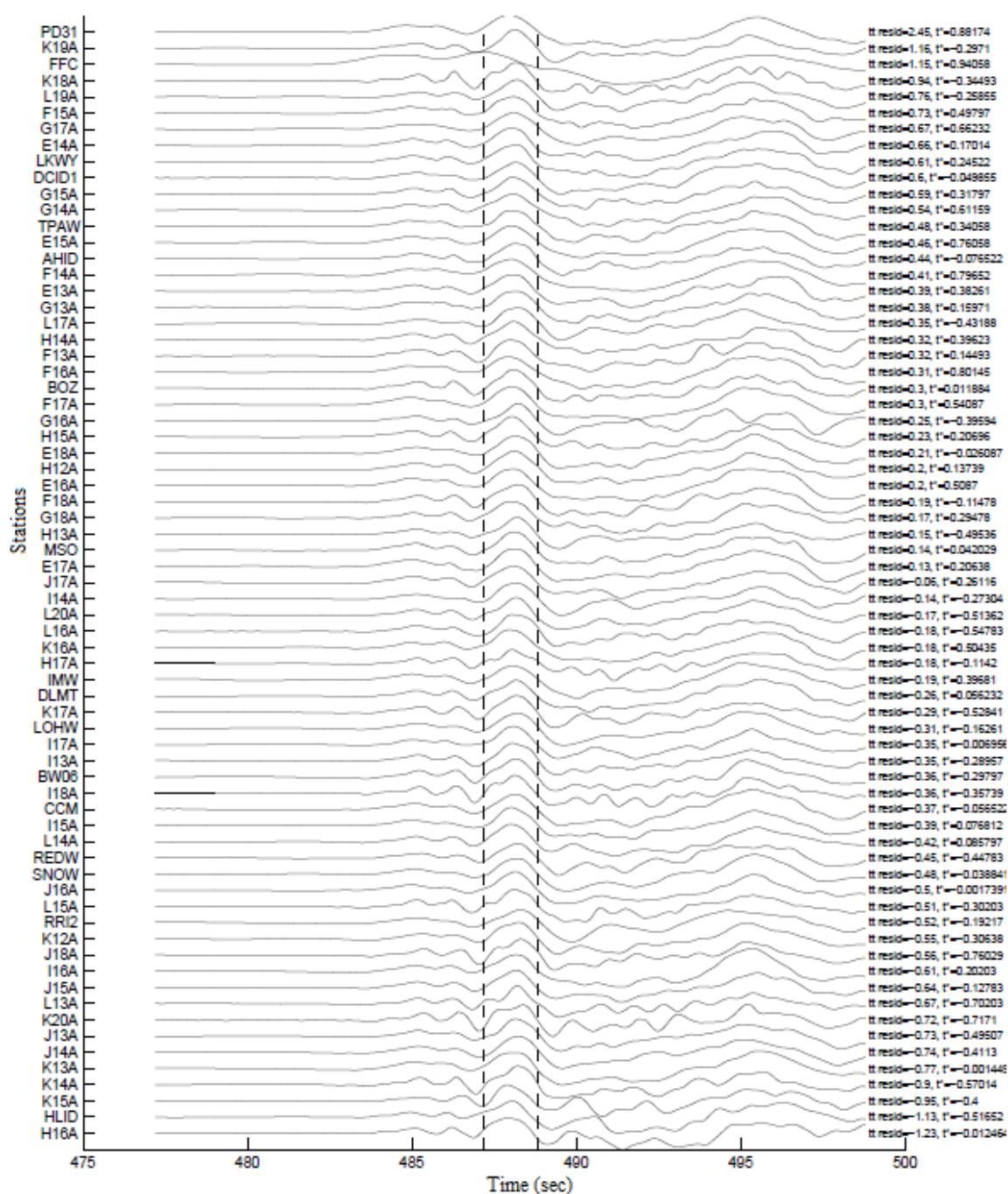


Figure 38.  $t^*$  estimated sorted by  $tt$  value. Dashed line indicates the portion of the wave picked.



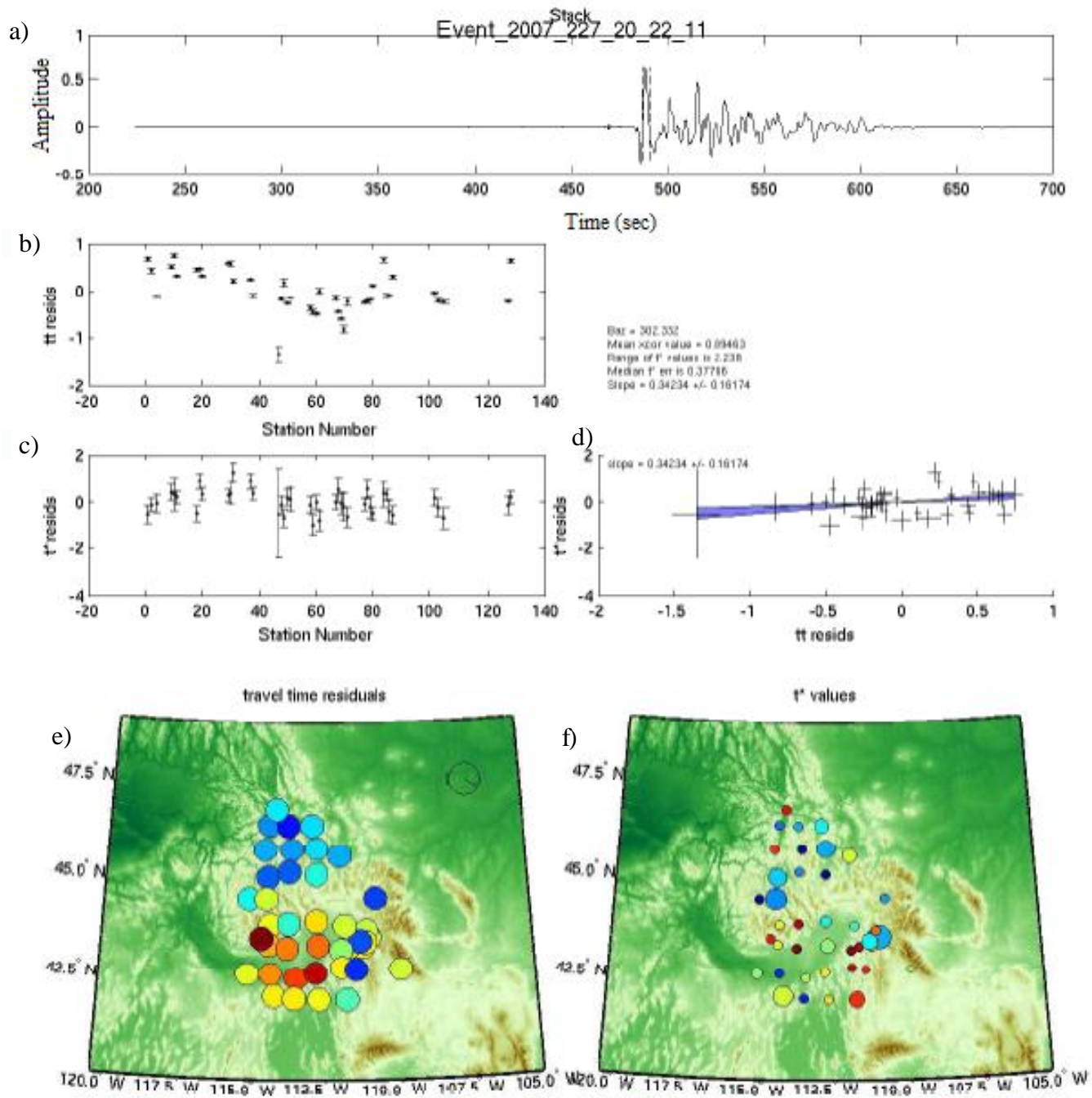


Figure 40. Measurements of  $t^*$  and  $tt$  estimates. Summarized results for Event 2007-22:11. Detail are as in Figure 22.



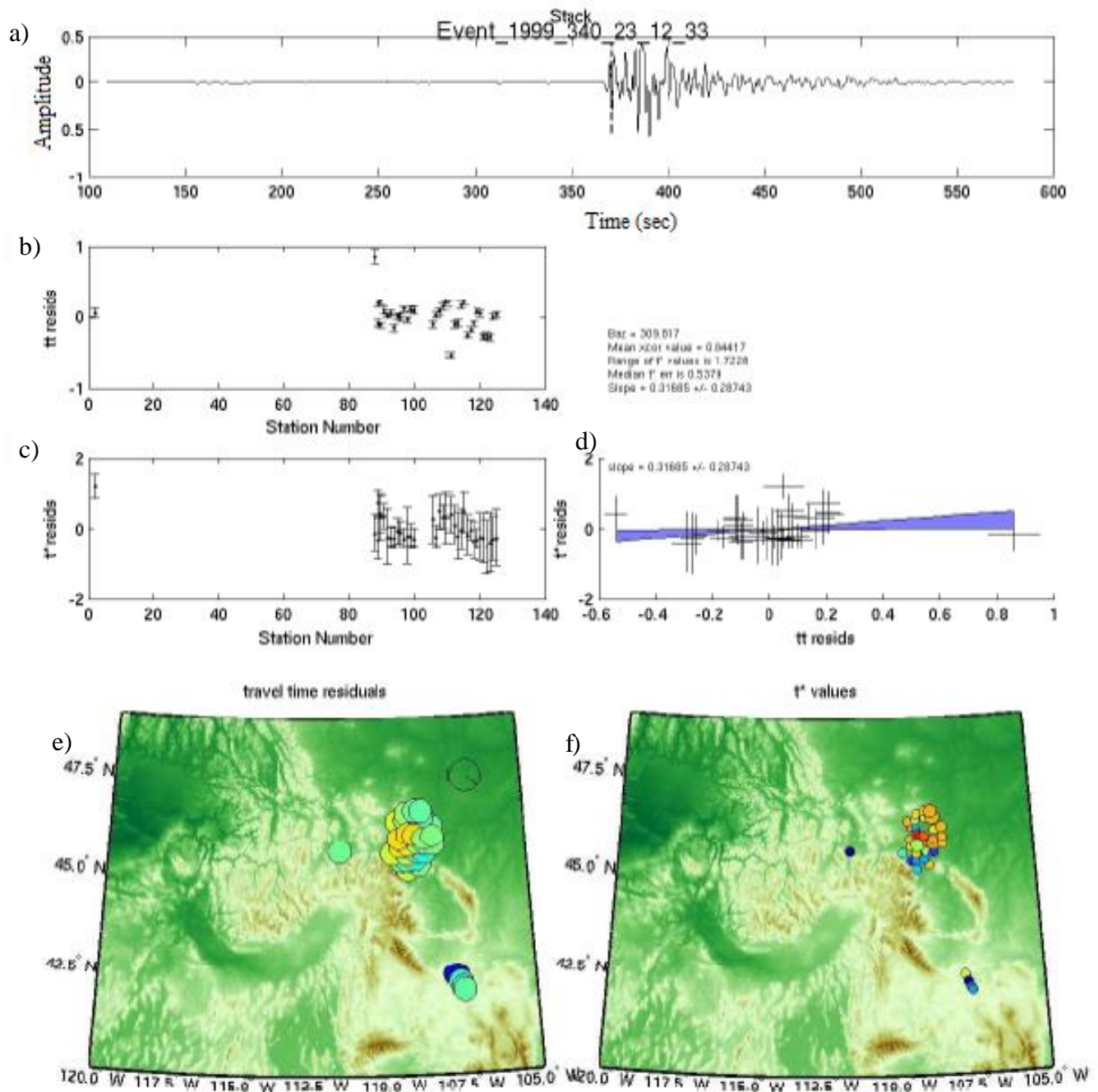


Figure 41 Measurements of  $t^*$  and  $tt$  estimates. Summarized results for Event 1999-12:33. Details are as in Figure 22.

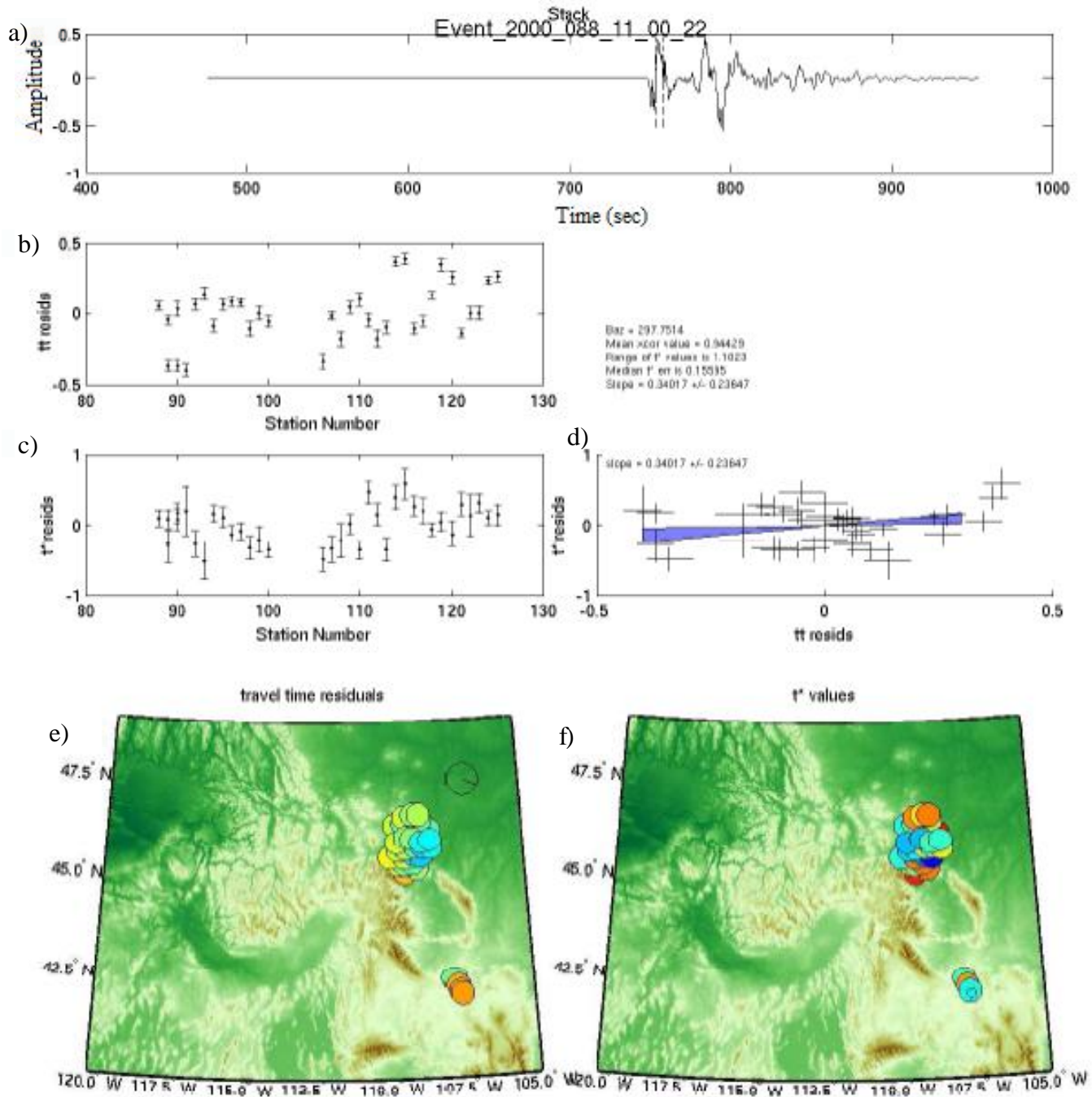


Figure 42. Measurements of  $t^*$  and  $tt$  estimates. Summarized results for Event 2000-00:22. Details are as in Figure 22.

variations are also smaller than the  $tt$  variations, and indeed they are. Visual inspection of Figures 41 and 42 shows that  $t^*$  variations also show some correlation for nearby stations (stations that are closer show closer values; however, even though both events come in from the same direction (southeast), the  $t^*$  results are not that similar for common stations between the two events.

All in all, the results for the inclusion of the cratonic stations are similar to the initial  $t^*$  results. There is a large scatter in results, and no clear patterns in  $t^*$  or  $dt^*/dtt$  seem evident (Figure 43, and 44). Again, the  $dt^*/dtt$  value when all the data is considered is negative, in this case  $-0.042 \pm 0.009$ , and the  $dt^*/dtt$  values for all the events seems randomly scattered with a mean near zero (see Table 3).

In Table 4, the event-averaged  $t^*$  and  $tt$  for all is presented. Surprisingly, the mean  $t^*$  for CCM is  $-0.07$ , and for FFC is  $0.12$ s. This is unexpected since the cratonic stations lie on cold, presumably less-attenuating mantle, and are expected to have the lowest  $tt$  and  $t^*$  values.

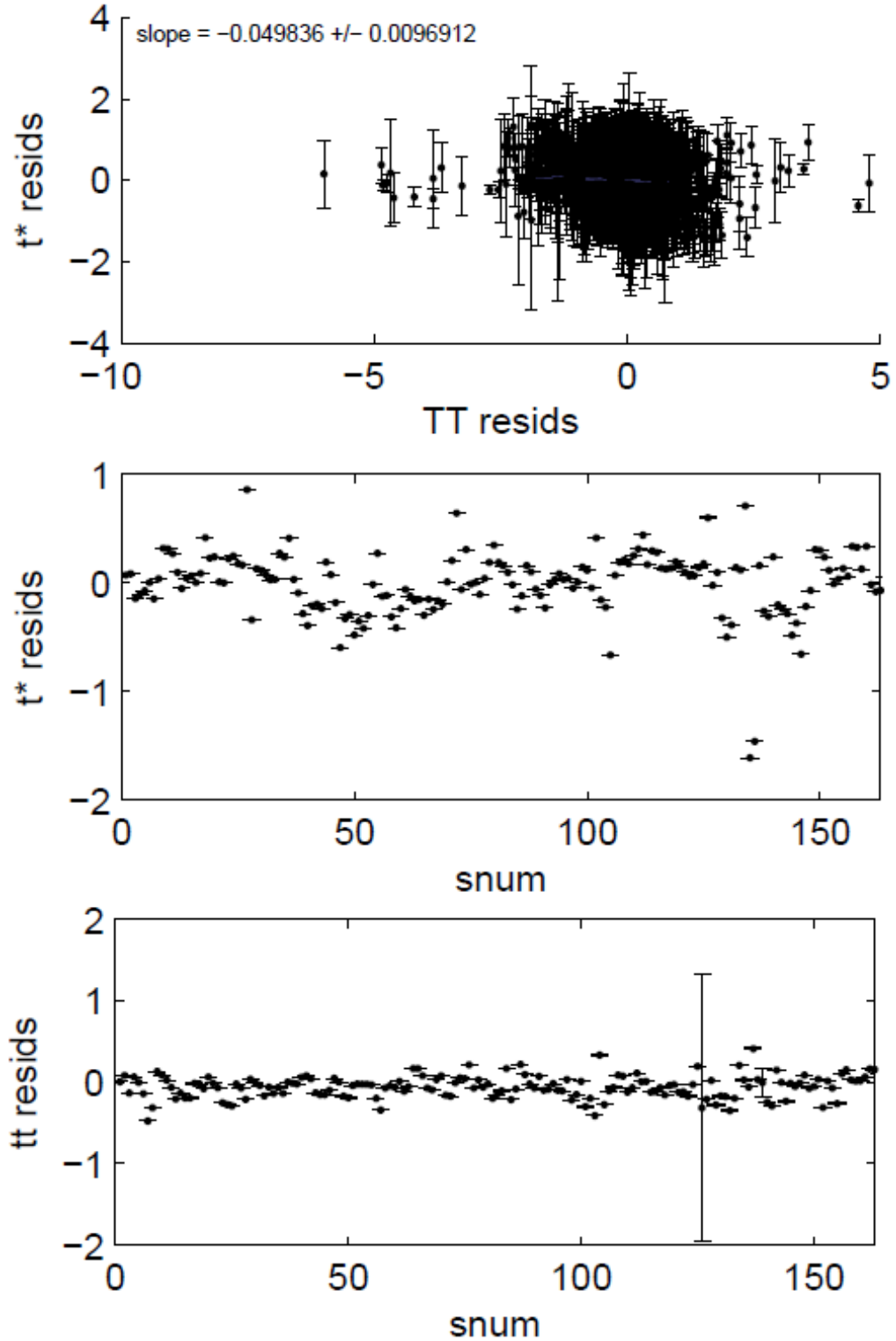


Figure 43. Slope results,  $t^*$  residuals and  $tt$  residuals for all 235 events. Again, note that most of the slope events fall into the negative region of the plot. Snum refers to station number, which was given arbitrarily.

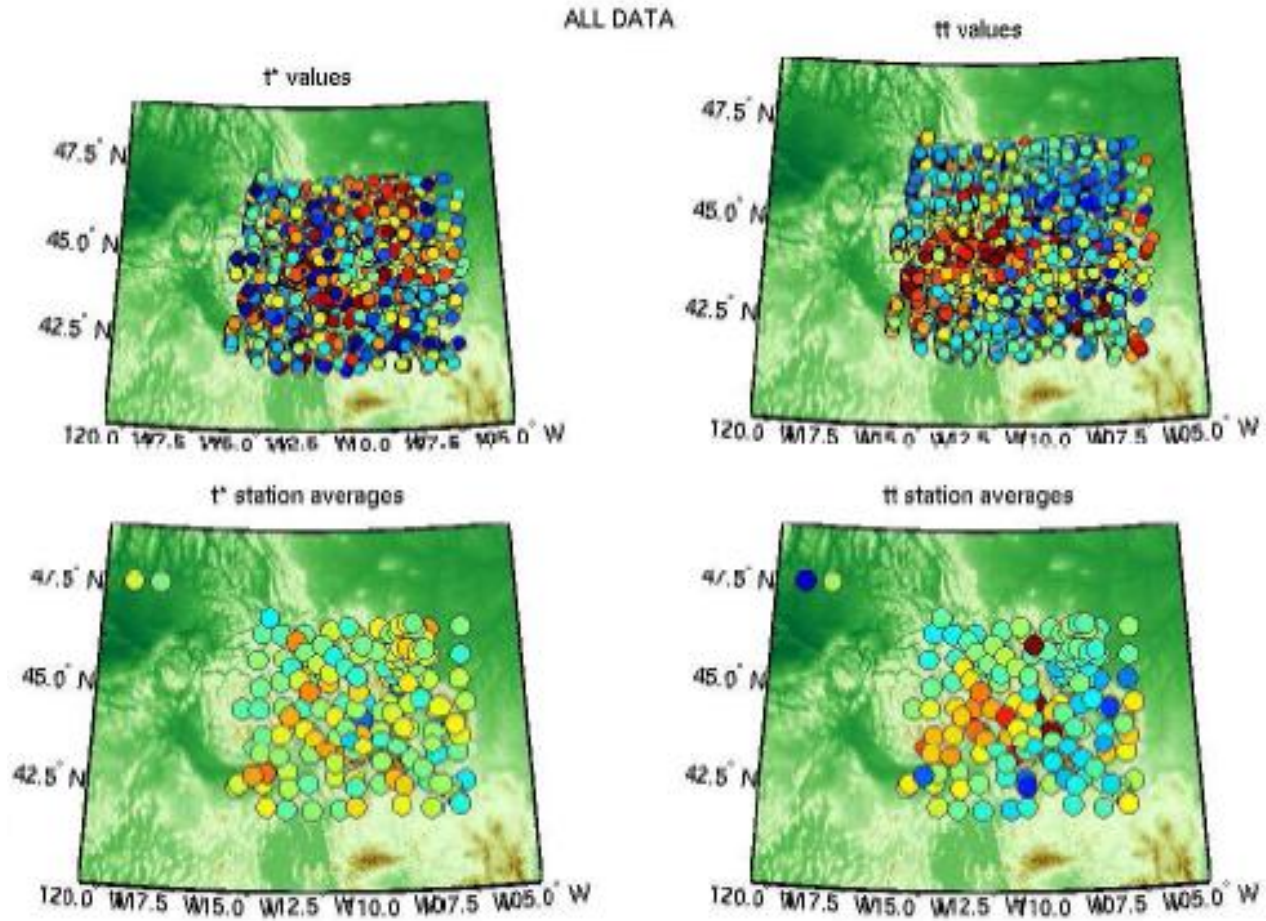


Figure 44. Station averages map for all 235 events.  $t^*$  and  $tt$  values map for all 235 events (stations repeated from one event to the other). Cratonic stations are shown in the northwestern region of the map. Details of the circles are as in Figure 22.



Table 3.  $t^*$  results for all events with the inclusion of cratonic stations FFC and CCM.

Event name (year-hour:min)	Range of $t^*$ (s)	Slope	Slope error
1999 14:16	1.6057	0.21792	0.44737
1999 21:15	2.2106	1.505	0.2807
1999 01:53	1.3276	-0.33717	0.19409
1999 12:33	1.7228	0.31685	0.28743
1999 19:49	1.9766	-0.707	0.27186
1999 29:49	0.65571	0.10604	0.11777
1999 38:30	1.4018	0.60807	0.2693
1999 29:19	1.98	-0.1784	1.0907
2000 59:21	1.8237	-0.89339	0.34232
2000 47:20	1.1312	0.16526	0.18448
2000 54:40	-	-	-
2000 26:50	0.948	0.046124	0.14981
2000 21:07	1.1221	-0.16022	0.13195
2000 43:58	1.6278	0.52268	0.31455
2000 00:22	1.1023	0.34017	0.23647
2000 27:23	1.031	-0.10054	0.078468
2000 36:32	0.78533	0.070742	0.10937
2000 43:18	1.5295	-0.24785	0.11923
2000 57:02	1.6428	-0.086058	0.13494
2000 55:35	1.5341	-0.3257	0.14997
2000 40:41	1.1051	-0.1845	0.14247
2000 51:46	1.734	-0.039918	0.1721
2000 53:35	2.1311	-0.22757	0.063692
2000 25:45	1.58	0.026898	0.0590541
2000 09:38	2.3637	0.1562	0.11028
2000 13:02	2.4699	-0.40402	0.10588
2000 27:12	1.3011	-0.059818	0.04866
2000 08:41	-	-	-
2000 55:59	1.4271	-0.14518	0.0078488
2000 17:52	2.29	0.0063482	0.132325
2000 23:43	-	-	-
2000 58:44	2.4362	-0.6934	0.13415
2000 30:19	1.4605	0.1666	0.052268
2000 59:58	2.4591	-0.17194	0.1039
2000 25:13	1.6886	0.12749	0.07928
2000 11:06	1.356	-0.0803053	0.055494

2000	19:21	-	-	-
2000	23:54	1.6453	-0.051577	0.084901
2001	49:28	2.2551	-0.3878	0.091343
2001	33:32	1.184	-0.070269	0.12164
2001	10:14	-	-	-
2001	22:05	1.3853	0.061855	0.09788
2001	27:53	1.3676	0.0606	0.05947
2001	00:57	2.0065	0.05685	0.12144
2001	49:53	1.4618	-0.000042909	0.085963
2001	40:50	1.6738	0.12977	0.21661
2001	57:26	0.9713	-0.059055	0.15669
2001	41:57	0.83111	-0.33605	0.17597
2001	48:47	0.9025	-0.40286	0.26931
2001	33:14	1.6025	-0.43162	0.33581
2001	18:31	1.7644	-0.48164	0.25368
2001	10:42	1.3475	0.23812	0.22999
2001	06:31	1.345	-0.037948	0.27858
2001	38:43	2.02	-0.0349	0.48393
2001	21:36	1.11	0.40694	0.24848
2001	32:43	-	-	-
2001	11:23	0.228	0.098502	0.07179
2001	48:37	1.805	1.4498	0.60426
2001	40:07	-	-	-
2001	14:26	-	-	-
2001	20:38	-	-	-
2001	24:47	-	-	-
2001	32:32	0.868	0.17334	0.31947
2001	01:53	0.965	0.44988	1.0178
2001	32:29	-	-	-
2002	09:52	1.112	0.9277	0.42086
2002	11:28	-	-	-
2002	56:22	0.71143	0.013309	0.11223
2002	52:50	1.6486	-0.28074	0.22342
2002	59:32	1.08	0.05183	0.28666
2002	08:36	0.62667	-0.068187	13887
2002	16:44	0.852	-0.10117	0.32102
2002	57:52	1.5733	-0.2425	0.25917
2002	01:01	-	-	-
2002	39:32	0.596	0.49211	0.4474

2002	57:22	1.3911	-0.31619	0.21178
2002	09:11	0.7125	-0.058177	0.082485
2002	09:05	-	-	-
2002	37:42	1.7325	-0.1226	0.27046
2002	14:06	0.724	-0.26229	0.38992
2002	53:53	0.40571	0.035243	0.13683
2003	46:43	1.4778	-0.4678	0.25173
2003	32:36	2.1978	-0.33639	0.13722
2003	03:41	2.336	-0.59698	0.49183
2003	54:12	-	-	-
2003	36:17	1.5167	0.75273	0.1875
2003	27:04	-	-	-
2003	03:35	0.85143	-0.018462	0.1975
2003	24:33	1.7844	-0.34152	0.25801
2003	24:33	-	-	-
2003	8:02	-	-	-
2003	19:38	0.29333	0.063576	0.081965
2003	30:41	2.072	-0.27643	0.25647
2003	12:34	1.2	0.37902	0.15803
2003	25:31	0.75778	-0.066735	0.086774
2003	28:00	1.0111	0.54928	0.32234
2003	45:36	0.81429	0.34514	0.32259
2003	50:06	1.535	0.27978	0.39348
2003	08:00	-	-	-
2003	33:25	1.5564	-0.12508	0.28823
2003	52:46	1.726	0.22481	0.31859
2003	36:53	0.91556	0.093152	0.18538
2003	03:25	1.4378	-0.4493	0.4453
2003	06:55	0.4175	0.14196	0.18194
2003	06:28	1.9156	-0.49571	0.37151
2003	52:36	-	-	-
2003	43:02	1.3771	0.35487	0.18567
2003	26:09	0.97778	0.070732	0.11953
2003	40:45	-	-	-
2003	11:11	-	-	-
2004	43:11	1.4475	0.54091	0.36422
2004	27:46	-	-	-
2004	23:35	-	-	-
2004	36:50	1.085	0.77437	0.98825
2004	41:27	0.776	0.3438	0.40298

2004	07:07	1.78	-0.4245	0.29342
2004	57:18	1.7311	-0.55841	0.24895
2004	29:35	1.0175	-0.34309	0.21524
2004	53:06	0.675	0.059045	0.15399
2004	26:53	1.2625	0.31292	0.13439
2004	08:50	0.84333	-0.061667	0.20132
2004	56:00	-	-	-
2004	34:52	2.1971	-0.44807	0.22627
2004	06:56	1.4556	0.19278	0.19461
2004	07:22	1.3636	0.16765	0.57372
2004	35:13	-	-	-
2004	32:14	1.554	-0.026902	0.24206
2004	15:11	1.248	0.027931	0.192338
2004	20:13	1.4433	0.36443	0.43087
2005	17:52	1.0533	-0.2184	0.41787
2005	11:36	1.3475	-0.26567	0.32595
2005	34:25	1.045	-0.068619	0.1391
2005	53:41	1.565	-0.06042	0.2076
2005	23:54	-	-	-
2005	43:12	-	-	-
2005	12:20	-	-	-
2005	11:35	1.396	0.10991	0.20088
2005	44:33	2.034	-0.4179	0.17792
2005	10:16	1.85	0.28549	0.26703
2005	16:43	0.99333	-0.40936	0.47087
2005	03:15	1.38	-0.4405	0.18529
2005	46:28	0.67429	0.043717	0.1431
2005	51:07	1.314	-0.40591	0.097105
2005	44:42	1.6782	-0.26795	0.21492
2005	38:51	1.7533	-0.087228	0.25154
2005	26:56	0.93167	-0.021621	0.13206
2005	13:09	1.6945	-0.028979	0.27091
2005	16:06	1.7182	-0.065121	0.23243
2006	13:40	1.6486	-0.19029	0.31944
2006	34:55	1.3822	-0.043686	0.17814
2006	02:59	0.732	0.27249	0.11787
2006	48:43	1.0629	0.41528	0.33036
2006	21:00	1.3473	-0.089588	0.16456
2006	30:45	1.1667	-0.093244	0.28734
2006	25:02	1.4164	0.057774	0.16201
2006	58:06	1.29	-0.2629	0.27151

2006	17:17	2.4527	-0.21374	0.26428
2006	40:58	2.046	-0.0063845	0.29655
2006	26:40	2.1036	-0.26795	0.21451
2006	42:51	1.352	-1.7463	0.92126
2006	12:00	1.14	-0.14775	0.18338
2006	18:42	1.4455	-0.26614	0.14922
2006	40:00	-	-	-
2006	50:36	1.0436	0.062242	0.19152
2006	44:46	1.4145	0.21141	0.5441
2006	18:51	2.2327	-0.74221	0.20352
2006	22:09	1.89	0.014011	0.10847
2006	50:23	1.475	-0.331155	0.25919
2006	06:02	2.2643	0.046138	0.10726
2006	05:58	1.5071	0.058844	0.1003
2006	48:56	2.1933	-0.26228	0.14972
2006	26:34	1.176	-0.21433	0.10976
2006	14:13	2.1389	-0.12547	0.14422
2006	40:55	0.623634	-0.005089	0.021477
2007	23:21	1.9313	0.16817	0.24994
2007	37:45	1.3193	0.1978	0.086154
2007	11:05	1.8464	-0.73249	0.19469
2007	40:01	0.93308	0.081922	0.092971
2007	41:57	1.5093	0.016956	0.1319
2007	39:56	2.4303	-1.5035	0.34058
2007	22:12	1.4572	0.09327	0.096185
2007	29:40	1.054	-0.24833	0.13165
2007	13:22	1.617	0.06143	0.086728
2007	17:37	0.96296	0.064059	0.089141
2007	34:52	2.0474	-0.059805	0.1509
2007	08:51	2.6643	-0.60561	0.16324
2007	21:42	0.9993	-0.021963	0.096972
2007	22:11	2.238	0.34234	0.16174
2007	40:57	2.5585	-1.2399	0.19771
2007	39:27	1.806	0.14321	0.12005
2007	42:29	1.6458	-0.34152	0.14555
2007	05:18	2.4633	-0.20068	0.19197
2007	49:14	2.3064	-0.36445	0.18848
2007	08:30	1.8369	0.13485	0.075229
2007	30:17	1.4092	0.086744	0.071642
2007	40:50	2.0817	-0.2228	0.13377
2007	05:58	2.3071	-0.20129	0.093887

2007	13:00	1.464	-0.21215	0.14622
2007	00:19	1.5369	-0.3921	0.10624
2007	09:17	2.0452	-0.1059	0.083711
2007	30:27	1.1372	-0.21206	0.061056
2007	04:56	1.4032	0.047791	0.10024
2008	38:14	2.0284	-0.10033	0.11155
2008	50:18	1.8826	-0.24057	0.12287
2008	09:22	1.4658	-0.03273	0.076422
2008	31:02	1.9997	0.18007	0.10813
2008	59:51	1.4519	0.07598	0.078439
2008	58:19	2.222	0.28444	0.11102
2008	14:49	-	-	-
2008	33:37	1.7009	0.39116	0.067161
2008	45:20	-	-	-
2008	51:29	1.7776	0.26269	0.076483
2008	35:34	2.3382	-0.054256	0.15585
2008	43:45	2.5952	0.16731	0.10638
2008	12:04	2.1173	0.16513	0.09075
2008	26:34	-	-	-
2008	39:29	2.3231	-0.1286	0.10859
2008	39:52	0.8406	0.16358	0.04853
2008	26:19	2.0282	0.18815	0.092897
2008	00:36	1.5694	-0.11272	0.10521
2008	08:14	2.2359	-0.17429	0.095188
2008	20:50	2.2831	0.10934	0.11878
2008	19:31	2.152	0.12888	0.13123
2008	41:25	2.276	0.16946	0.099196
2008	10:33	1.8495	-0.097215	0.085713
2008	55:57	0.98182	0.14106	0.07439
2008	22:02	0.91802	-0.0065968	0.044838
2008	02:58	1.9407	0.20763	0.080752
2009	49:30	2.4822	-0.10138	0.10114
2009	50:29	2.0602	0.11764	0.095152
2009	17:40	2.2934	-3.6057	0.38851
2009	23:33	1.5567	0.08196	0.079088
2009	17:58	1.8255	0.084667	0.178675
2009	24:45	2.4449	-0.16792	0.13801
2009	30:33	2.1982	0.024327	0.12403

Table 4.  $t^*$  mean and  $tt$  mean for all stations within the 235 events.

Station Name	$t^*$ mean <sup>6</sup>	$tt$ mean
AHID	-0.04	0.11
BOZ	0.17	0.06
BRK	-0.32	-0.08
BW06	0.26	-0.30
CCM <sup>7</sup>	-0.07	0.09
CIC	-0.21	0.02
DCID1	-0.30	0.07
DLMT	-0.24	-0.17
E13A	0.14	0.33
E14A	0.11	0.32
E15A	0.09	0.22
E16A	0.02	0.03
E17A	-0.09	0.10
E18A	0.03	0.25
E19A	-0.19	0.27
E20A	-0.16	0.21
E21A	0.30	0.26
F13A	0.04	0.28
F14A	0.08	0.18
F15A	0.07	0.08
F16A	0.15	0.01
F17A	0.02	0.07
F18A	0.01	0.26
F19A	-0.17	0.33
F20A	-0.15	0.16
F21A	0.30	0.23
FFC <sup>8</sup>	0.12	0.84
FLWY	-0.15	-0.24
G13A	0.23	0.11
G14A	0.19	0.03
G15A	-0.03	-0.05
G16A	-0.18	-0.04
G17A	0.03	0.22
G18A	0.08	0.30
G20A	-0.08	0.32
G21A	0.07	0.17
H12A	0.06	-0.06
H13A	0.03	-0.12
H14A	0.17	-0.24
H15A	0.18	-0.54

<sup>6</sup>  $t^*$  mean and  $tt$  mean, refers to the mean value of those measurements within the events that contains the same station.

<sup>7</sup> CCM as well as FFC<sup>8</sup> are the two cratonic stations used to weight against the other stations, as we expect to see high frequency components in these regions (stations location).

<sup>8</sup> FFC<sup>7</sup> as well as CCM are the two cratonic stations added, their respected values are in bold

H16A	0.22	-0.76
H17A	0.07	-0.19
H18A	-0.10	0.09
H19A	0.05	0.54
H20A	-0.14	0.16
H21A	-0.11	-0.29
HLID	0.14	-0.59
I13A	-0.01	-0.30
I14A	-0.10	-0.31
I15A	-0.11	-0.43
I16A	0.00	-0.44
I17A	0.03	-0.26
I18A	0.00	-0.14
I19A	0.00	0.05
I20A	0.09	0.27
I21A	-0.05	-0.33
IMW	-0.20	-0.12
J13A	-0.08	-0.36
J14A	-0.04	-0.38
J15A	-0.05	-0.23
J16A	-0.02	-0.16
J17A	-0.01	-0.02
J18A	-0.09	-0.07
J19A	0.45	-0.12
J20A	0.21	-0.03
J21A	0.06	-0.11
K12A	-0.11	-0.21
K13A	-0.06	-0.26
K14A	0.02	-0.21
K15A	0.05	-0.17
K16A	-0.06	0.11
K17A	-0.09	-0.28
K18A	0.08	0.38
K19A	0.06	0.30
K20A	0.12	0.05
K21A	0.19	-0.05
L13A	-0.13	0.00
L14A	0.04	0.06
L15A	0.04	0.15
L16A	-0.04	0.27
L17A	-0.09	0.20
L19A	-0.12	0.14
L20A	-0.06	0.14
LKWY	0.22	-0.47
LOHW	-0.15	-0.12
MOOW	-0.32	-0.06
MSO	0.17	0.07



N00	0.06	0.13
N01	0.03	-0.06
N02	-0.04	-0.08
N03	0.13	-0.21
N04	-0.23	0.02
N05	-0.17	0.02
N06	-0.07	-0.01
N07	-0.23	0.03
N08	-0.12	0.00
N09	-0.15	0.00
N10	-0.22	-0.04
N11	-0.12	0.15
N12	-0.01	0.06
NST	-0.22	0.13
PD31	-0.32	0.57
REDW	-0.39	-0.17
RLMT	0.24	-0.22
RR12	-0.28	-0.21
S01	-0.03	0.07
S02	-0.07	0.20
S03	0.12	0.21
S04	0.07	0.14
S05	-0.04	0.27
S06	0.10	0.26
S07	0.15	0.22
S09	-0.03	0.18
S10	-0.04	0.25
S11	0.12	0.25
S13	-0.08	0.14
S14	0.00	0.14
S15	-0.14	0.16
S16	-0.08	0.18
S17	-0.02	0.14
S18	-0.06	0.07
S19	-0.07	0.10
S20	-0.20	0.09
S21	-0.12	0.14
S22	0.13	0.15
SH0	-0.31	0.60
SNOW	-0.16	-0.05
TPAW	0.10	0.26
Y01	-0.14	-0.45
Y02	-0.15	-0.42
Y03	-0.17	-0.29
Y04	-0.13	-0.05
Y05	-0.06	0.01
Y07	-0.02	0.54

Y100	0.26	-1.29
Y101	0.14	-1.02
Y102	0.40	-0.25
Y103	0.16	-0.22
Y104	-0.01	-0.31
Y105	-0.19	-0.08
Y106	-0.28	-0.06
Y12	0.18	-0.22
Y13	-0.09	-0.28
Y14	-0.23	-0.36
Y15	0.00	-0.38
Y16	-0.08	-0.55
Y17	0.17	-0.21
Y18	0.26	-0.14
Y19	0.06	0.18
Y20	-0.01	0.26
Y22	0.06	0.27
Y23	0.09	0.01
Y24	0.14	-0.04
Y25	-0.04	0.03
Y26	-0.04	0.23
Y31	0.19	0.00
Y32	0.19	0.33
Y33	0.06	0.35
Y34	0.09	0.09
Y35	0.06	0.13
Y37	0.26	-0.04
Y38	0.17	-0.30
Y39	0.07	-0.06
Y40	0.27	-0.01
Y43	0.13	0.13
Y44	-0.07	0.11
Y45	-0.16	0.07
Y46	-0.02	0.35
Y47	0.10	0.09
Y50	0.02	-0.04
Y51	0.04	-0.05
Y61	-0.08	0.24
Y62	-0.04	-0.33
Y63	-0.15	0.32
Y64	-0.11	-0.03

## Chapter 5

### DISCUSSION

The  $t^*$  results look almost random, and the mean slope of  $dt^*/dtt = -0.081 \pm 0.009$  is distinctly different from the  $\sim 0.4$  value expected and any prediction based on intrinsic attenuation. Even when a spatial pattern in  $t^*$  is found, such as for Event 2008-19:31, it does not correlate with the relative travel times (Figure 46e and f). Of particular surprise is that the two cratonic stations do not clearly show a lower  $t^*$  than the Yellowstone region stations. Given the clear higher velocity under FFC and CCM found in every mantle tomographic image, there seems to be a clear disconnect between velocity and  $t^*$ . The lack of a pattern becomes clearer when all the event results are put together (Figure 45). It is possible that this plot is misleading, as each event has had the mean  $t^*$  and  $tt$  subtracted from it, leaving residuals scattered around 0. It is not too hard to calculate event statics which would add the mean  $t^*$  or  $tt$  that best fits the data and produces the most coherent structure; however, the lack of clear correlation when  $t^*$  is plotted versus  $tt$  suggests this procedure would be pointless.

As a conclusion, three possibilities seem likely for our results: 1)  $t^*$  indeed may vary in the seemingly random fashion observed; 2) our method may not be capable of

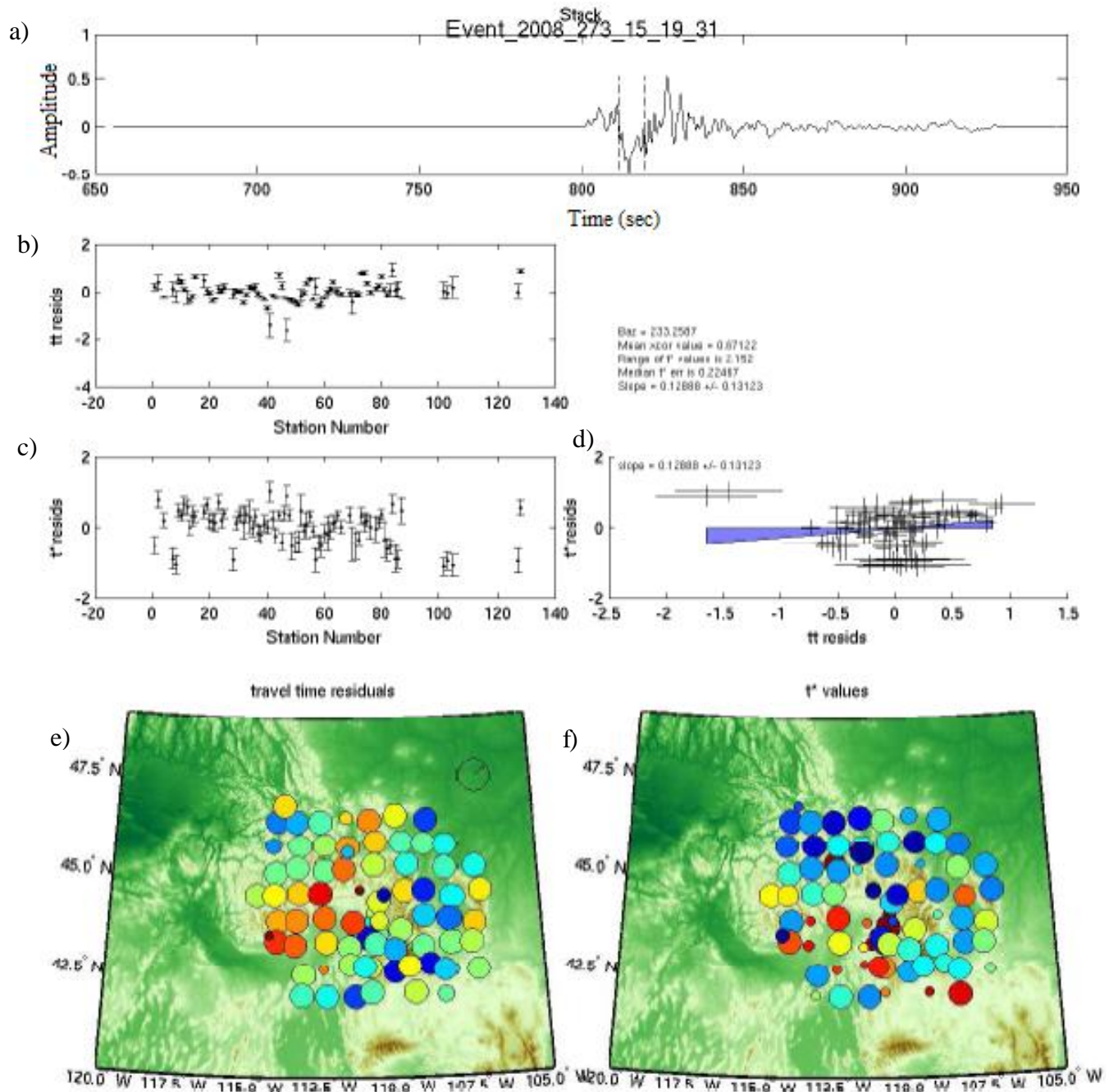


Figure 46. Measurements of  $t^*$  and  $tt$  estimates. Summarized results for Event 2008-19:31: a) waveform stack, b) travel time residuals as a function of station number, c)  $t^*$  residuals as a function of station number, d)  $t^*$  residuals as a function of travel time residuals, e) travel time residuals mapped, and f)  $t^*$  values mapped. Circles, represent the stations, warm colors refers to high values of  $t^*$  and  $tt$ , and size of the circles represent the measurement variation (error) which is inversely proportional to its size.

resolving  $t^*$  variations; or 3) other mechanisms such as scattering may play a more significant role in the spectral content of seismograms than mantle attenuation variations.

During the time of this study, a new paper came out on  $t^*$  variations around Yellowstone. *Adams and Humphreys* [2010] found a similar lack of correlation between seismic velocities and  $Q$  in the Yellowstone vicinity. They infer that the attenuation variation in the Yellowstone region is not primarily under thermal control; rather the dominant effect is the presence of water. Water can affect attenuation by increasing the mobility of defects which causes greater seismic energy loss. *Adams and Humphreys* [2010] suggest that the mantle in the region that has not been affected by melting has been pervasively hydrated by Farallon subduction. In plume-affected mantle, partitioning of water into the melt has dehydrated it. The subsolidus plume mantle is thus hot and dry and relatively unattenuating, and it is surrounded by wet and attenuating mantle. For this model to work, they suggest the excess temperature of the plume can only be around 50°C. *Lawrence et al.* [2006] found a similar variation between attenuation and velocity in the Yellowstone region, which they ascribe to variation in water content as well.

Another possible reason for the unexpected patterns in the vicinity of the Yellowstone plume could be due to scattering or multi-pathing (focusing and defocusing of the wave –Figure 47). *Sun and Helmberger* [2010] approximated the effects of wave scattering in S-waves by assuming a main arrival and a secondary scattered arrival that arrives slightly later in the trace. They measured the difference between these presumed primary and secondary ( $\Delta_{LR}$ ) arrival times. Their  $\Delta_{LR}$  patterns match those predicted

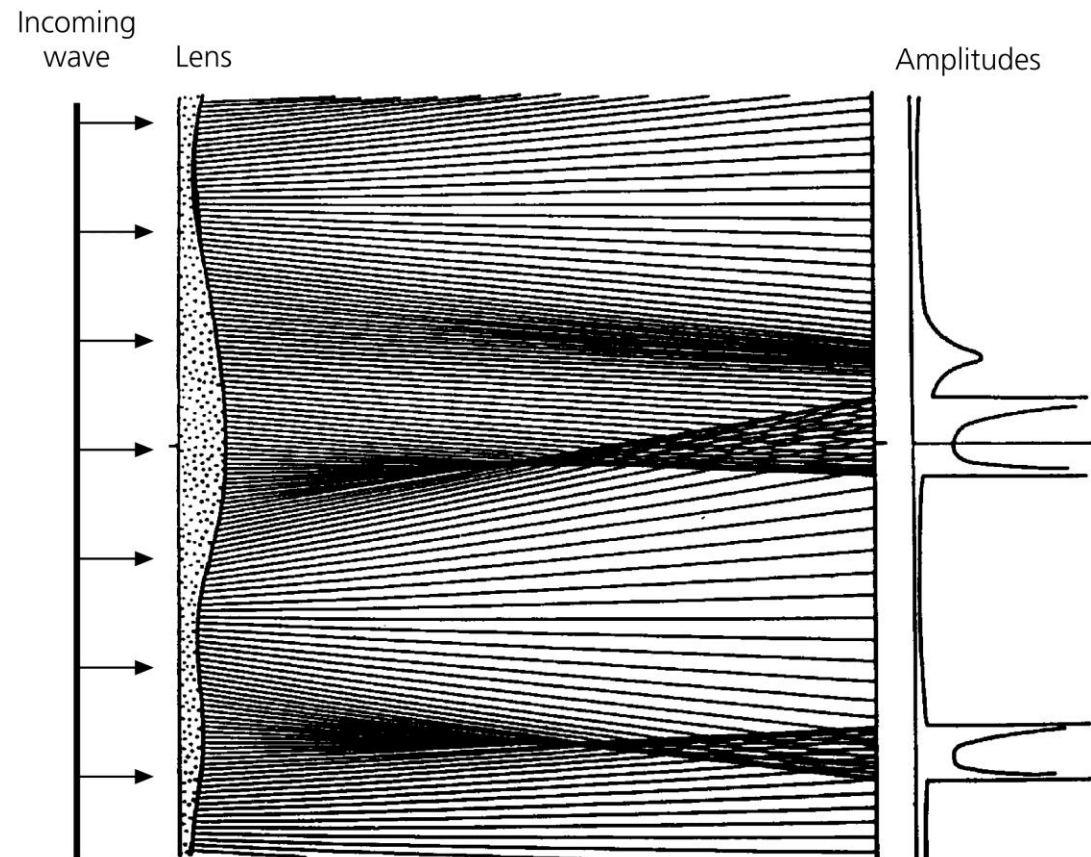


Figure 47. Focusing and defocusing of an incident wave. Example of velocity heterogeneities affecting wave amplitudes [Stein, 2005].

by a narrow mantle plume-like feature that is 50 km wide and having a 2.5% velocity reduction that extends westward into the lower mantle as proposed by *Smith et al.* [2009].

In contrast, in Tanzania, *Venkataraman et al.*, [2004] measured  $P$ -wave spectral amplitude ratio from deep focus earthquakes to estimate regional variations in sublithospheric mantle attenuation beneath the Tanzania craton and the eastern branch of the East African Rift. Using the *Karato* [1993] velocity and temperature relation they were able to estimate that the temperature beneath the rifted lithosphere was higher than the ambient mantle. In this location, it seems that there is a correlation between velocity and  $Q$ .

These observations suggest that the simple correlation between velocity and  $Q$  initially assumed was simplistic, and hydration of the mantle may be a significant factor that needs to be considered. An additional possibility is that the method employed in this study was not useful. It is possible that the Futterman operator used is not appropriate for estimating attenuation variations. *Adams and Humphreys* [2010] tried both a time-domain method similar to this study, but with a different Futterman operator, and also a frequency-domain method called spectral ratios. This method involves taking the natural logarithm of the spectral ratio of the amplitudes taken for the same earthquake recorded at different stations (say  $i$  and  $j$ ):

$$\ln[R_{ij}(\omega)] = \ln \left[ \frac{O_i(\omega)}{O_j(\omega)} \right] = \frac{-\omega(t_i^* - t_j^*)}{2} = \frac{-\omega \Delta t_{ij}^*}{2} \quad (33)$$

where  $\Delta t^*_{ij}$  is inferred from all possible pairs of the stations  $(ij)$ .  $\Delta t^*_{ij}$  can be determined by fitting a straight line to the spectral ratio of each pair of stations using least squares. The slope of this straight line then will give  $\Delta t^*_{ij}$ , which has been used successfully to infer temperature [Venkatamaran, 2004], but with large scatter in results.

Another possibility can be that the waveform picking method utilized was inappropriate and included a scattered pulse that polluted the measurement (Figure 48). A future direction for this study would be to test different permutations of the Futterman operator, in conjunction with spectral ratios, to see if results show consistency. It would also be useful to measure  $t^*$  in a region with velocity variations, but where mantle hydration state is fairly homogenous, to see if temperatures could be constrained in the absence of the effects of water.



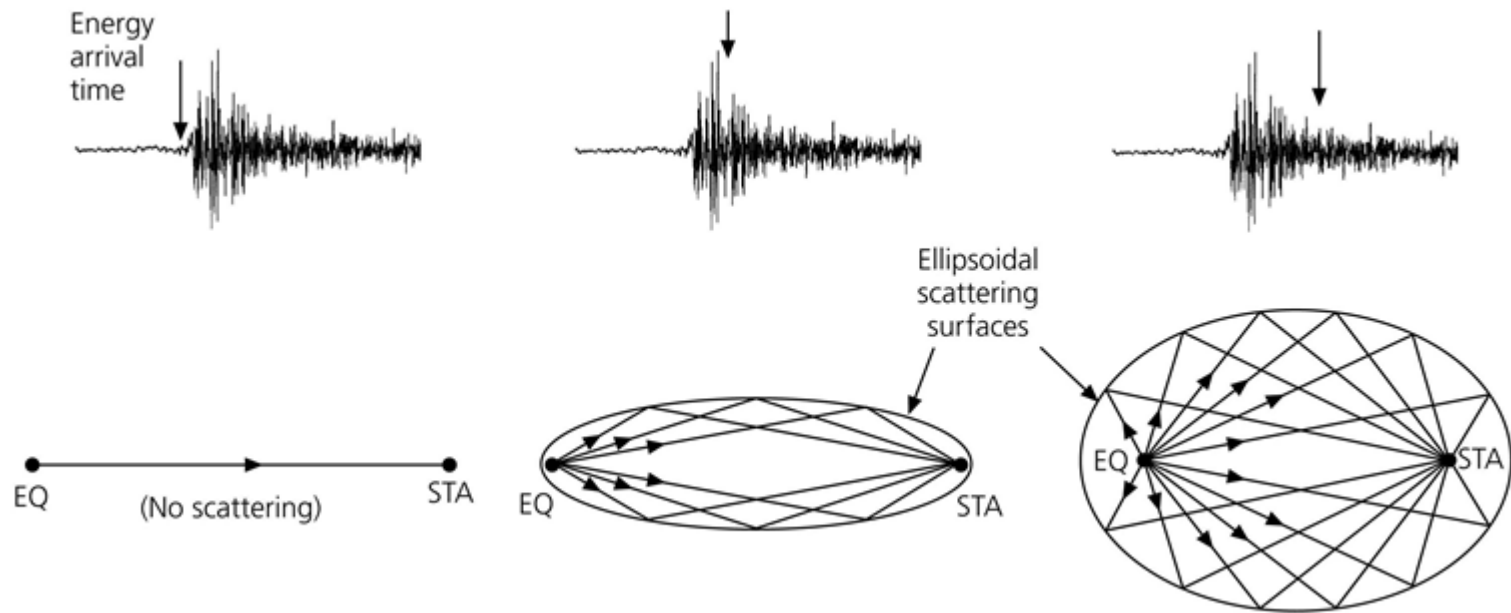


Figure 48. Waveform pulses and how it is affected by scattering [Stein, 2005]. Arrows indicate the portion of the waveform that is been explained by scattering within the elliptical region shown in the bottom half of the figure.

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## Appendix I

### STANDING ORDER FOR DATA

### How SOD works?

Standing Ordering for Data (SOD) is a robust Data Handling Interface (DHI) that permits you select and download earthquakes meeting any type of specific parameters. SOD has commands that allow you to define your data based on earthquakes magnitude, location of the earthquakes as well as their recording stations, and even the time bias within specific seismic phase arrivals. All of these parameters are affixed to the SOD's configuration in the form of standing order (SO). This implies that it does not act on the data parameters until an earthquake is detected and located. This SO as an XML file, specifies the earthquakes channels and seismograms of interest. SOD is even capable of post-processing operations, as mean removal, saving data to a SAC or mini SEED file, as well as other advanced operations (as calculating signal to noise and deconvolving the instrument response). Created by the University of South Carolina.

### Yellowstone recipe: Input/output

An XML file was developed in order to access the data needed. Parameters within the data includes P-waves generated by earthquakes with moment magnitude ( $M_w$ ) > 6.4 at distances >  $30^\circ$ , gathered by 46 stations within Yellowstone array and 31 stations from the Billings array with any other array in the site area. The depths of the earthquakes used are deep greater than 200 km earthquakes. The XML follows the SOD commands line in order to SOD gather the earthquakes data. Three major activities are included in the XML. Event arm, which gathers the earthquakes to produce a time window, a

network arm, that gathers the channels, and a waveform arm, that gathers the seismograms. The XML created is shown bellow.

```
<?xml version="1.0"?>
<sod>
  <eventArm>
    <eventFinder>
      <name>IRIS_EventDC</name>
      <dns>edu/iris/dmc</dns>
      <originTimeRange>
        <startTime>
          <year>1995</year>
          <month>1</month>
          <day>1</day>
        </startTime>
        <endTime>
          <now/>
        </endTime>
      </originTimeRange>
      <magnitudeRange>
        <min>6.4</min>
      </magnitudeRange>
      <catalog>WHDF</catalog>
    </eventFinder>
    <originPointDistance>
      <latitude>44</latitude>
      <longitude>-111</longitude>
```

```

        <unit>DEGREE</unit>

        <min>30</min>

        <max>180</max>

    </originPointDistance>

    <printlineEventProcess/>
</eventArm>

<networkArm>

    <networkFinder>

        <name>IRIS_NetworkDC</name>

        <dns>edu/iris/dmc</dns>

    </networkFinder>

    <stationBoxArea>

        <latitudeRange>

            <min>42</min>

            <max>47</max>

        </latitudeRange>

        <longitudeRange>

            <min>-115</min>

            <max>-107</max>

        </longitudeRange>

    </stationBoxArea>

    <channelAND>

        <bandCode>B</bandCode>

        <gainCode>H</gainCode>

    </channelAND>

    <printlineChannelProcess/>
</networkArm>

```



```

<waveformArm>
  <phaseRequest>
    <model>prem</model>
    <beginPhase>ttp</beginPhase>
    <beginOffset>
      <unit>SECOND</unit>
      <value>-120</value>
    </beginOffset>
    <endPhase>ttp</endPhase>
    <endOffset>
      <unit>SECOND</unit>
      <value>+120</value>
    </endOffset>
  </phaseRequest>
  <fixedDataCenter>
    <name>IRIS_PondDataCenter</name>
    <dns>edu/iris/dmc</dns>
  </fixedDataCenter>
  <someCoverage/>
  <printlineSeismogramProcess/>
    <rMean/>
    <rTrend/>
    <sacWriter/>
  </waveformArm>
</sod>

```

The output of the recipe or XML file gathered a total of 657 events from 1995 until 2009 as sac files.

#### References

Owens, T. J. C., H. P. and Oliver-Paul, P. (2004), SOD, Seismological Research Letters, 75, 515-520.

## Appendix II

### STATIONS PARAMETERS

## Stations

As mentioned in Chapter 2, data used are from all broadband stations operating between 1995 and 2009 box centered on Yellowstone. The box ranged from 42°N to 47°N, and from 115°W to 107°W giving a total of 174 stations used (Figure 15). Arrays within this box include the 46 stations Yellowstone array (2000-2001), the 31 stations Billings array (2000-2001), and the Earthscope Transportable Array (~2008-2010). For comparison, data from two cratonic stations were also requested (Figure 16): Cathedral Cave, Missouri (CCM), and Flin Flon, Canada (FFC). Stations parameters are listed below in Table II.1. Standing Ordering for Data was used to gather the waveform data with specific parameters [Owens, 2004]: *P*-waves generated by earthquakes with a moment magnitude ( $M_W$ ) > 6.4 at distances > 30° (distance range from 30° to 180°) at a depth > 200 km.

Table II.1. Station code, latitude, and longitude for all stations used.

Station Code	Latitude	Longitude
AHID	42.77	-111.1
BOZ	45.65	-111.63
BRK	42.55	-114.97
BW06	42.77	-109.56
CIC	42.95	-113.21
CCM	38.06	-91.25
DCID1	43.59	-111.19
DLMT	45.36	-112.6
E13A	46.44	-114.19
E14A	46.42	-113.49
E15A	46.42	-112.64
E16A	46.53	-111.68
E17A	46.46	-110.86

E18A	46.57	-109.91
E19A	46.46	-108.79
E20A	46.5	-108.13
E21A	46.54	-107.08
F13A	45.79	-114.33
F14A	45.81	-113.37
F15A	45.84	-112.49
F16A	45.78	-111.63
F17A	45.91	-110.66
F18A	45.9	-109.72
F19A	45.85	-108.94
F20A	45.8	-108.15
F21A	45.82	-107.12
FFC	54.73	-101.98
FLWY	44.08	-110.7
G13A	45.09	-114.23
G14A	45.24	-113.46
G15A	45.17	-112.49
G16A	45.23	-111.81
G17A	45.32	-110.74
G18A	45.32	-109.56
G20A	45.22	-108.21
G21A	45.23	-107.21
H12A	44.55	-114.86
H13A	44.56	-114.26
H14A	44.62	-113.37
H15A	44.62	-112.64
H16A	44.7	-111.25
H17A	44.4	-110.58
H18A	44.68	-109.66
H19A	44.67	-108.99
H20A	44.49	-108
H21A	44.63	-107.04
HLID	43.56	-114.41
I13A	43.91	-114.12
I14A	43.93	-113.45
I15A	44	-112.49
I16A	43.88	-111.49
I17A	43.92	-110.58
I18A	43.7	-109.82
I19A	44.04	-108.99

I20A	43.95	-108.13
I21A	43.81	-107.29
IMW	43.9	-110.94
J13A	43.4	-114.17
J14A	43.32	-113.52
J15A	43.4	-112.43
J16A	43.27	-111.61
J17A	43.36	-110.71
J18A	43.21	-110.02
J19A	43.26	-109.05
J20A	43.35	-108.08
J21A	43.35	-107.45
K12A	42.64	-114.9
K13A	42.65	-114.08
K14A	42.55	-113.18
K15A	42.69	-112.53
K16A	42.83	-111.59
K17A	42.75	-110.92
K18A	42.64	-110.04
K19A	42.82	-108.85
K20A	42.66	-108.34
K21A	42.63	-107.25
L13A	42.09	-113.94
L14A	42.03	-113.24
L15A	42	-112.39
L16A	42.01	-111.43
L17A	42.1	-110.87
L19A	42.1	-109.36
L20A	42.01	-108.34
LKWY	44.57	-110.4
LOHW	43.61	-110.6
MOOW	43.75	-110.75
MSO	46.83	-113.94
N00	42.46	-107.7
N01	42.28	-107.6
N01	46.28	-109.41
N02	42.15	-107.5
N02	46.25	-109.21
N03	42.07	-107.46
N04	46.21	-108.54
N05	46.25	-108.3

N06	46.42	-109.52
N07	46.44	-109.24
N08	46.5	-108.86
N09	46.51	-108.59
N10	46.61	-109.19
N11	46.67	-108.89
N12	46.65	-108.65
NST	42.91	-113.98
PD31	42.77	-109.56
REDW	43.36	-110.85
RLMT	45.12	-109.27
RRI2	43.35	-111.32
S01	45.18	-109.22
S02	45.27	-108.77
S03	45.38	-109.43
S04	45.38	-109.18
S05	45.41	-108.94
S06	45.58	-108.61
S07	45.57	-109.74
S09	45.56	-109.2
S10	45.62	-108.87
S11	45.58	-108.61
S13	45.75	-109.43
S14	45.79	-109.19
S15	45.83	-108.82
S16	45.84	-108.58
S17	45.8	-108.25
S18	45.95	-109.5
S19	46.08	-109.15
S20	46.06	-108.94
S21	45.95	-108.6
S22	46	-108.29
SHO	42.85	-114.43
SNOW	43.46	-110.76
TPAW	43.49	-110.95
Y01	44.39	-113.17
Y02	44.07	-112.64
Y03	43.81	-112.32
Y04	43.51	-111.9
Y05	43.19	-111.58
Y07	42.56	-110.89

Y100	44.72	-110.49
Y101	44.01	-109.99
Y102	44.32	-110.6
Y103	44.58	-110.81
Y104	44.5	-109.94
Y105	44.98	-110.71
Y106	43.94	-110.64
Y12	45.6	-113.11
Y13	45.27	-112.82
Y14	44.99	-112.46
Y15	44.58	-112.06
Y16	44.4	-111.6
Y17	44.1	-111.19
Y18	43.75	-111.03
Y19	43.62	-110.6
Y20	43.17	-110
Y22	42.59	-109.25
Y23	46.28	-112.93
Y24	45.98	-112.62
Y25	45.71	-112.18
Y26	45.45	-111.75
Y31	43.74	-109.98
Y32	43.58	-109.45
Y33	43.23	-108.98
Y34	42.97	-108.56
Y35	42.57	-108.04
Y37	46.18	-112.03
Y38	45.9	-111.61
Y39	45.59	-111.22
Y40	45.35	-110.75
Y43	44.45	-109.6
Y44	44.1	-109.19
Y45	43.76	108.68
Y46	43.6	-108.2
Y47	45.99	-110.04
Y50	45.15	-108.97
Y51	44.77	-108.53
Y61	46.6	-111.03
Y62	46.17	-110.56
Y64	44.11	-107.47



## Appendix III

### EVENTS PARAMETERS

### Events gathered

As mentioned in the Chapter 2, the data gathered from all stations (including cratonic stations) by the use of SOD [Owens, 2004] were: P-waves generated by earthquakes with a moment magnitude ( $M_w$ ) > 6.4 at distances > 30° (distance range from 30° to 180°) at a depth > 200 km. From these a total of 657 events were gathered and subjected to quality control. From this 657, 297 events were classified as good events, based upon a minimum number of five stations per event and a cross-correlation value greater than 0.6. Figure 17, show all events in their respective location around the globe. Table III.2, show all 297 events used with their respective location (latitude/longitude).

Table III.2. Latitude, longitude, and magnitude of all the events used.

Events name <sup>1</sup> (Date, Time)	Latitude	Longitude	Magnitude
7/11/1999 14:16	15.78	-88.33	6.6
10/13/1999 33:40	54.66	-161.19	6.5
11/26/1999 21:15	-16.42	168.21	6.4
11/30/1999 01:53	-18.9	-69.17	6.6
12/6/1999 12:33	57.41	-154.49	6.8
12/7/1999 19:49	57.36	-154.51	6.5
12/7/1999 29:49	-15.91	-173.98	6.4
12/10/1999 38:30	-36.21	-97.32	6.5
12/29/1999 29:19	-10.86	165.35	6.8
1/8/2000 19:46	-9.81	159.81	6.4
1/8/2000 59:21	-23.17	-70.12	6.4
1/8/2000 47:20	-16.93	-174.25	6.5
1/26/2000 26:50	-17.27	-174	6.4
1/28/2000 21:07	43.05	146.84	6.7
2/25/2000 43:58	-19.53	173.82	7.1
3/28/2000 00:22	22.34	143.73	6.8
4/23/2000 27:23	-28.31	-62.99	6.6
5/4/2000 36:32	-17.91	-178.52	6.5

<sup>1</sup> Events names are based upon the event's date and time.

5/12/2000	43:18	-23.55	-66.45	7.2
6/6/2000	57:02	29.42	131.42	6.4
6/10/2000	23:29	23.84	121.23	6.4
6/16/2000	55:35	-33.88	-70.09	6.5
6/17/2000	40:41	63.97	-20.49	6.6
6/21/2000	51:46	63.98	-20.76	6.6
7/21/2000	53:35	9.42	-85.33	6.4
7/30/2000	25:45	33.9	139.38	6.5
8/3/2000	09:39	-12.04	166.45	6.5
8/4/2000	13:02	48.79	142.25	7.1
8/6/2000	27:12	28.86	139.56	7.3
8/9/2000	08:41	-15.69	167.99	6.4
8/9/2000	55:59	-16.8	174.33	6.4
9/26/2000	17:52	-17.18	-173.93	6.4
9/28/2000	23:43	-0.22	-80.58	6.6
10/4/2000	58:44	-15.42	166.91	6.9
10/25/2000	32:24	-6.55	105.63	6.6
12/6/2000	11:06	39.57	54.8	6.7
12/20/2000	23:54	-39.01	-74.66	6.4
1/9/2001	49:28	-14.93	167.17	6.6
1/13/2001	33:32	13.05	-88.66	6.4
1/19/2001	10:14	-11.66	166.38	6.4
2/13/2001	22:05	13.67	-88.94	6.5
3/24/2001	27:53	34.08	132.53	6.4
4/9/2001	00:57	-32.67	-73.11	6.7
4/28/2001	49:53	-18.06	-176.94	6.8
5/25/2001	40:50	44.27	148.39	6.7
5/26/2001	57:26	-20.29	-177.84	6.4
6/3/2001	41:57	-29.67	-178.63	6.8
6/14/2001	48:47	51.16	-179.83	6.5
6/23/2001	33:14	-16.27	-73.64	6.7
6/26/2001	18:31	-17.75	-71.65	6.7
7/3/2001	10:42	21.64	142.98	6.5
7/4/2001	06:31	-21.73	-176.71	6.5
7/7/2001	38:43	-17.54	-72.08	6.6
7/26/2001	21:36	39.06	24.24	6.6
7/28/2001	32:43	59.03	-155.12	6.6
8/13/2001	11:23	41.05	142.31	6.4
9/12/2001	48:37	-20.99	-179.11	6.5
9/29/2001	40:07	-18.5	168.16	6.4
9/29/2001	40:07	-18.5	168.16	6.4

10/8/2001	20:38	52.63	160.21	6.4
10/8/2001	20:38	52.63	160.21	6.4
11/28/2001	32:32	15.57	-93.11	6.4
12/2/2001	01:53	39.4	141.09	6.5
12/3/2001	32:29	-16.5	-177.54	6.4
12/18/2001	02:58	23.95	122.73	7.3
12/23/2001	52:54	-9.61	159.53	7
1/16/2002	09:52	15.5	-93.13	6.4
2/3/2002	11:28	38.57	31.27	6.4
3/28/2002	56:22	-21.66	-68.33	6.5
3/31/2002	52:50	24.28	122.18	6.4
4/1/2002	59:32	-29.67	-71.38	6.4
4/18/2002	08:36	-27.54	-70.59	6.7
7/31/2002	16:44	7.93	-82.79	6.4
8/14/2002	57:52	14.1	146.2	6.4
8/19/2002	08:24	-23.88	178.5	7
9/15/2002	39:32	44.83	129.92	6.4
9/24/2002	57:22	-31.52	-69.2	6.4
9/24/2002	01:28	-10.65	161.21	6.5
10/12/2002	09:11	-8.3	-71.74	6.5
10/17/2002	23:55	-19.84	-178.4	6.4
10/19/2002	09:05	44.3	149.96	6.4
11/3/2002	37:42	38.89	141.98	6.4
11/7/2002	14:06	51.2	179.33	6.4
11/17/2002	53:53	47.82	146.21	7.3
12/12/2002	30:42	-4.79	153.28	6.7
1/4/2003	15:03	-20.57	-177.66	6.5
1/20/2003	43:06	-10.49	160.77	6.7
1/21/2003	46:47	13.63	-90.77	6.5
2/19/2003	32:36	53.65	-164.64	6.6
2/24/2003	03:41	39.61	77.23	6.4
3/11/2003	27:32	-4.69	153.24	6.8
3/14/2003	54:12	-17.42	-175.18	6.4
3/17/2003	36:17	51.27	177.98	6.7
4/17/2003	48:38	37.53	96.48	6.4
5/1/2003	27:04	39.01	40.46	6.4
5/4/2003	15:18	-30.53	-178.23	6.5
5/4/2003	08:46	-30.59	-178.29	6.4
5/13/2003	21:14	-17.29	167.74	6.4
5/14/2003	03:35	18.27	-58.63	6.5
5/26/2003	24:33	38.85	141.57	6.7

6/15/2003	24:33	51.55	176.92	6.4
6/16/2003	08:02	55.49	160	6.9
6/20/2003	19:38	-7.61	-71.72	6.4
6/20/2003	30:41	-30.61	-71.64	6.4
6/23/2003	12:34	51.44	176.78	7
7/15/2003	46:38	-3.83	152.17	6.5
7/25/2003	37:45	-1.53	149.69	6.4
7/27/2003	04:11	-21.08	-176.59	6.6
7/27/2003	25:31	47.15	139.25	6.8
9/2/2003	28:00	-15.23	-173.22	6.6
9/7/2003	19:20	-22.47	172.12	6.4
9/22/2003	45:36	19.78	-70.67	6.6
9/25/2003	50:06	41.82	143.91	6.9
9/25/2003	08:00	41.77	143.59	6.4
9/27/2003	33:25	50.04	87.81	6.5
9/27/2003	52:47	50.09	87.77	6.6
9/29/2003	36:53	42.45	144.38	6.5
9/30/2003	08:37	-30.44	-177.4	6.5
10/1/2003	03:25	50.21	87.72	7.1
10/8/2003	06:55	42.65	144.57	6.6
10/31/2003	06:28	37.81	142.62	6.8
11/6/2003	38:04	-19.26	168.89	6.6
11/9/2003	52:36	-0.67	-19.69	6.6
11/17/2003	43:06	51.15	178.65	7.2
12/5/2003	26:09	55.54	165.78	6.5
12/10/2003	38:11	23.04	121.36	6.7
12/21/2003	40:45	-0.77	-20.6	6.6
12/25/2003	11:11	8.42	-82.82	6.4
12/25/2003	42:33	-22.25	169.49	6.5
12/27/2003	00:59	-22.02	169.77	7.1
12/27/2003	38:01	-21.67	169.84	6.7
1/25/2004	43:11	-16.83	-174.2	6.4
2/24/2004	27:46	35.14	-4	6.4
4/9/2004	23:35	-13.17	167.2	6.5
5/3/2004	36:50	-37.7	-73.41	6.5
8/28/2004	41:27	-34.93	-70.39	6.5
9/5/2004	07:07	33.07	136.62	6.7
9/5/2004	57:18	33.18	137.07	7.1
9/6/2004	29:35	33.21	137.23	6.4
9/7/2004	53:06	-28.57	-65.84	6.4
10/8/2004	27:53	-10.95	162.16	6.9

10/9/2004	26:53	11.42	-86.67	7
10/15/2004	08:50	24.53	122.69	6.4
11/11/2004	34:52	-11.13	162.21	6.6
11/15/2004	06:56	4.7	-77.51	6.6
11/17/2004	09:13	-20.07	-178.71	6.6
11/20/2004	07:22	9.6	-84.17	6.4
11/28/2004	35:13	-26.53	-113.83	6.6
11/28/2004	32:14	43.01	145.12	6.4
12/6/2004	15:11	42.9	145.23	6.5
12/14/2004	20:13	18.96	-81.41	6.7
1/16/2005	17:52	10.93	140.84	6.7
1/19/2005	11:36	34.06	141.49	6.4
1/22/2005	30:17	-7.73	159.48	6.5
2/5/2005	34:25	16.01	145.87	6.6
2/8/2005	48:22	-14.25	167.26	6.8
3/2/2005	42:12	-6.53	129.93	7
3/20/2005	53:41	33.81	130.13	6.7
3/21/2005	23:54	-24.98	-63.47	6.9
3/21/2005	43:12	-24.73	-63.51	6.4
4/11/2005	08:53	-21.98	170.61	6.8
5/5/2005	12:20	5.72	-82.84	6.5
5/21/2005	11:35	-3.29	-80.99	6.4
6/13/2005	44:33	-19.99	-69.2	6.8
6/14/2005	10:16	51.23	179.41	6.8
6/15/2005	52:24	-44.87	-80.56	6.5
7/2/2005	16:43	11.25	-86.17	6.4
8/3/2005	03:15	11.25	-85.54	6.5
8/16/2005	46:28	38.28	142.04	6.5
9/9/2005	26:43	-4.54	153.47	7.7
10/15/2005	51:07	25.32	123.36	6.5
10/19/2005	44:42	36.41	140.84	6.5
11/14/2005	38:51	38.11	144.9	6.7
11/17/2005	26:56	-22.32	-67.89	6.9
12/2/2005	13:09	38.09	142.12	6.5
12/7/2005	32:51	-30.01	-177.64	6.4
12/13/2005	16:06	-15.27	-178.57	6.8
1/2/2006	13:40	-19.93	-178.18	6.5
1/8/2006	34:55	36.31	23.21	6.5
1/23/2006	02:59	-17.42	167.71	6.4
2/2/2006	48:43	-17.75	-178.39	6.7
2/26/2006	08:27	-23.61	-179.99	6.4

3/31/2006	21:00	-29.61	-176.83	6.7
4/7/2006	30:45	-16.54	176.98	6.4
4/20/2006	25:02	60.95	167.09	6.8
4/29/2006	58:06	60.49	167.52	6.4
4/30/2006	17:17	-27.01	-70.96	6.4
4/30/2006	40:58	-27.21	-71.06	6.7
5/3/2006	26:40	-20.19	-174.12	7.2
5/10/2006	42:51	52.52	-169.26	6.4
5/16/2006	39:23	-31.78	-179.31	6.8
5/22/2006	12:00	60.77	165.74	6.7
6/14/2006	18:42	51.75	177.08	6.4
7/8/2006	40:01	51.21	-179.31	6.4
8/7/2006	18:54	-15.78	167.8	6.8
8/24/2006	50:36	51.15	157.52	6.5
8/25/2006	44:46	-24.41	-67.03	6.6
9/1/2006	18:51	-6.76	155.51	6.7
9/28/2006	22:09	-16.59	-172.03	6.5
9/30/2006	50:23	46.35	153.17	6.5
10/1/2006	06:02	46.47	153.24	6.4
10/12/2006	05:58	-31.3	-71.33	6.4
10/20/2006	48:56	-13.46	-76.68	6.6
11/7/2006	38:33	-6.48	151.2	6.5
11/13/2006	26:34	-26.04	-63.22	6.8
11/15/2006	14:13	46.59	153.27	6.5
11/15/2006	40:55	46.48	154.73	6.4
1/13/2007	23:21	46.24	154.52	7.3
1/31/2007	15:52	-29.78	-178	6.5
3/18/2007	11:05	4.59	-78.5	6.4
3/25/2007	40:01	-20.62	169.36	6.5
3/25/2007	41:57	37.34	136.59	6.8
3/25/2007	08:19	-20.75	169.35	7.1
4/1/2007	39:56	-8.46	157.04	6.8
4/1/2007	47:31	-7.17	155.78	6.6
4/4/2007	34:38	-7.78	156.5	6.4
4/4/2007	00:27	-20.71	168.83	6.4
4/4/2007	02:29	-20.69	169.06	6.4
5/6/2007	11:52	-19.4	-179.35	6.5
5/30/2007	22:12	52.14	157.29	6.4
6/13/2007	29:40	13.55	-90.62	6.5
6/28/2007	52:09	-7.97	154.63	6.7
7/16/2007	13:22	37.54	138.45	6.5

7/16/2007	17:37	36.81	134.85	6.8
7/21/2007	34:52	-22.15	-65.78	6.4
8/1/2007	08:51	-15.6	167.68	7.2
8/2/2007	21:42	51.31	-179.97	6.6
8/15/2007	22:11	50.32	-177.55	6.4
8/15/2007	40:57	-13.39	-76.6	6.7
8/16/2007	39:27	-9.83	159.47	6.7
8/20/2007	42:29	8.04	-39.25	6.4
9/2/2007	05:18	-11.61	165.76	7.3
9/10/2007	49:14	2.98	-77.97	6.7
9/26/2007	36:26	-4.99	153.5	6.6
9/28/2007	01:48	-21.21	169.36	6.4
9/28/2007	35:52	-21.13	169.37	6.6
9/28/2007	38:59	22	142.65	6.7
9/30/2007	08:30	10.45	145.72	6.4
10/5/2007	17:52	-25.19	179.46	6.5
10/16/2007	05:43	-25.78	179.53	6.6
10/31/2007	30:17	18.9	145.36	7.2
11/14/2007	40:50	-22.25	-69.89	6.7
11/15/2007	05:58	-22.93	-70.24	6.6
11/16/2007	13:00	-2.31	-77.84	6.8
11/27/2007	49:58	-10.95	162.15	6.7
11/29/2007	00:19	14.97	-61.26	6.9
12/9/2007	28:20	-26	-177.51	7
12/16/2007	09:17	-22.95	-70.18	6.4
12/19/2007	30:27	51.36	-179.52	6.4
12/26/2007	04:56	52.58	-168.2	6.4
1/15/2008	52:15	-21.98	-179.54	6.5
2/8/2008	38:14	10.67	-41.9	6.4
2/12/2008	50:18	16.36	-94.3	6.4
2/14/2008	09:22	36.5	21.67	6.6
3/3/2008	31:02	46.41	153.18	6.5
3/12/2008	23:34	-16.57	167.34	6.4
4/9/2008	13:17	-20.18	168.86	6.4
4/9/2008	46:12	-20.07	168.89	7.3
4/15/2008	59:51	51.85	-179.36	6.4
4/16/2008	54:19	51.88	-179.17	6.5
4/24/2008	14:49	-1.18	-23.47	6.5
4/28/2008	33:34	-19.94	168.95	6.4
5/2/2008	33:37	51.86	-177.53	6.8
5/7/2008	45:20	36.16	141.52	6.7

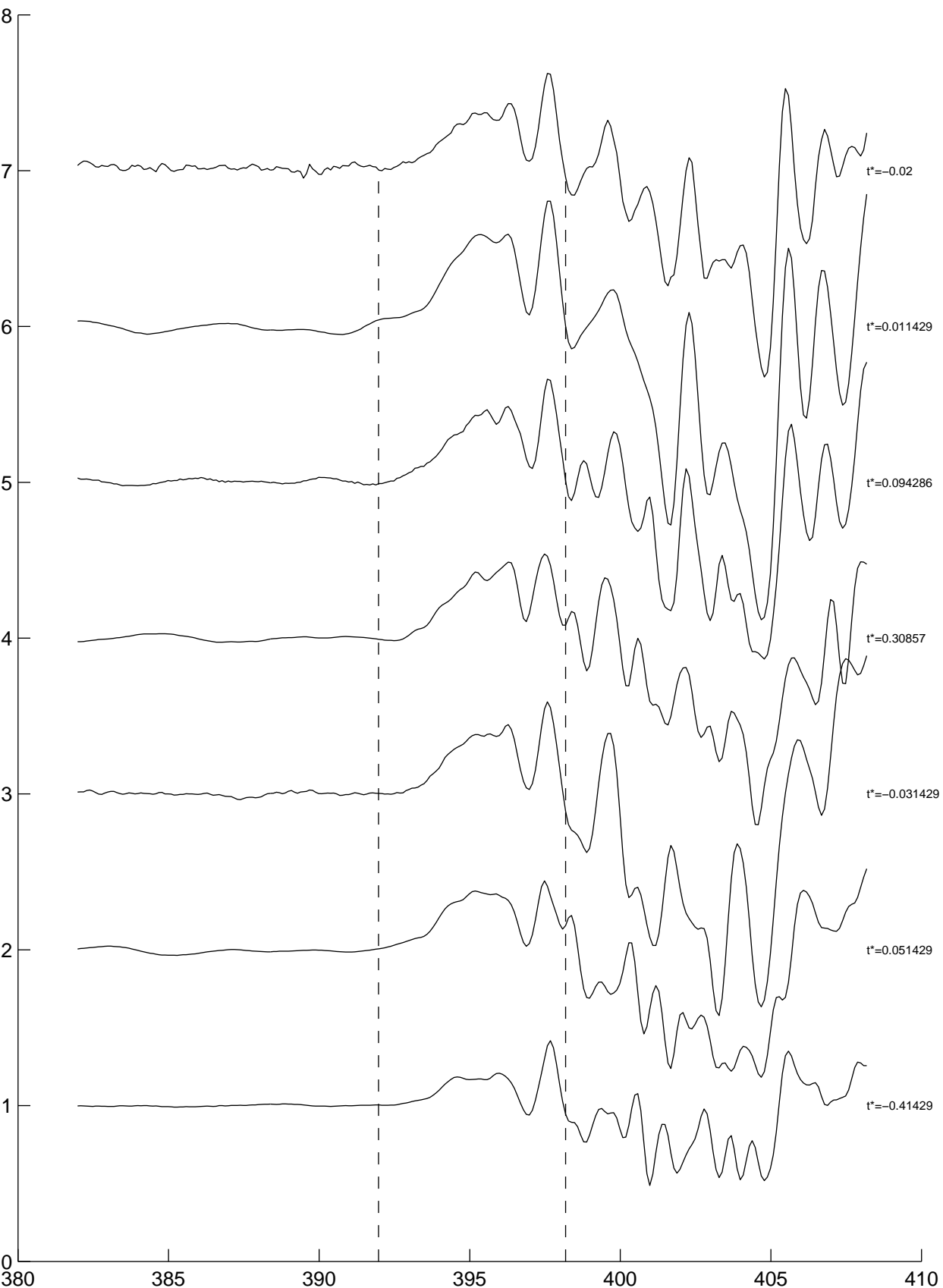


5/9/2008	51:29	12.52	143.18	6.7
5/23/2008	35:34	7.31	-34.9	6.4
6/13/2008	43:45	39.03	140.88	6.5
7/5/2008	12:04	53.88	152.89	6.8
7/15/2008	26:34	35.8	27.86	6.5
7/19/2008	39:28	37.55	142.21	7
7/19/2008	27:01	-11.04	164.49	6.4
7/19/2008	39:52	-17.34	-177.31	6.4
7/23/2008	26:20	39.8	141.46	6.6
8/26/2008	00:36	-7.64	-74.38	6.4
9/8/2008	52:07	-13.5	166.97	6.4
9/10/2008	08:14	8.09	-38.72	6.5
9/29/2008	19:31	-29.76	-177.68	6.5
10/5/2008	52:49	39.53	73.82	6.4
10/16/2008	41:25	14.42	-92.36	6.6
10/19/2008	10:33	-21.86	-173.82	6.8
10/22/2008	55:57	-18.41	-175.35	6.4
11/7/2008	19:35	-14.83	168.03	6.4
11/10/2008	22:02	37.57	95.83	6.4
11/24/2008	02:58	54.2	154.32	6.5
12/9/2008	23:59	-31.23	-176.92	6.7
1/15/2009	27:20	-22.35	170.64	6.5
1/15/2009	49:39	46.86	155.15	6.9
1/18/2009	11:48	-30.2	-177.95	6.4
1/19/2009	35:18	-22.6	170.91	6.4
2/18/2009	53:45	-27.42	-176.33	6.8
3/6/2009	50:29	80.32	-1.85	6.6
3/19/2009	17:40	-23.05	-174.66	7
4/7/2009	23:33	46.05	151.55	6.5
4/18/2009	17:58	46.02	151.43	6.6
5/16/2009	53:52	-31.52	-178.79	6.5
5/28/2009	24:45	16.72	-86.23	6.7
6/5/2009	30:33	41.82	143.45	6.4

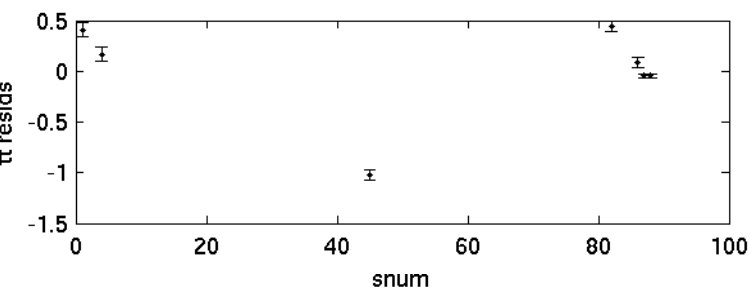
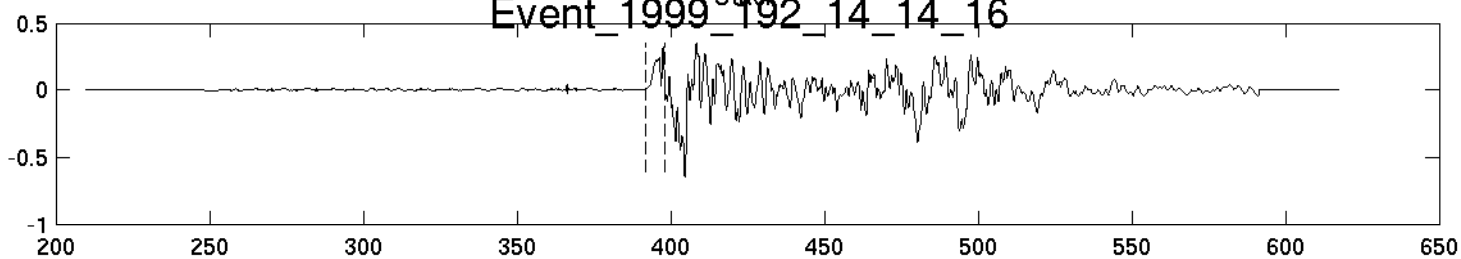
## Appendix IV

### INITIAL $t^*$ RESULTS

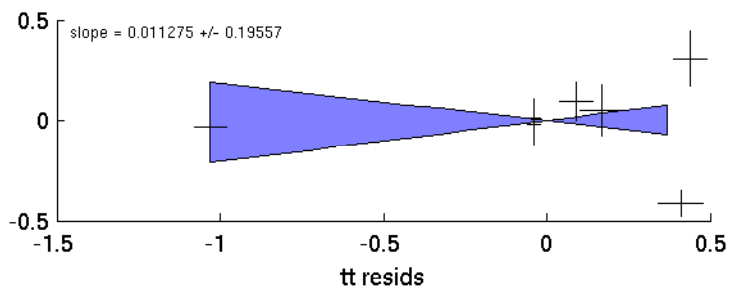
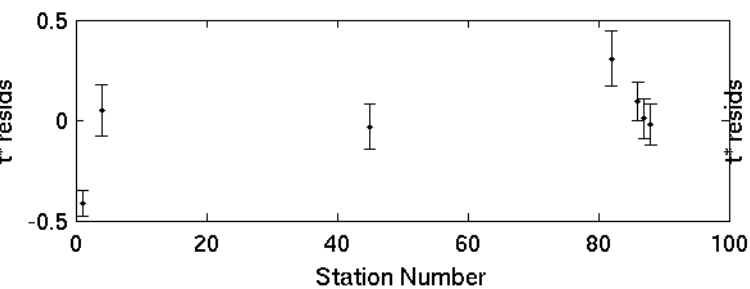
# Event\_1999\_192\_14\_14\_16



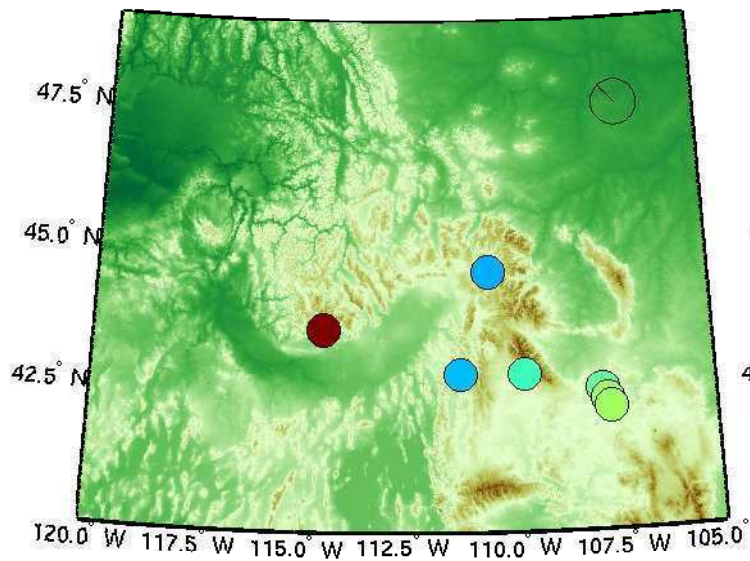
# Event\_1999\_192\_14\_14\_16



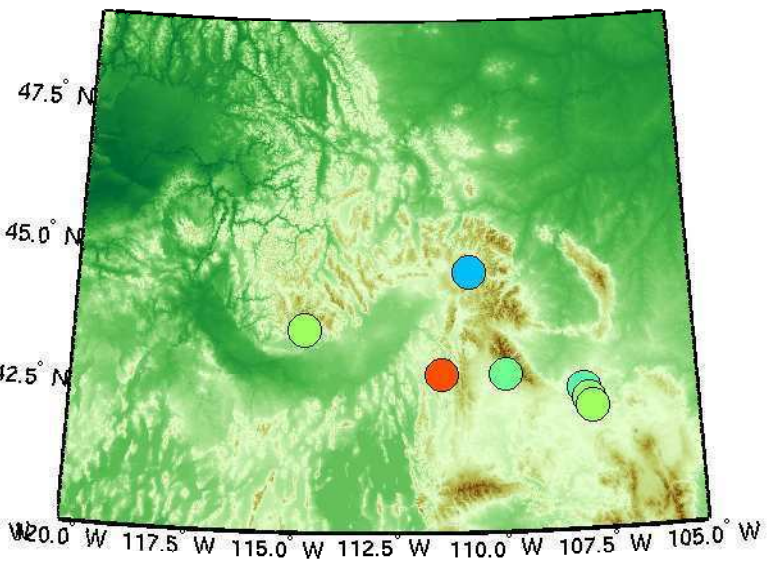
Baz = 139.8991  
Mean xcor value = 0.73143  
Range of  $t^*$  values is 0.72286  
Median  $t^*$  err is 0.099902



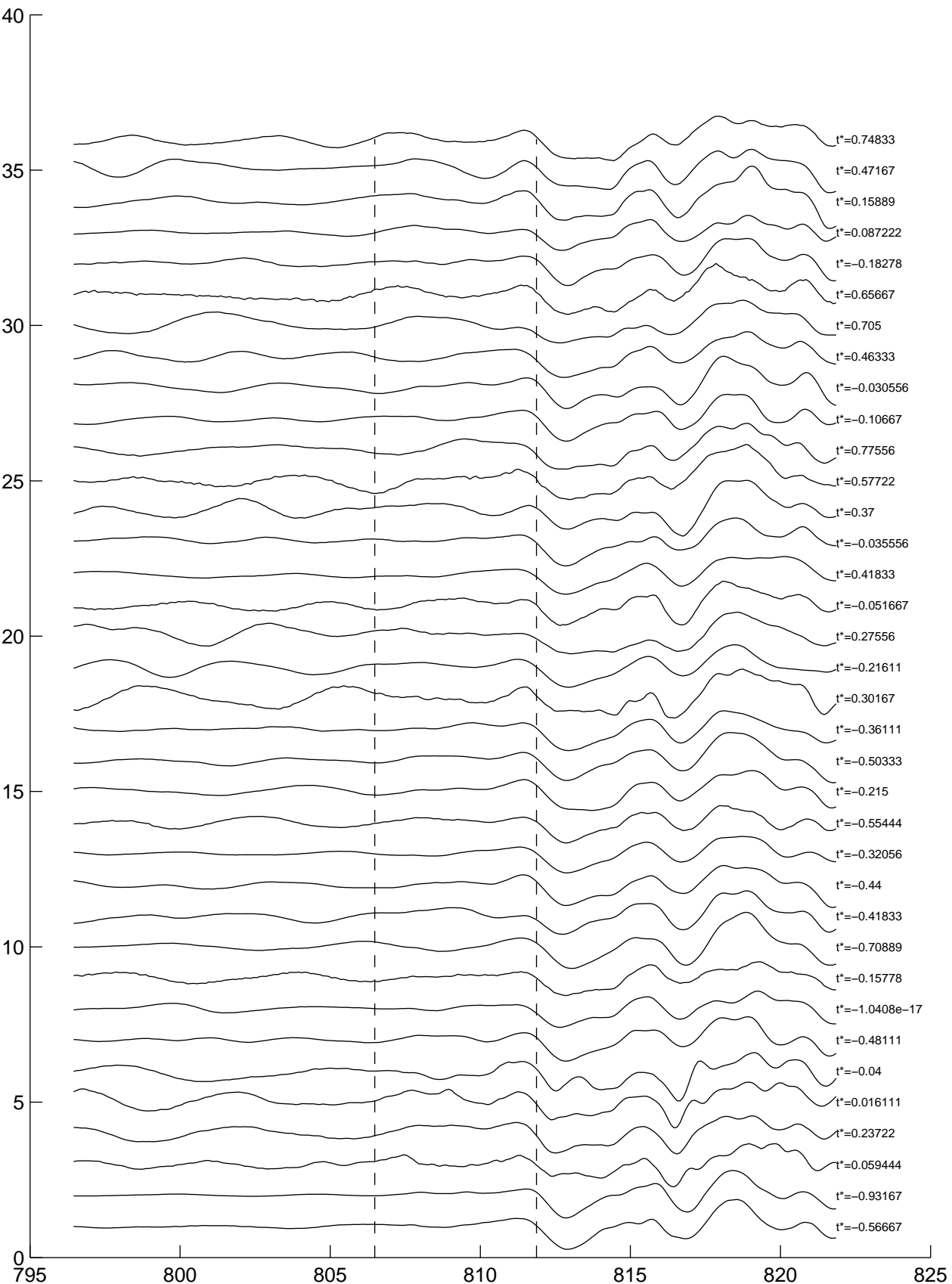
travel time residuals



$t^*$  values

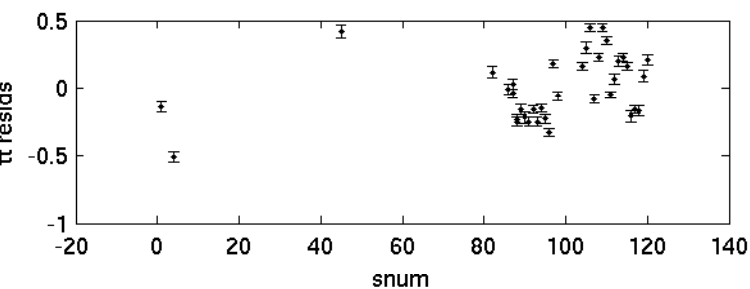
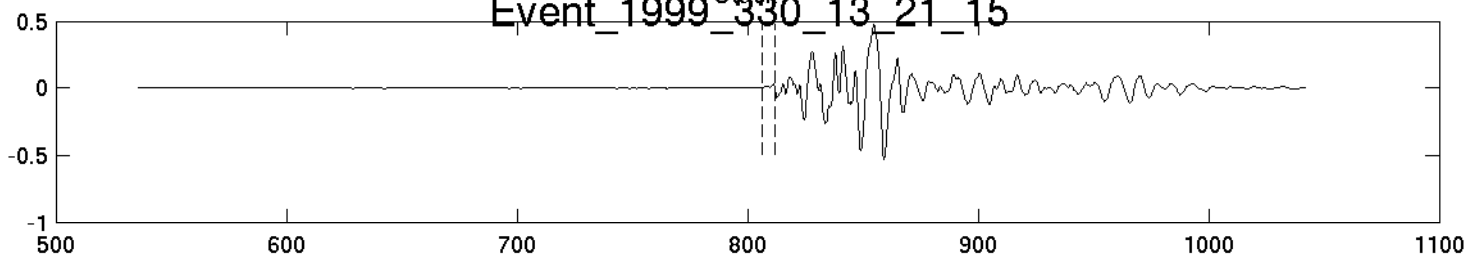


# Event\_1999\_330\_13\_21\_15

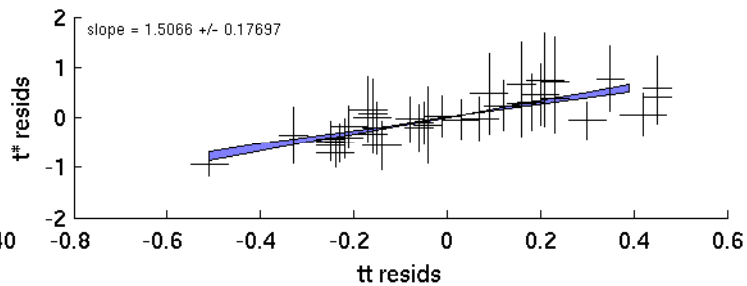
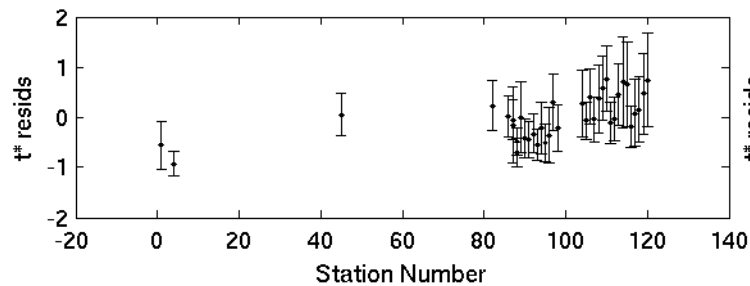


# Event\_1999\_330\_13\_21\_15

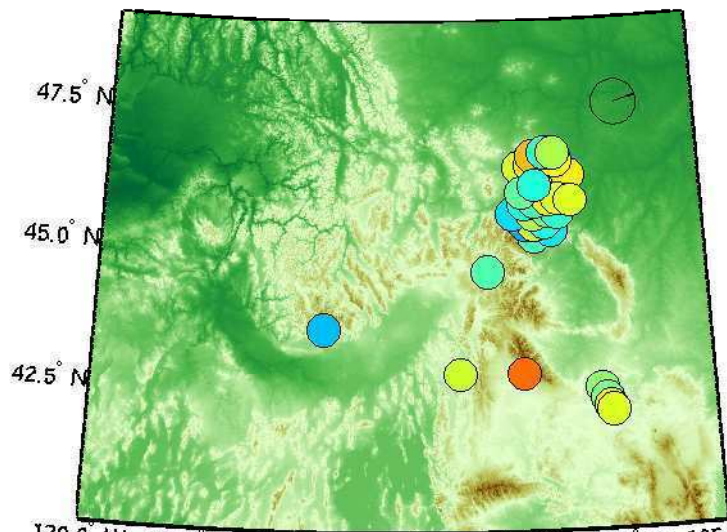
Stack



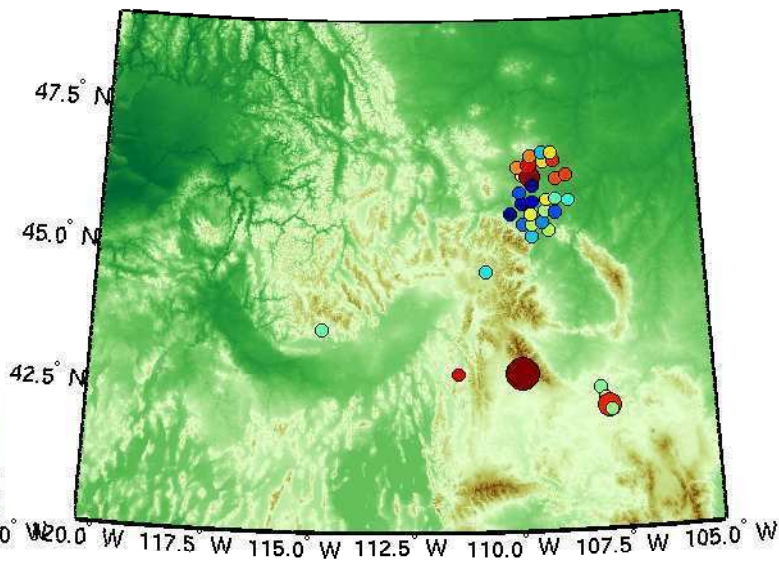
Baz = 253.3172  
Mean xcor value = 0.88139  
Range of  $t^*$  values is 1.7072  
Median  $t^*$  err is 0.48748



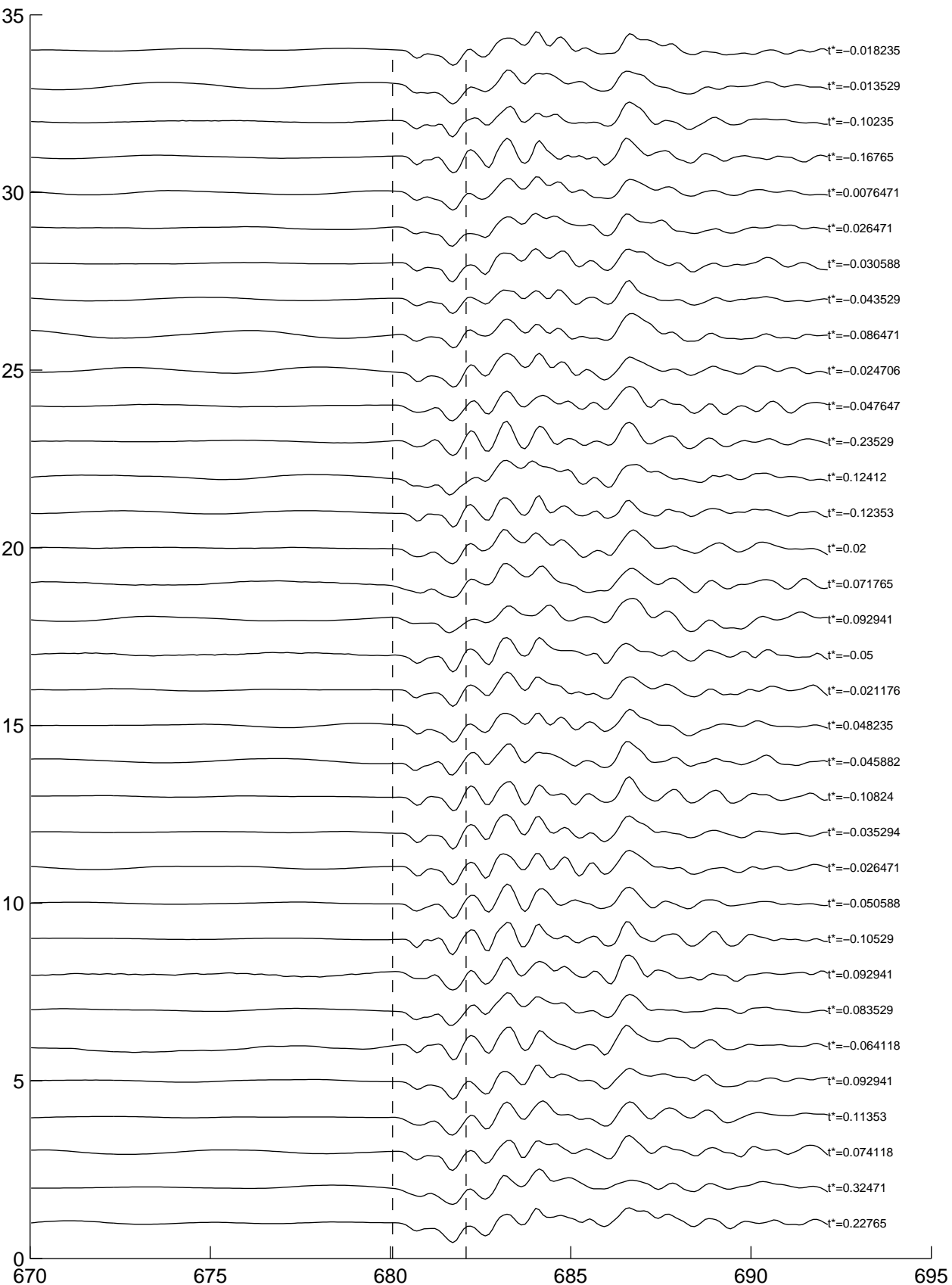
travel time residuals



$t^*$  values

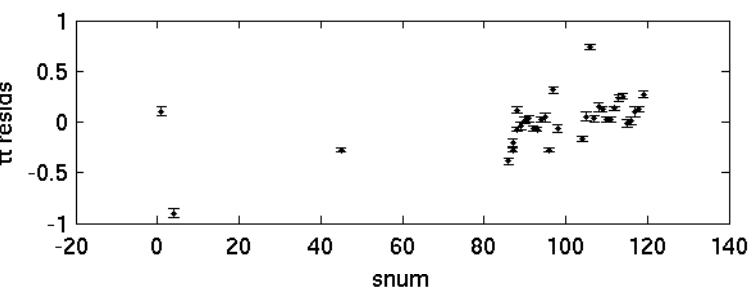
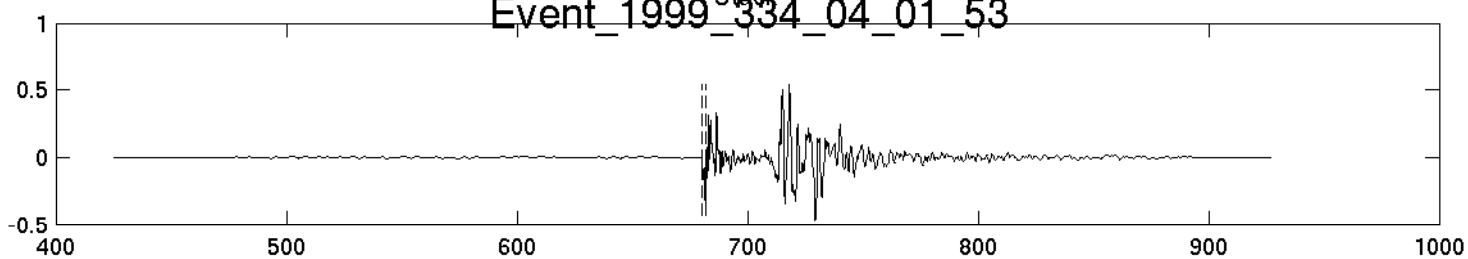


# Event\_1999\_334\_04\_01\_53

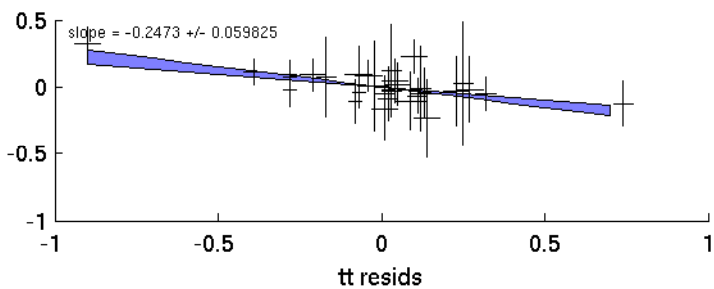
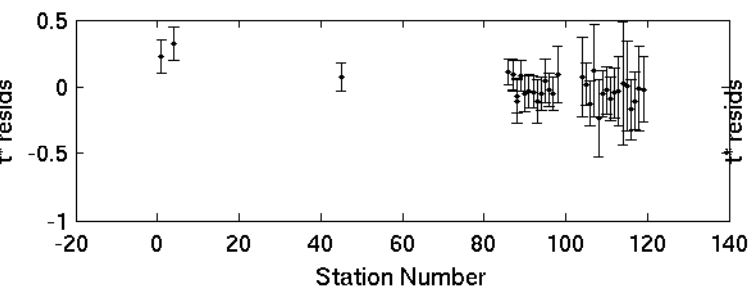




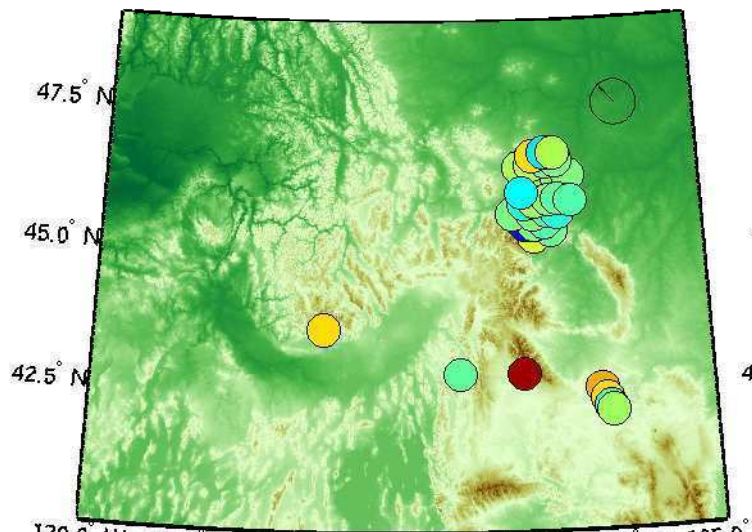
# Event\_1999\_334\_04\_01\_53



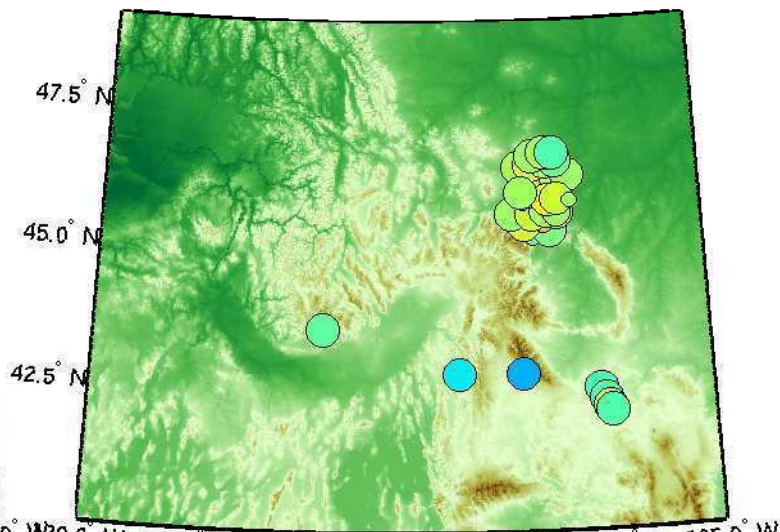
Baz = 140.825  
Mean xcor value = 0.71265  
Range of  $t^*$  values is 0.56  
Median  $t^*$  err is 0.16236



travel time residuals

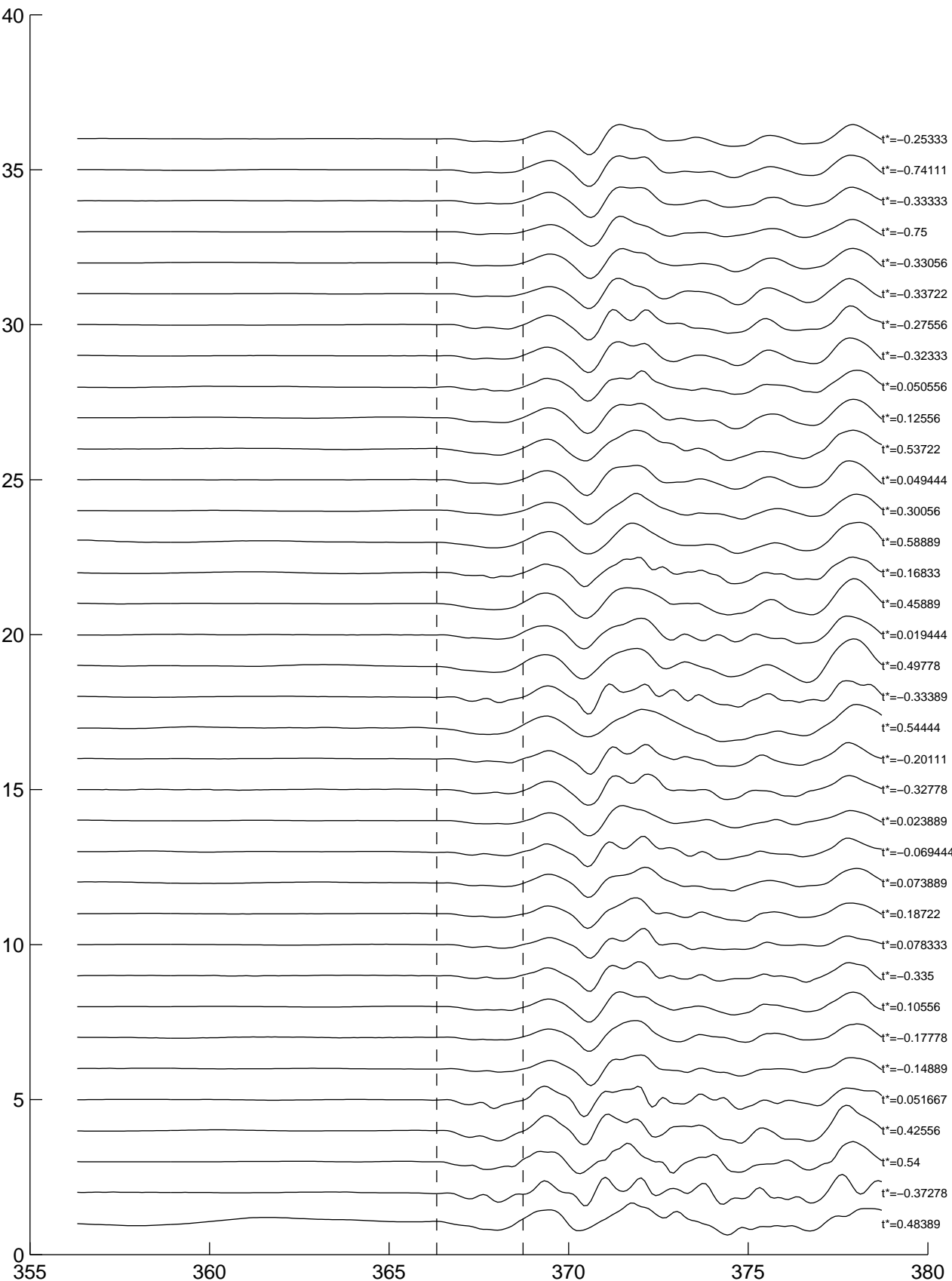


$t^*$  values

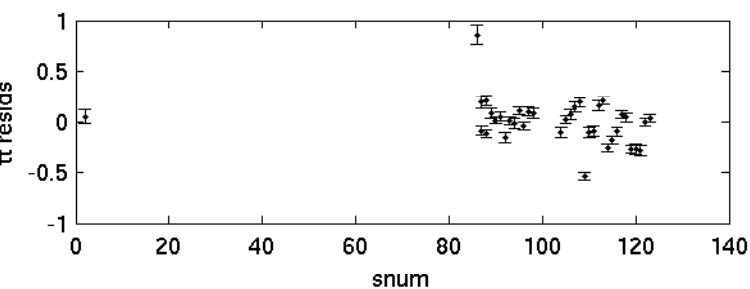
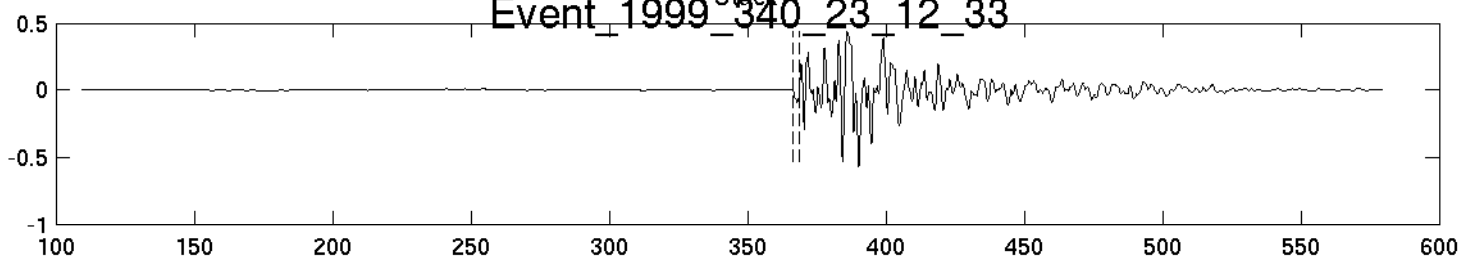




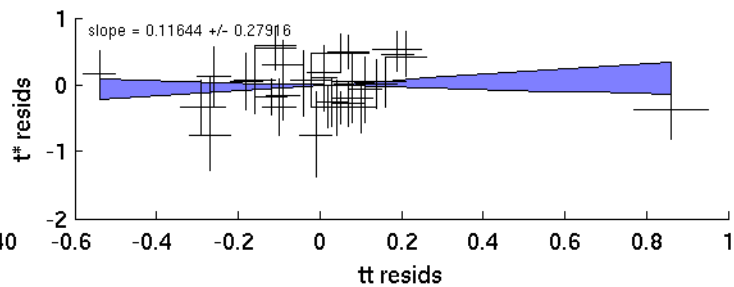
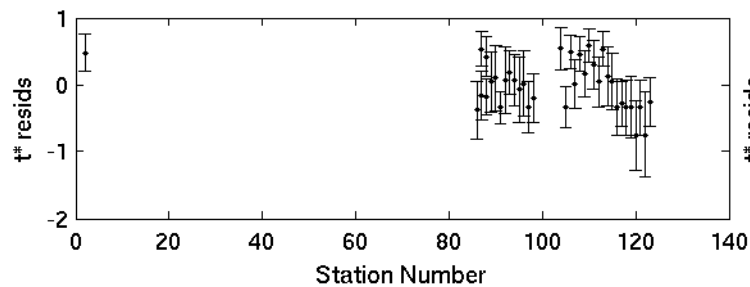
# Event\_1999\_340\_23\_12\_33



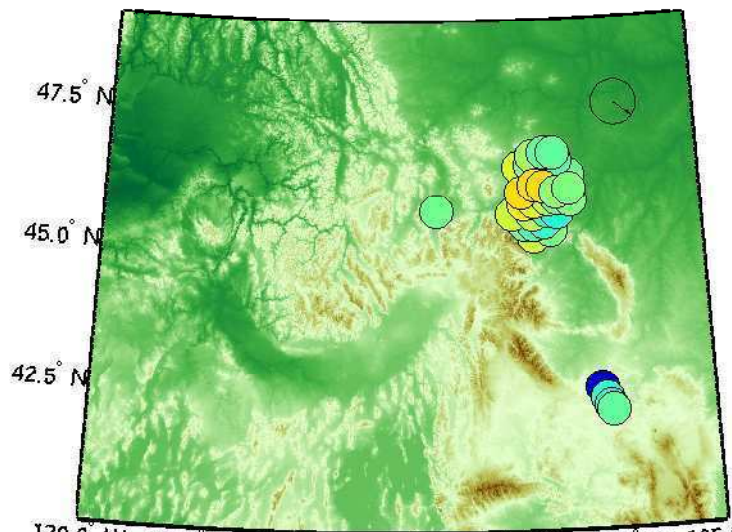
# Event\_1999\_340\_23\_12\_33



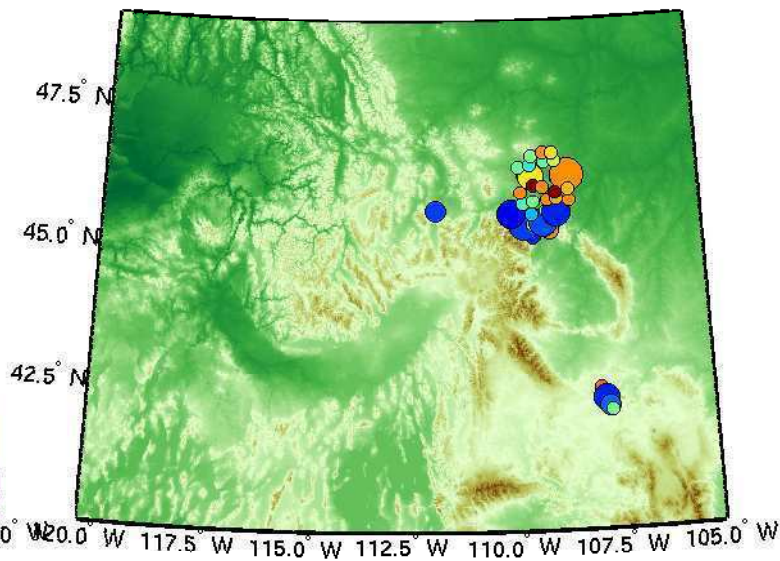
Baz = 309.817  
 Mean xcor value = 0.84417  
 Range of  $t^*$  values is 1.3389  
 Median  $t^*$  err is 0.36385



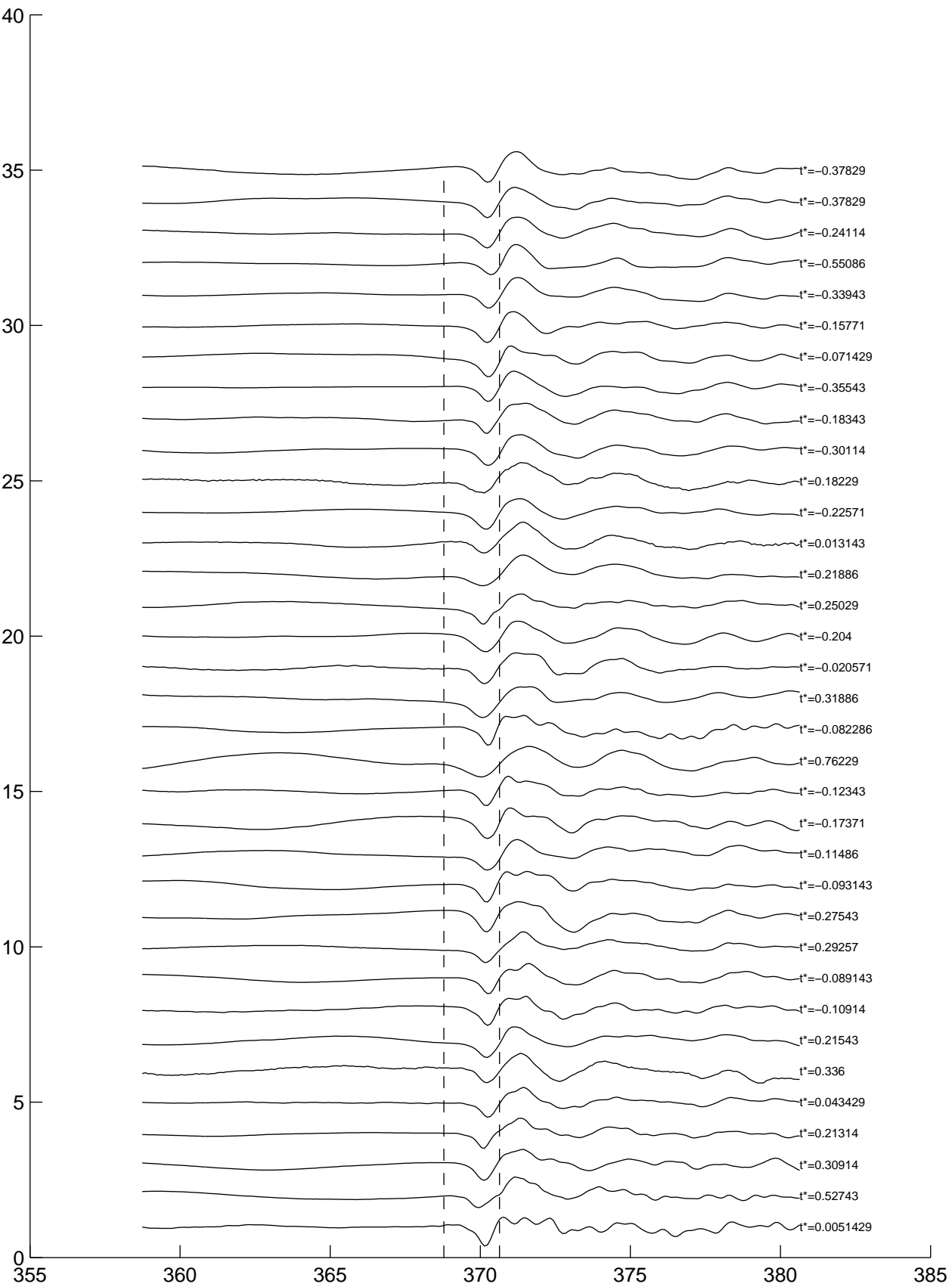
travel time residuals



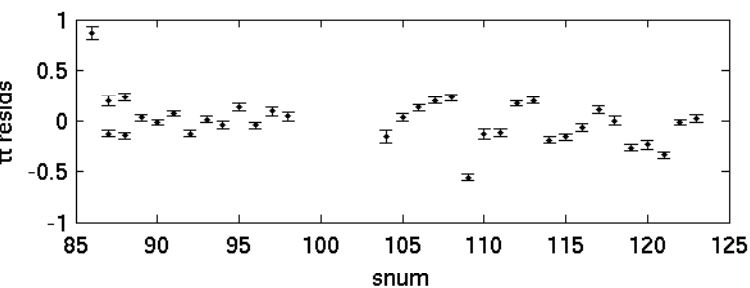
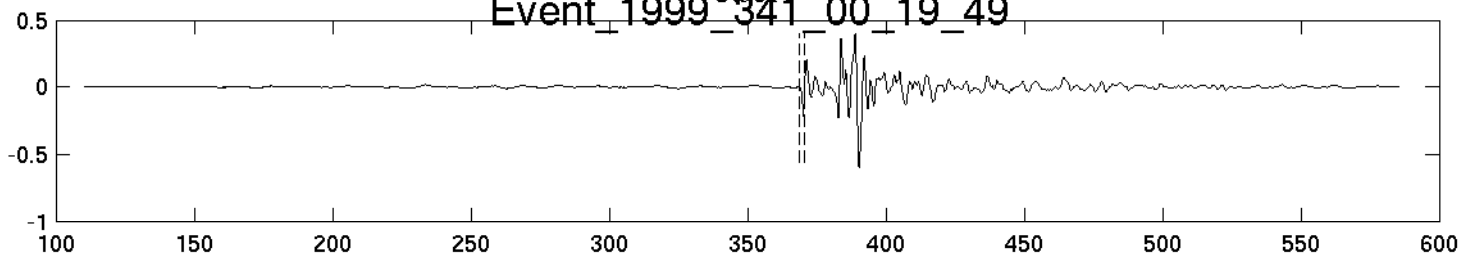
$t^*$  values



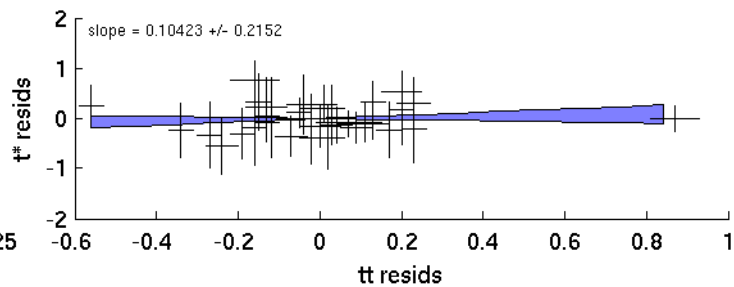
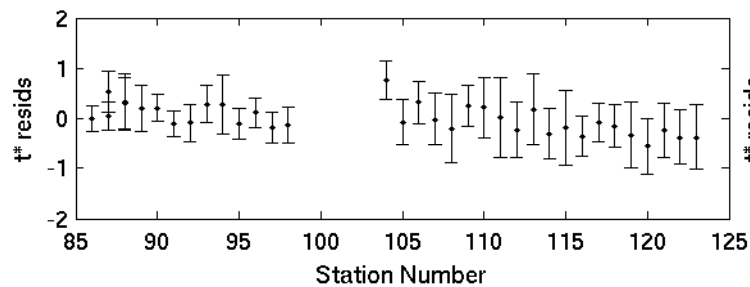
# Event\_1999\_341\_00\_19\_49



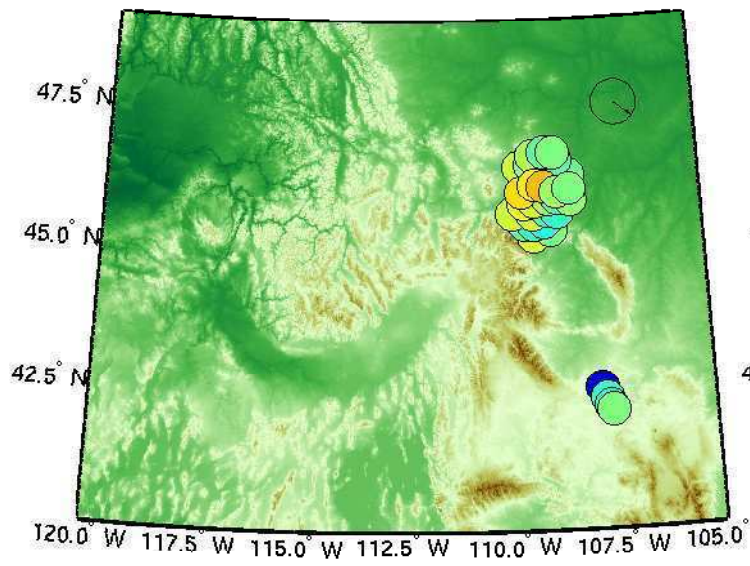
Event\_1999\_341\_00\_19\_49



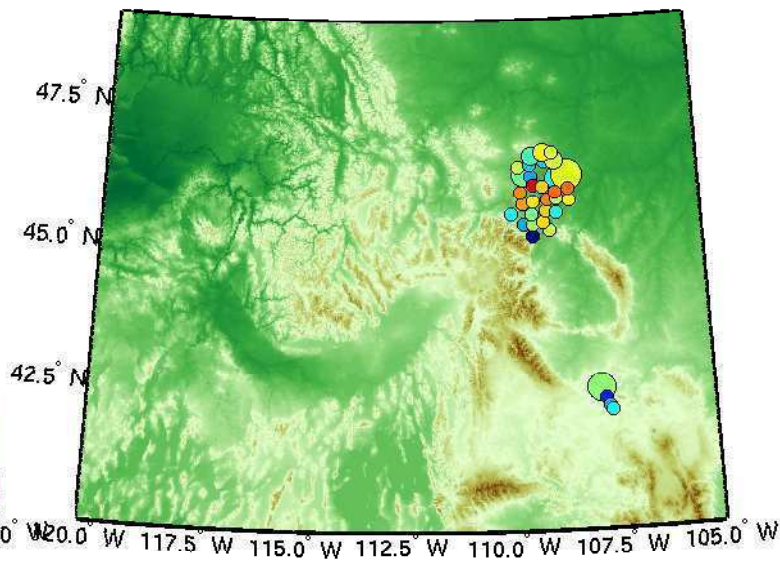
Baz = 309.7107  
Mean xcor value = 0.81286  
Range of  $t^*$  values is 1.3131  
Median  $t^*$  err is 0.45687



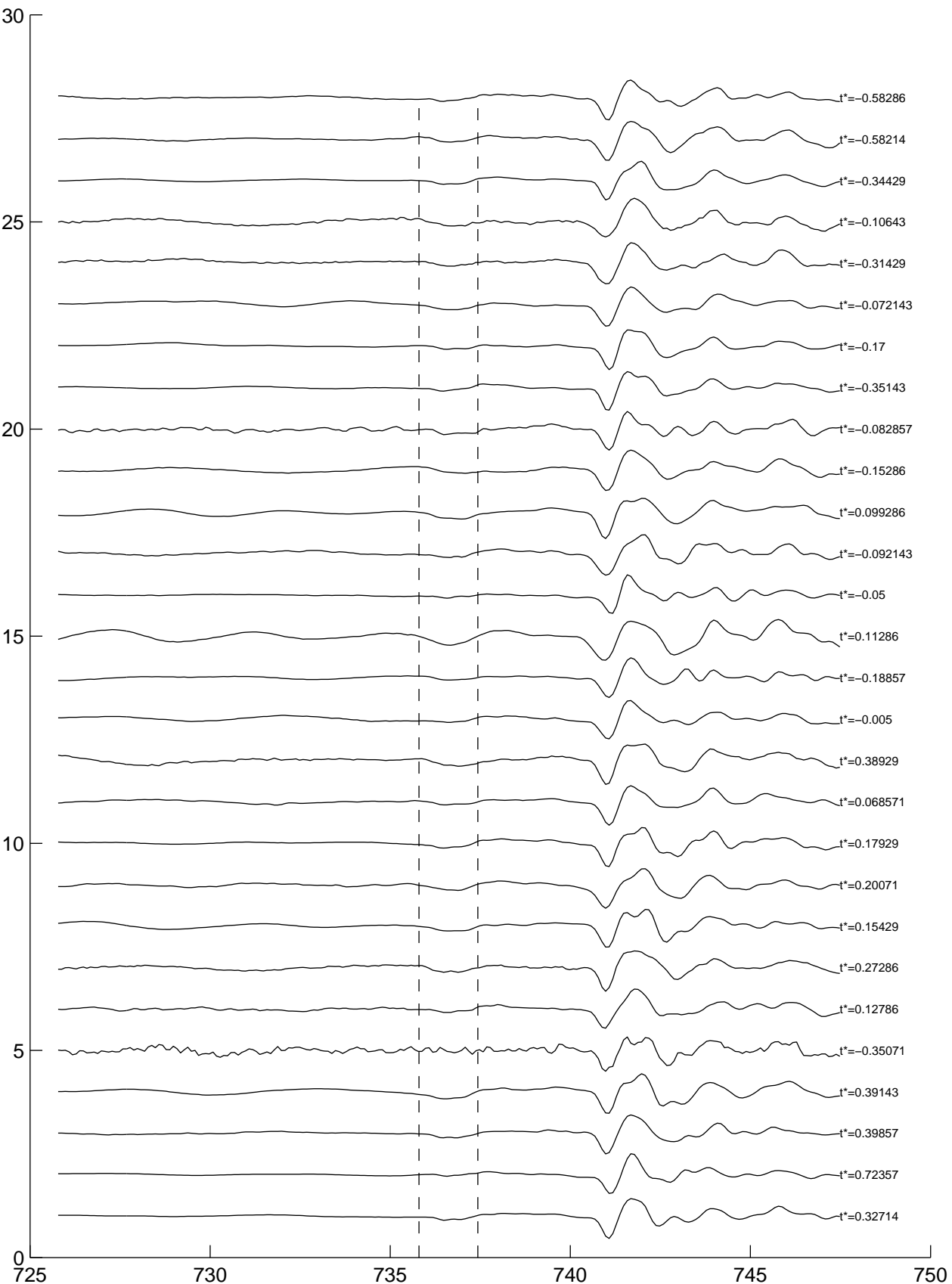
travel time residuals



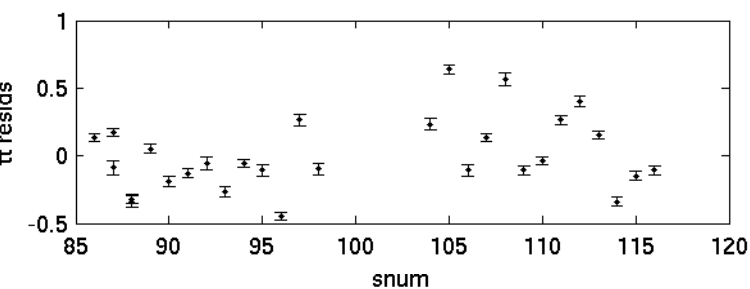
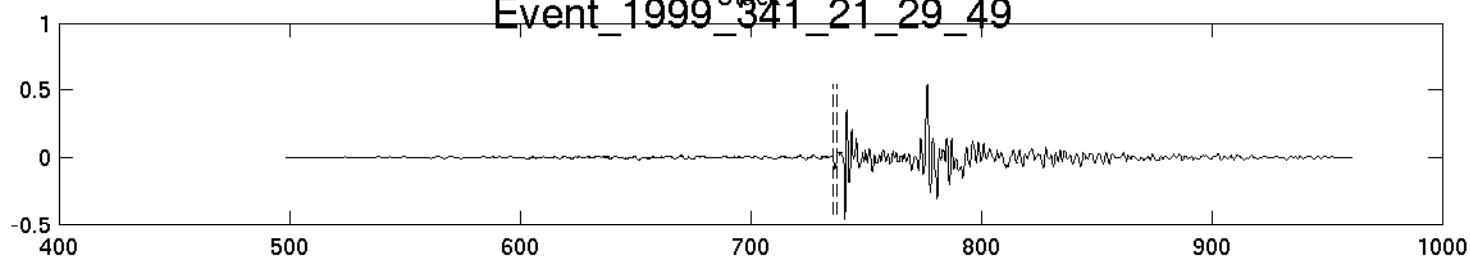
$t^*$  values



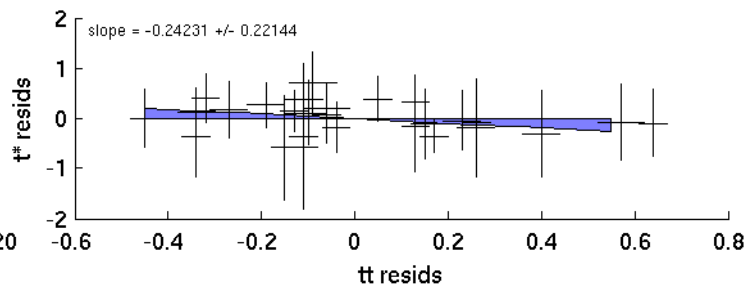
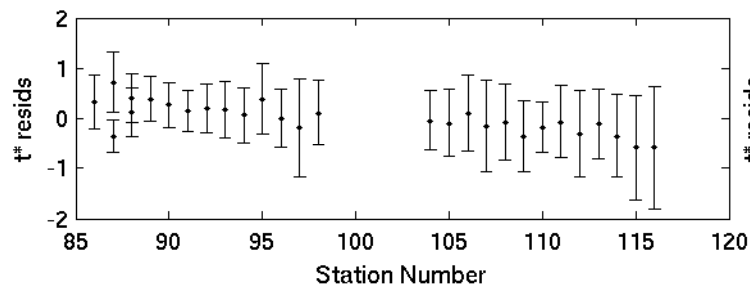
# Event\_1999\_341\_21\_29\_49



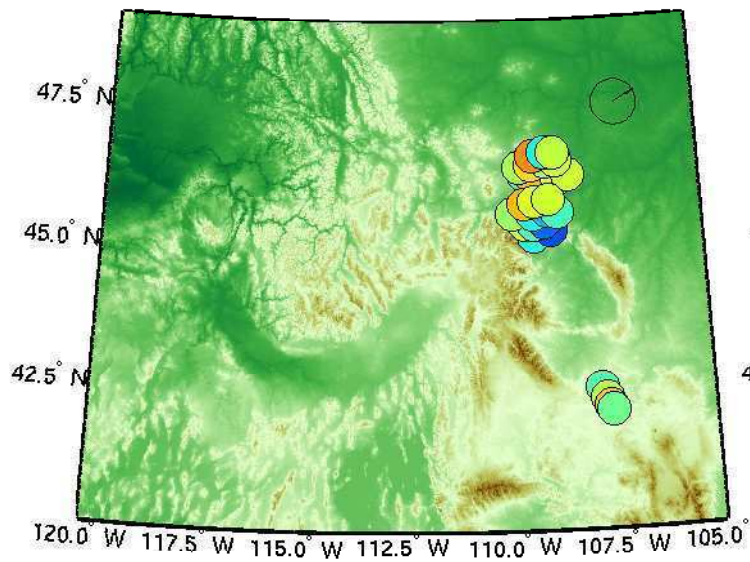
# Event\_1999\_341\_21\_29\_49



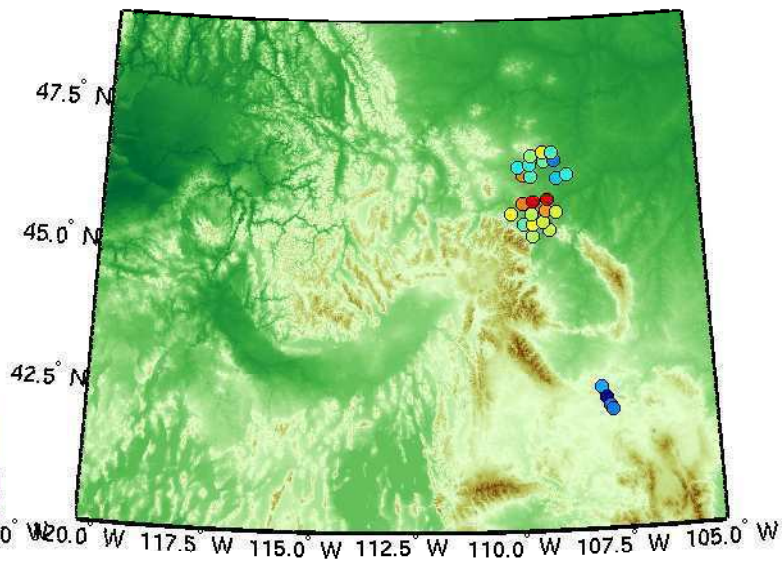
Baz = 241.191  
Mean xcor value = 0.6825  
Range of  $t^*$  values is 1.3064  
Median  $t^*$  err is 0.62126



travel time residuals

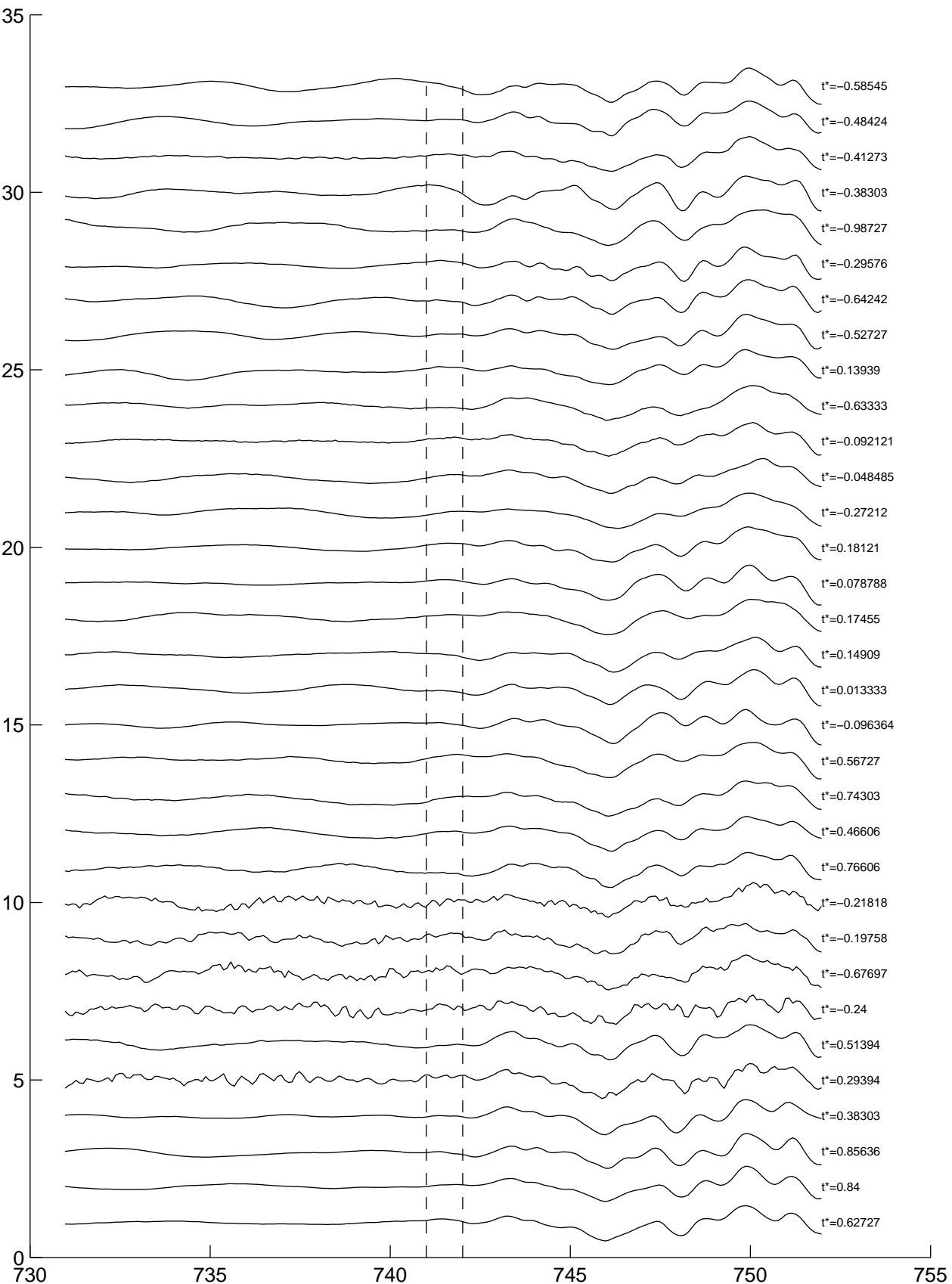


$t^*$  values



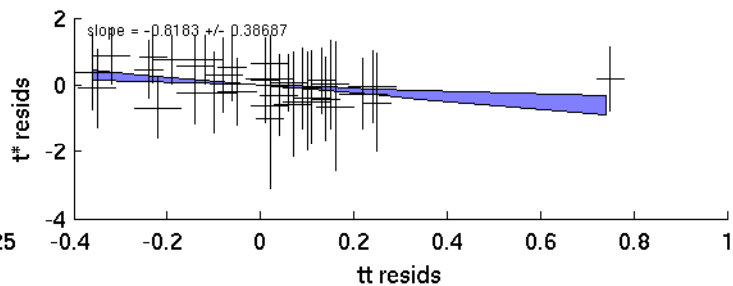
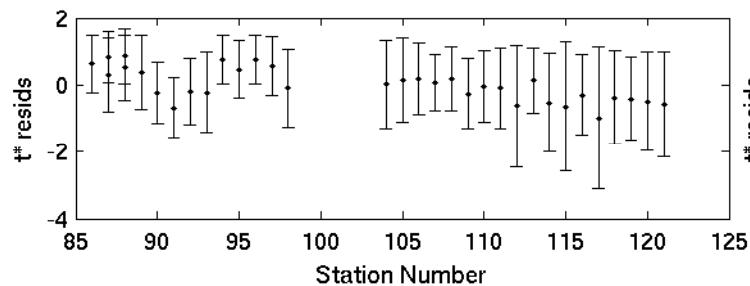
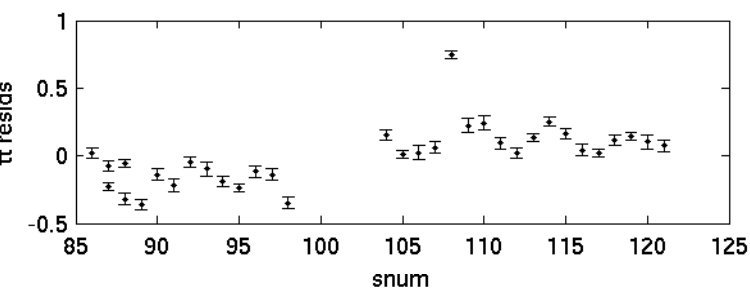
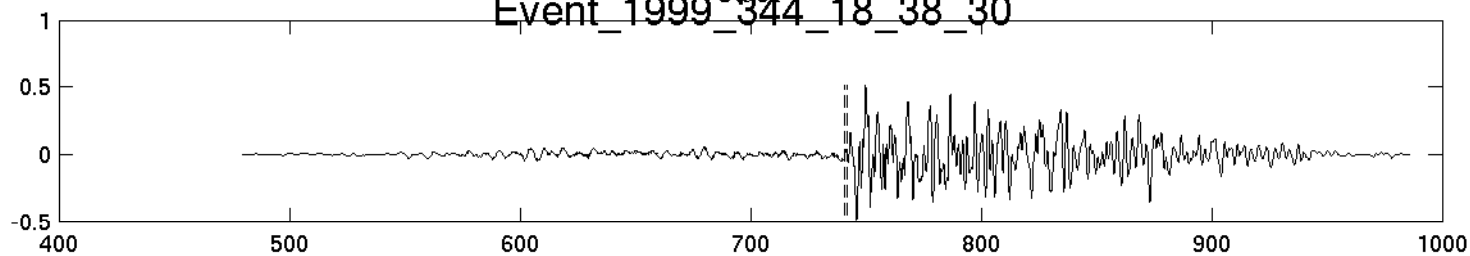


# Event\_1999\_344\_18\_38\_30

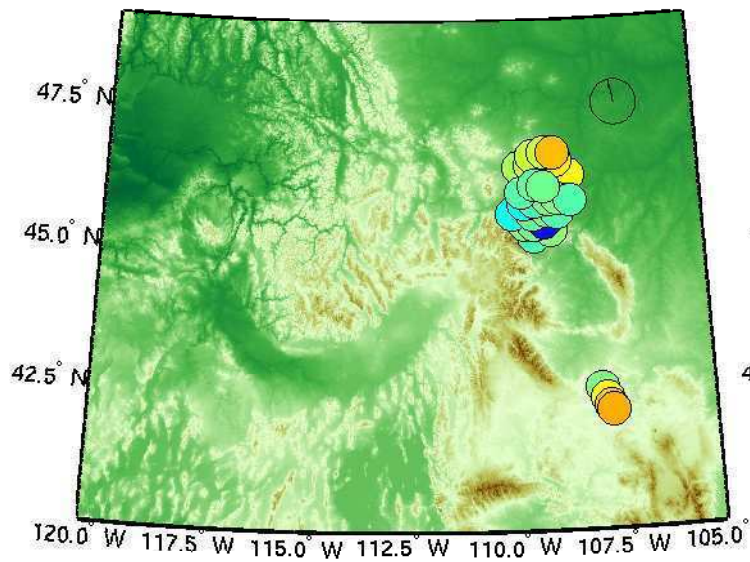


# Event\_1999\_344\_18\_38\_30

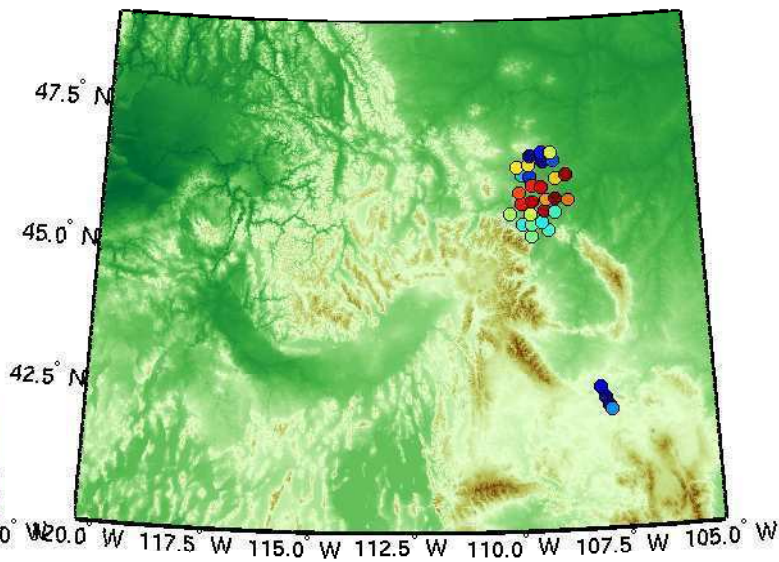
Stack



travel time residuals

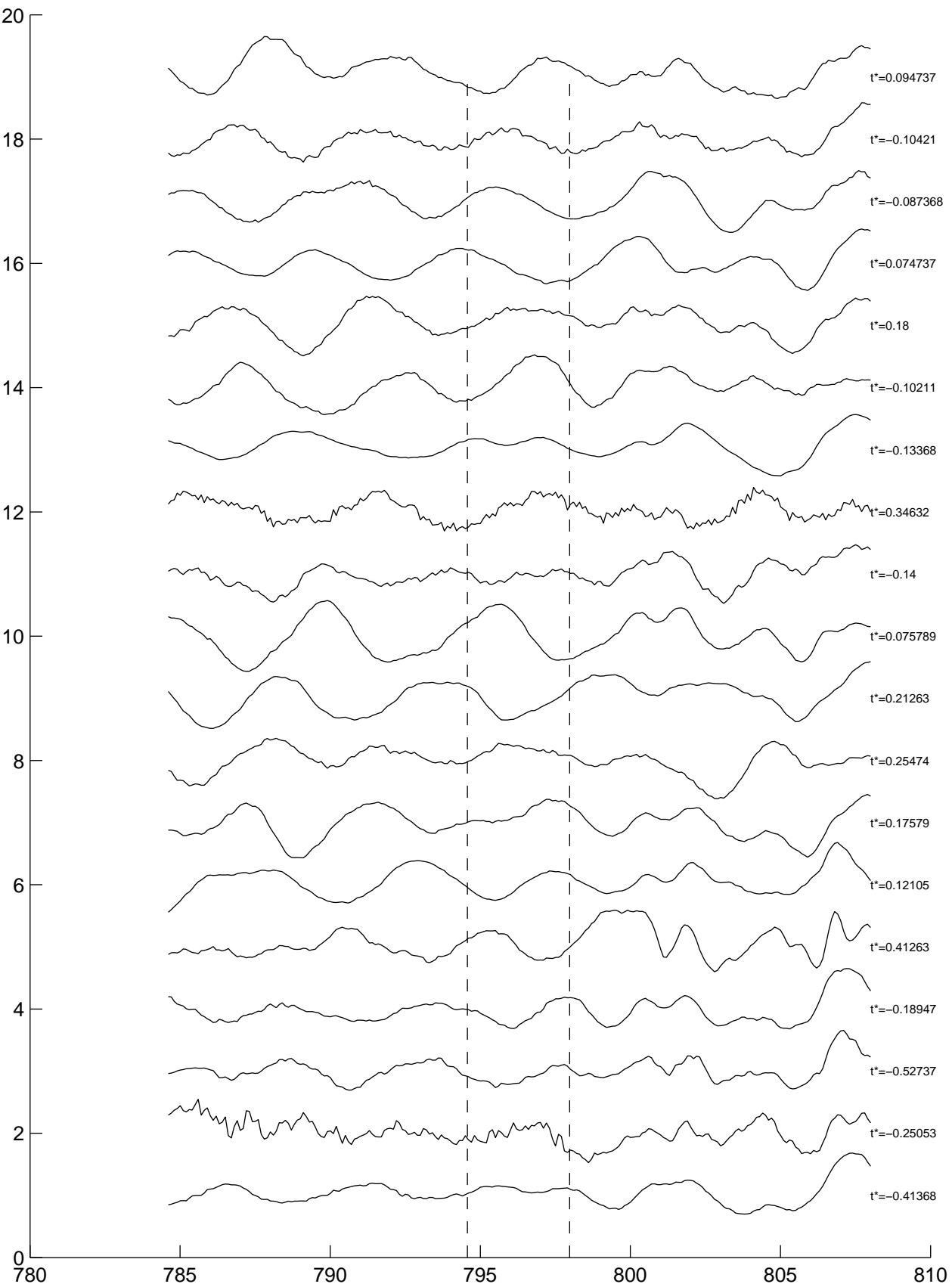


$t^*$  values



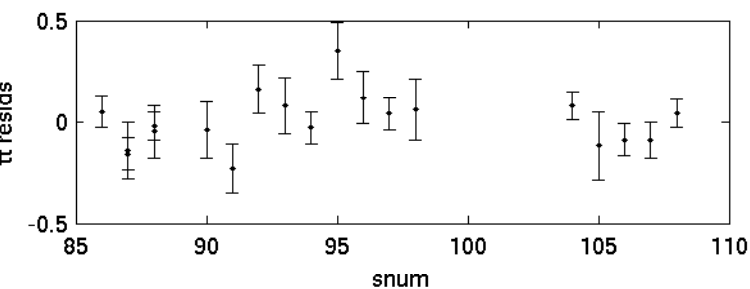
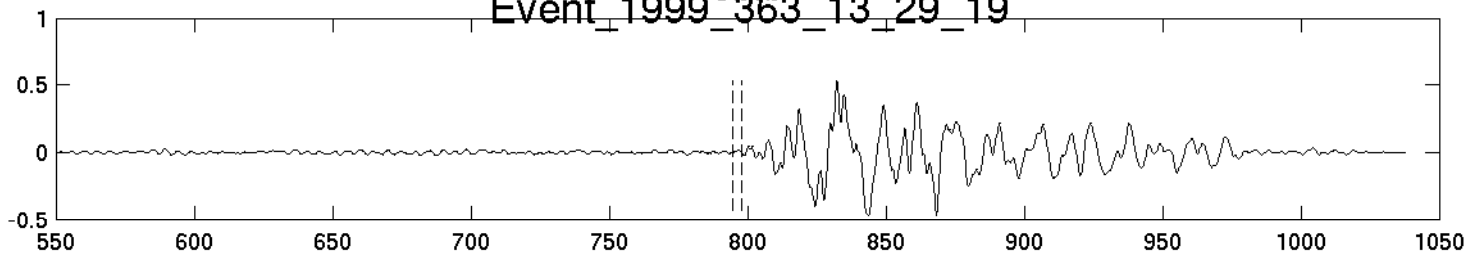


# Event\_1999\_363\_13\_29\_19

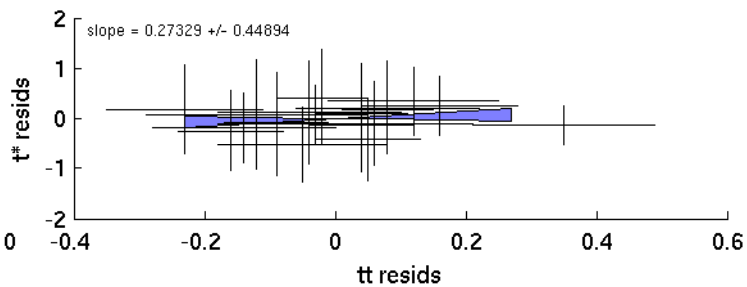
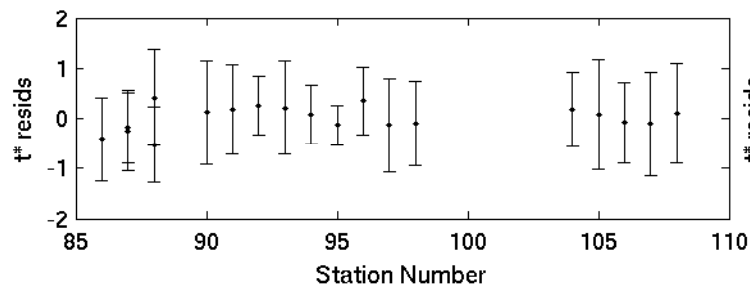


# Event\_1999\_363\_13\_29\_19

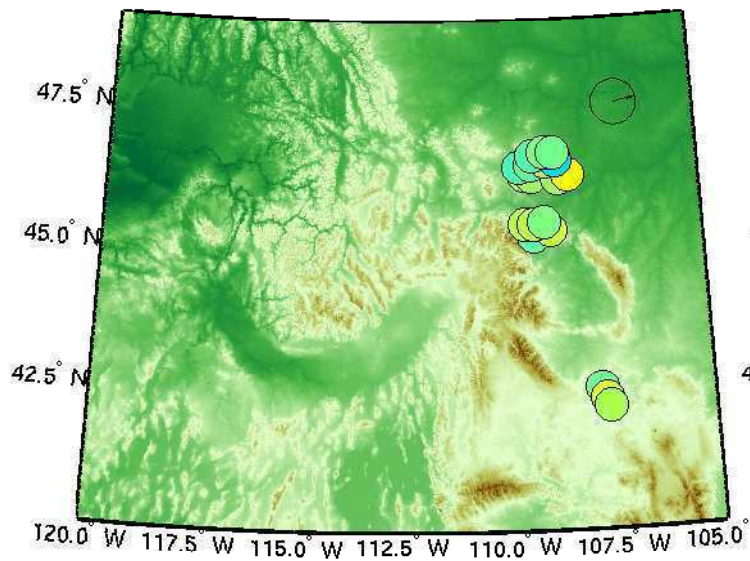
Stack



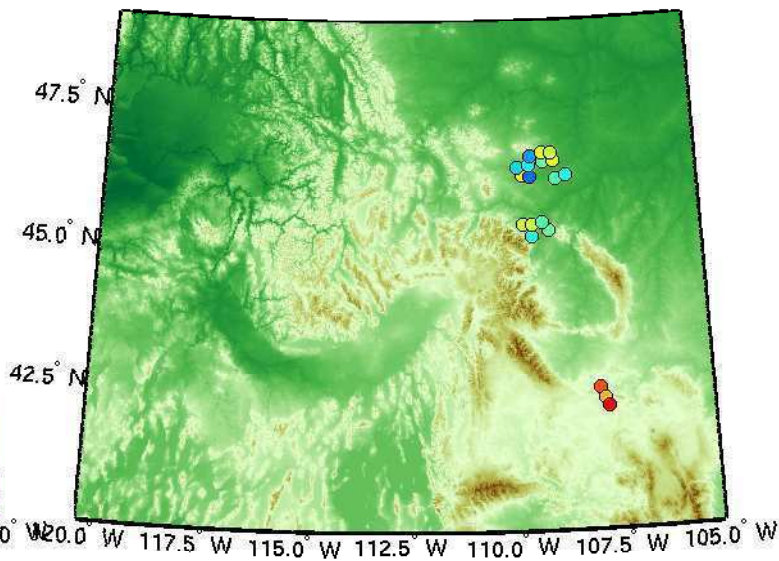
Baz = 259.4094  
Mean xcor value = 0.63263  
Range of  $t^*$  values is 0.94  
Median  $t^*$  err is 0.6319



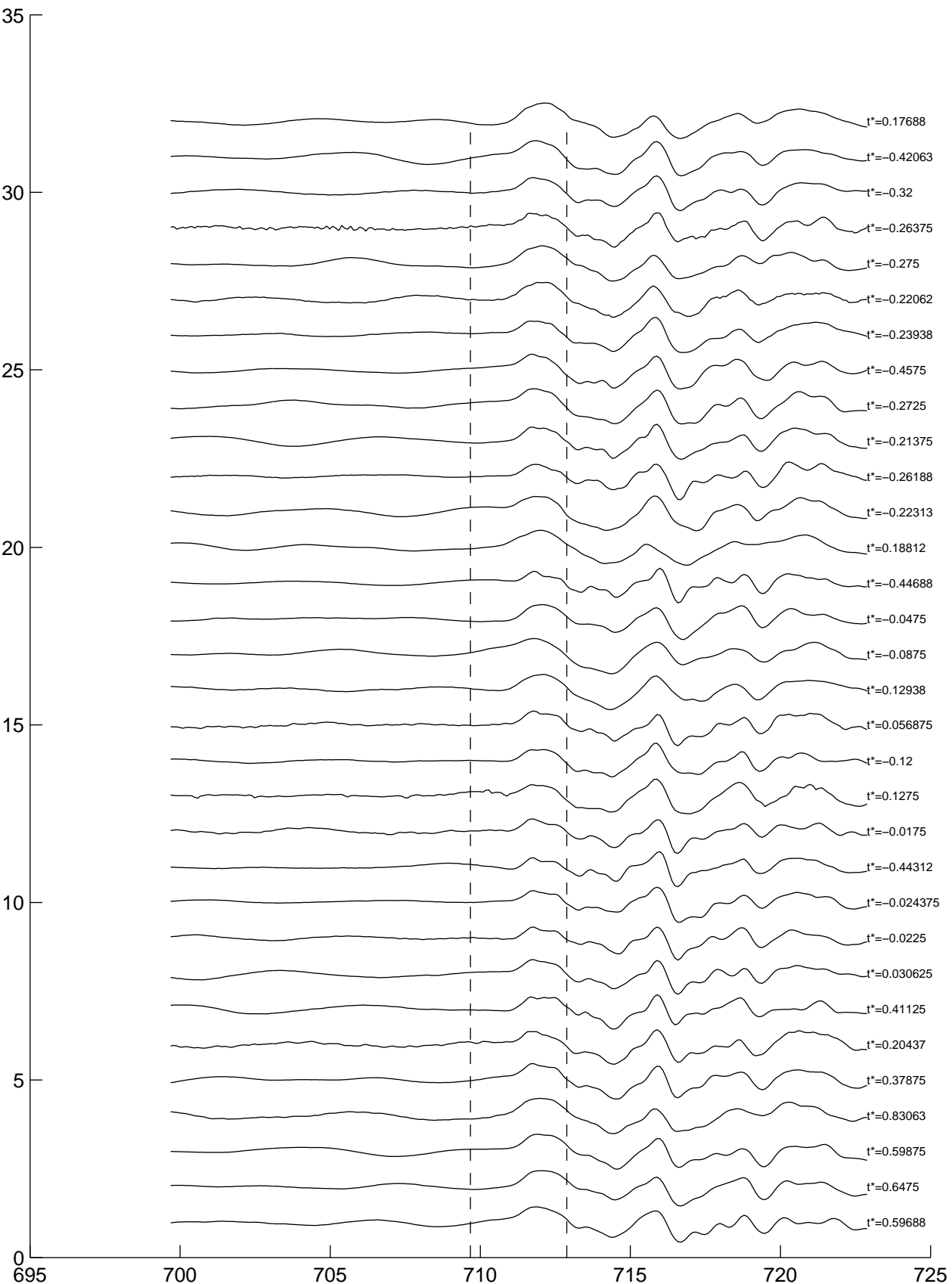
travel time residuals



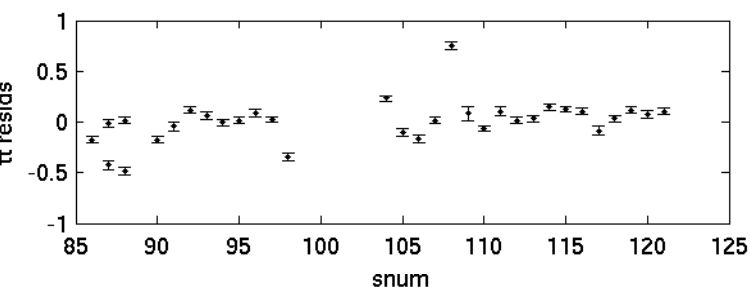
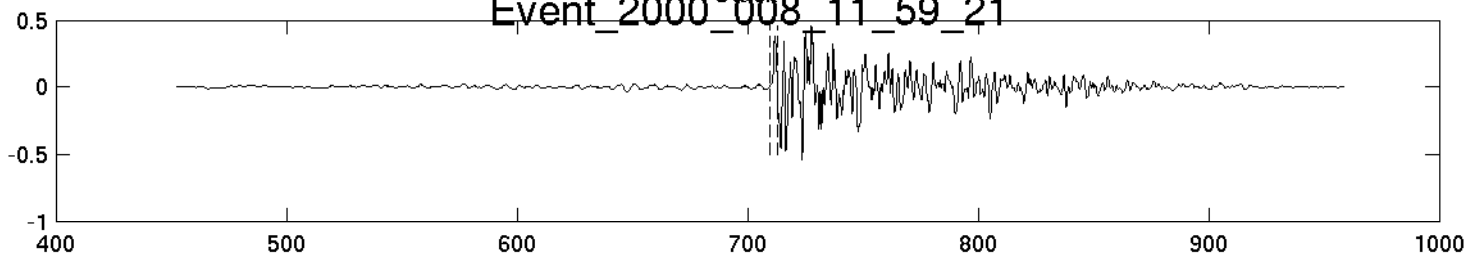
$t^*$  values



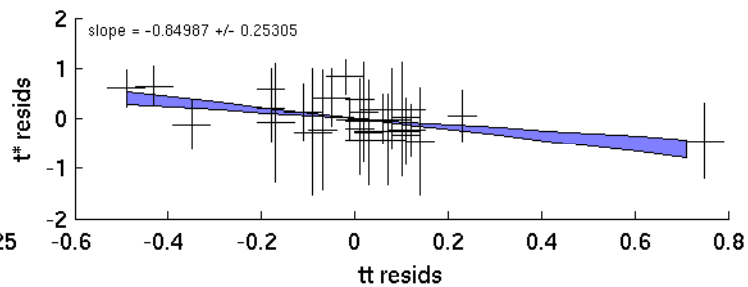
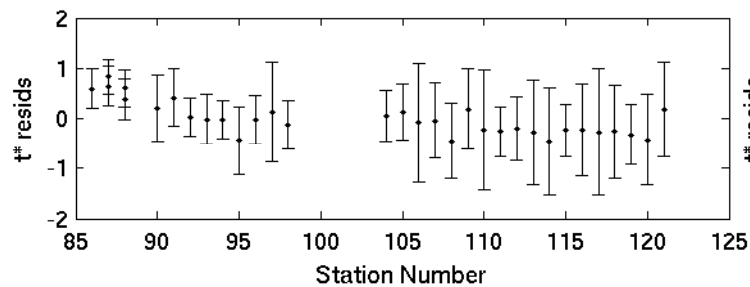
# Event\_2000\_008\_11\_59\_21



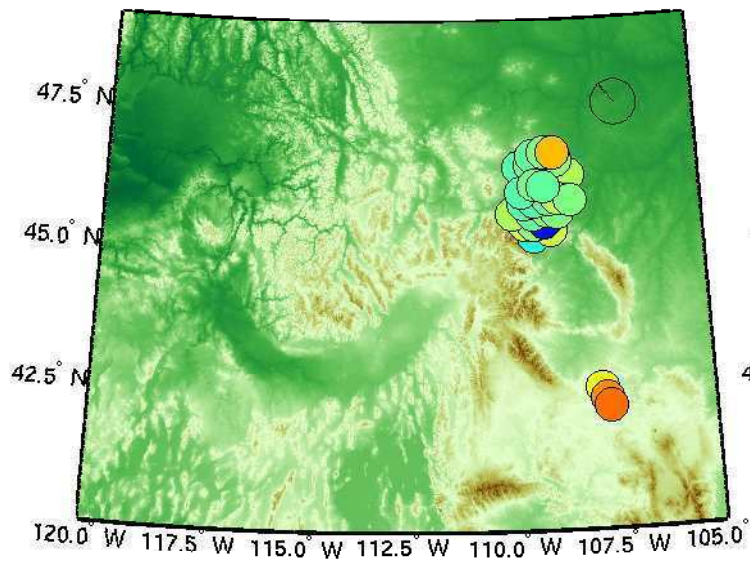
Event\_2000\_008\_11\_59\_21



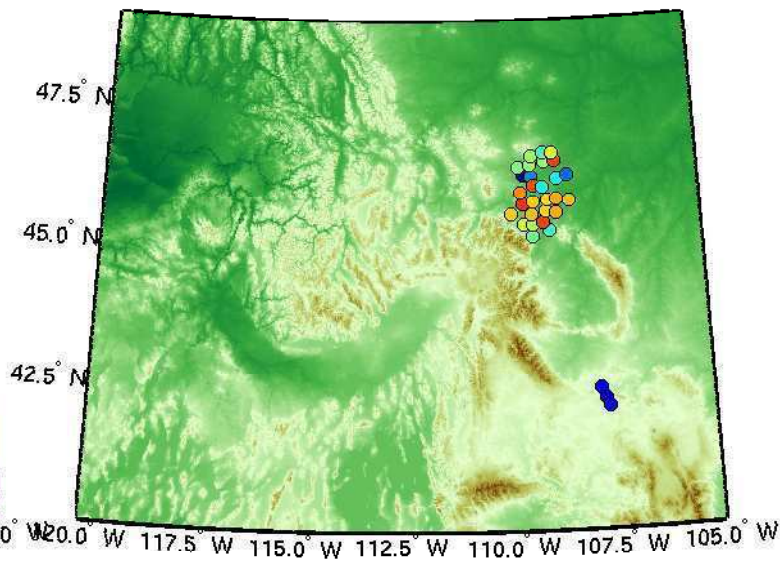
Baz = 143.8713  
Mean xcor value = 0.83219  
Range of  $t^*$  values is 1.2881  
Median  $t^*$  err is 0.61617



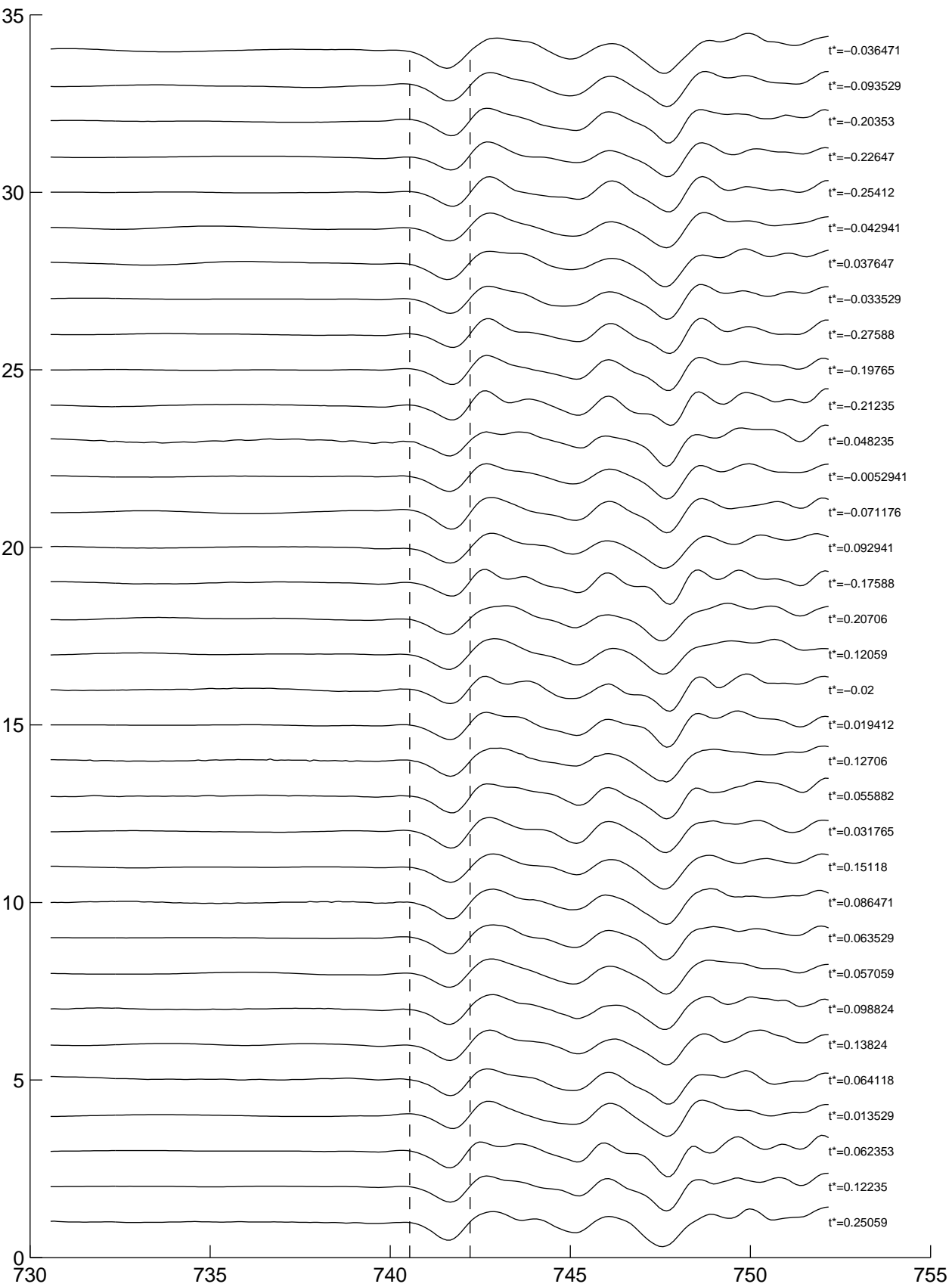
travel time residuals



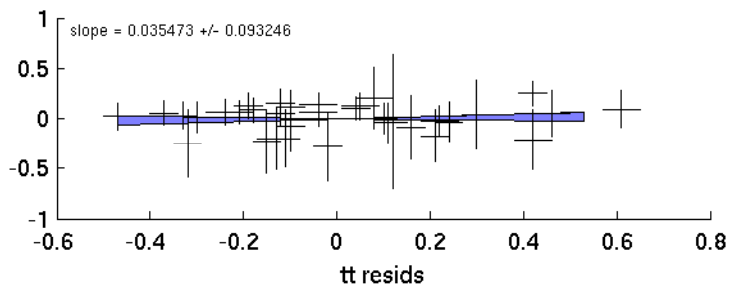
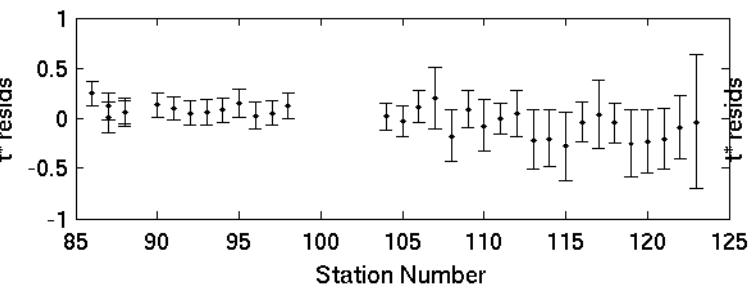
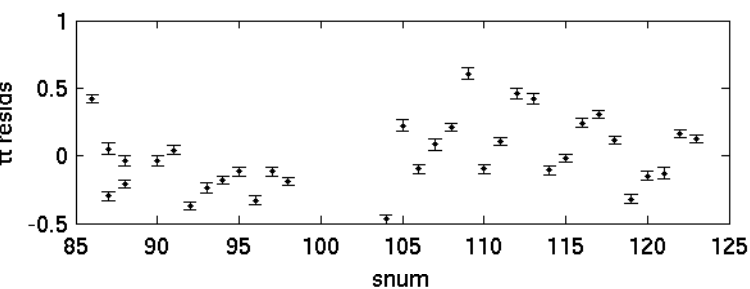
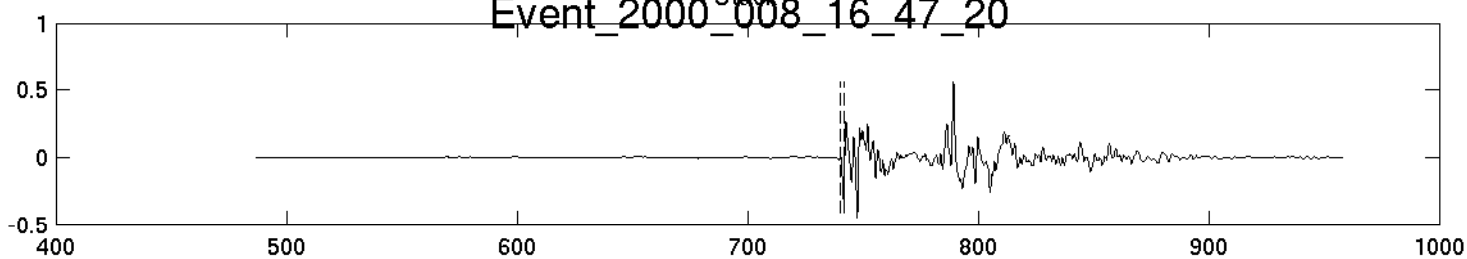
$t^*$  values



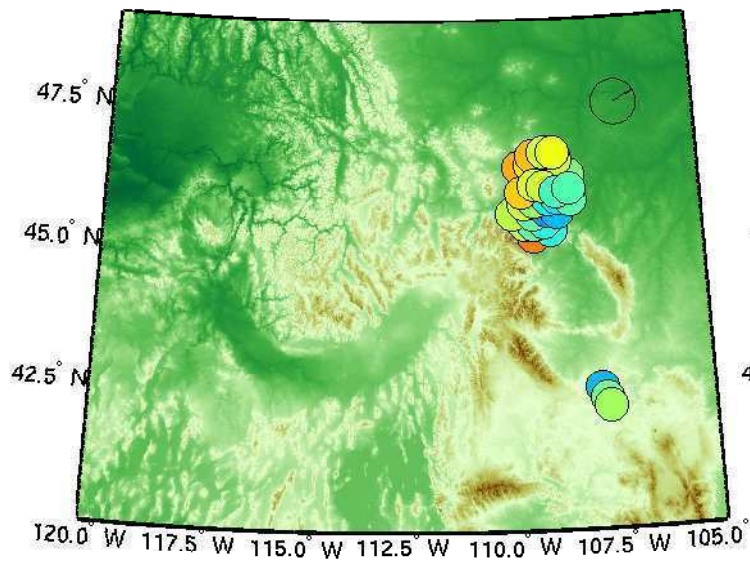
# Event\_2000\_008\_16\_47\_20



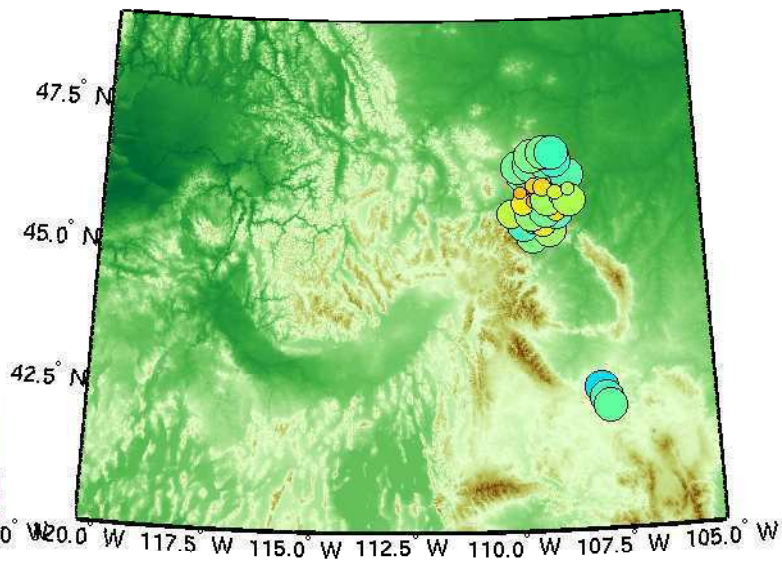
# Event\_2000\_008\_16\_47\_20



travel time residuals

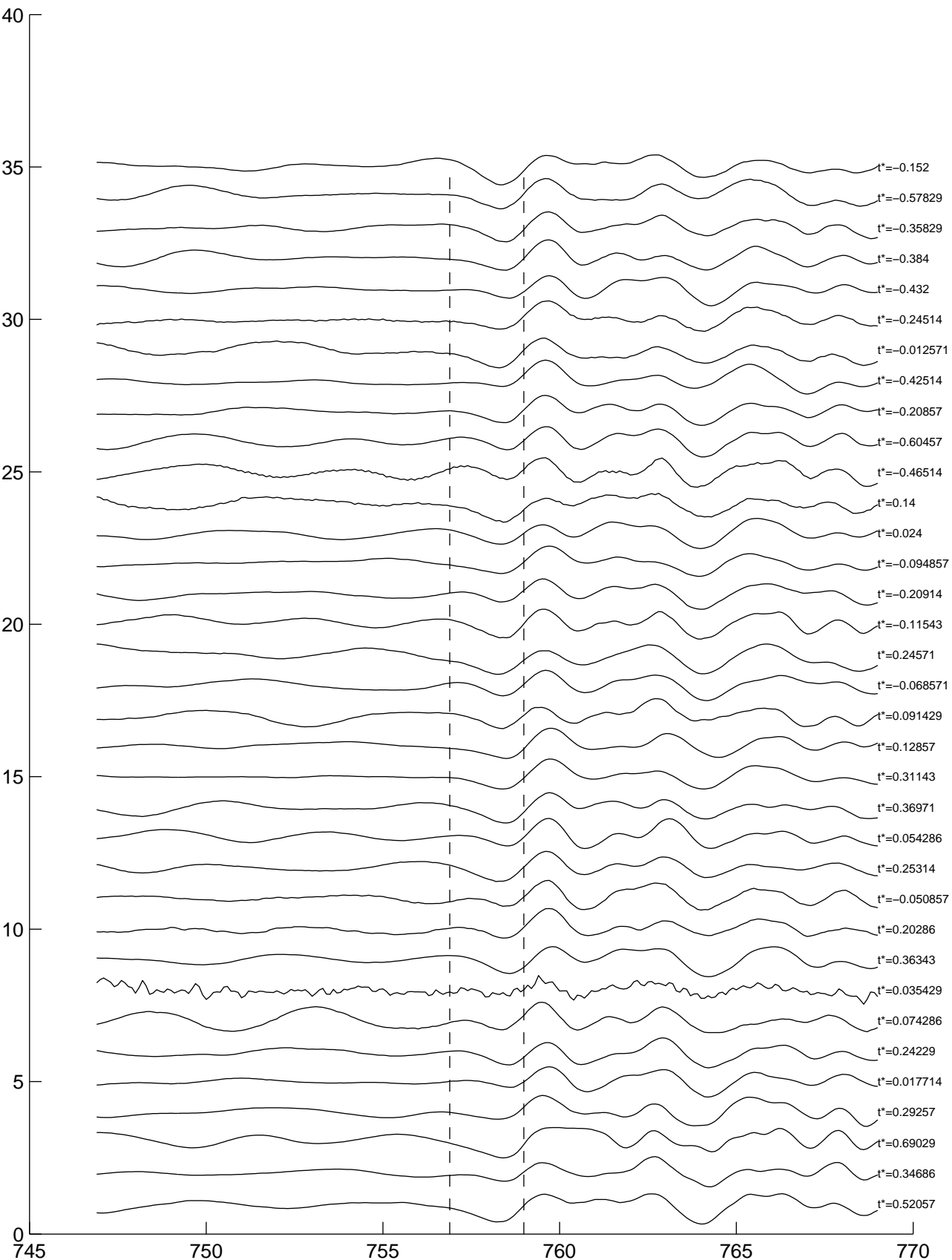


$t^*$  values

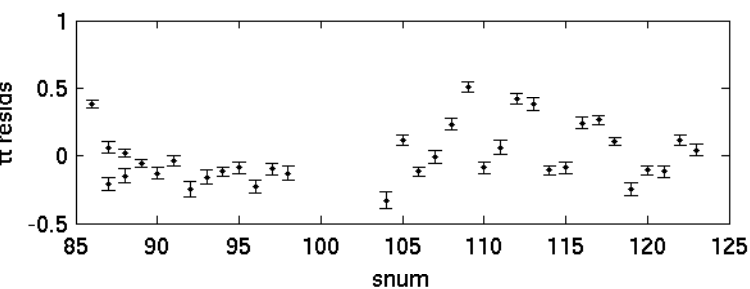
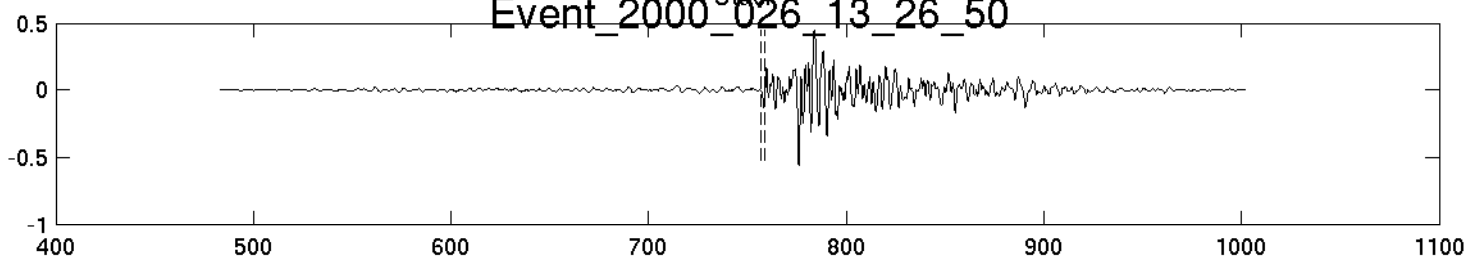




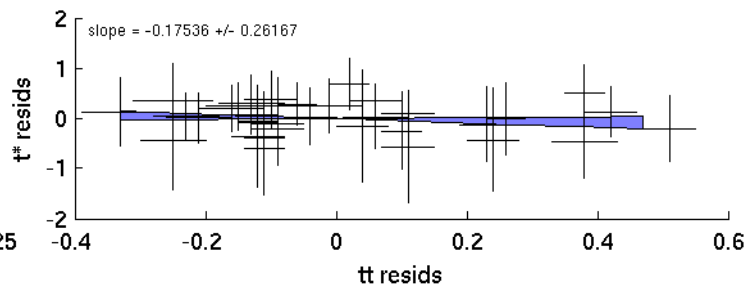
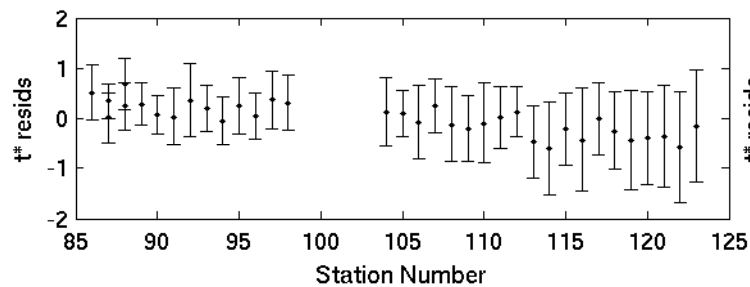
# Event\_2000\_026\_13\_26\_50



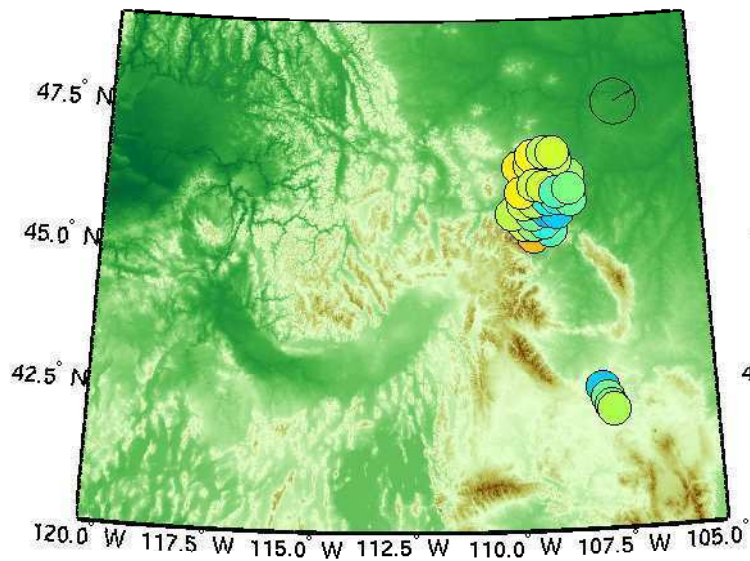
# Event\_2000\_026\_13\_26\_50



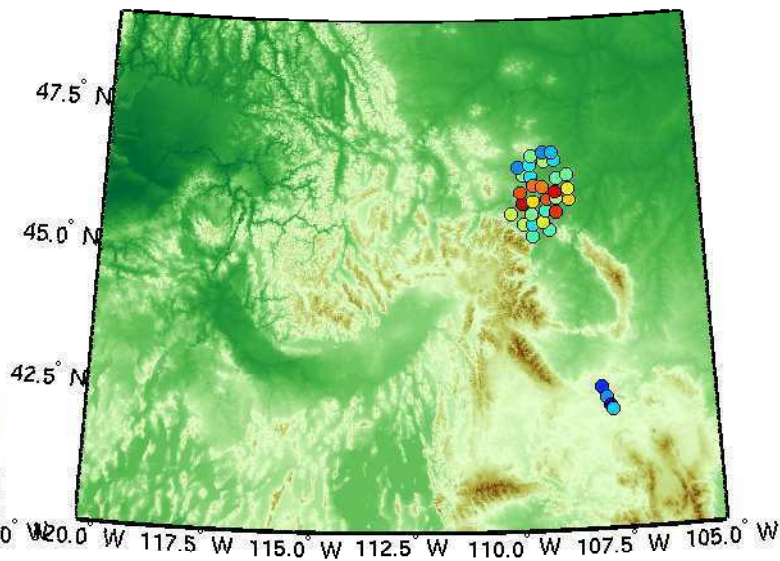
Baz = 240.3335  
 Mean xcor value = 0.83029  
 Range of  $t^*$  values is 1.2949  
 Median  $t^*$  err is 0.62321



travel time residuals

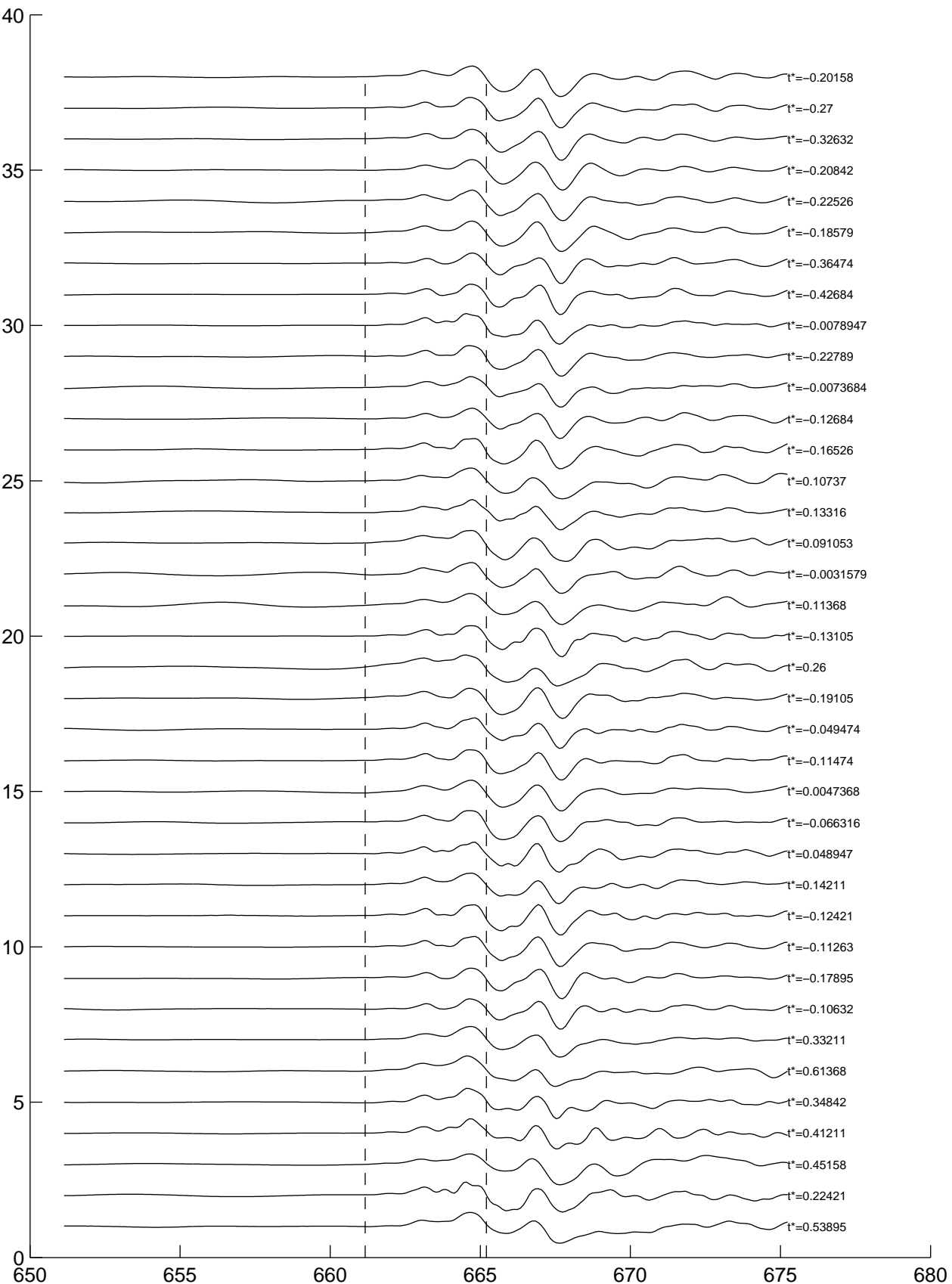


$t^*$  values

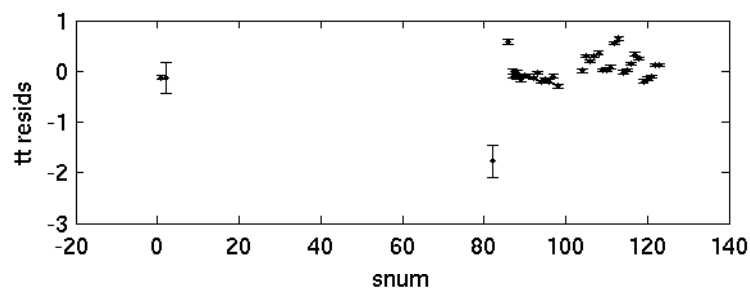
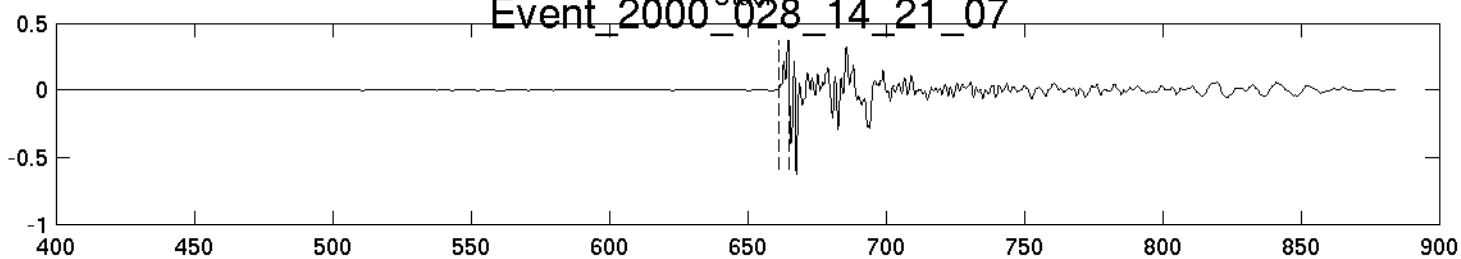




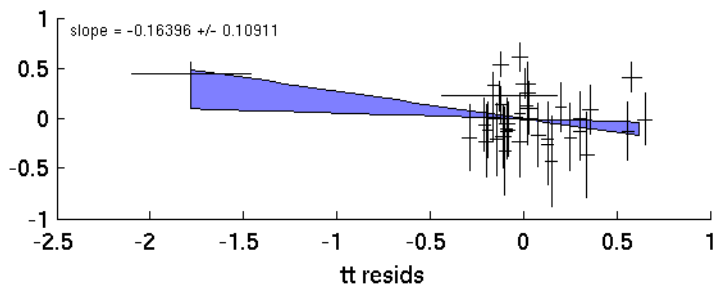
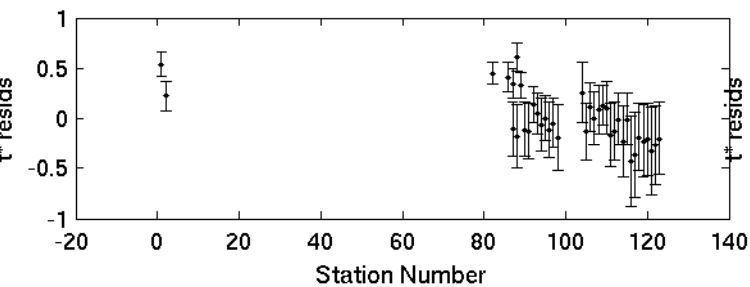
# Event\_2000\_028\_14\_21\_07



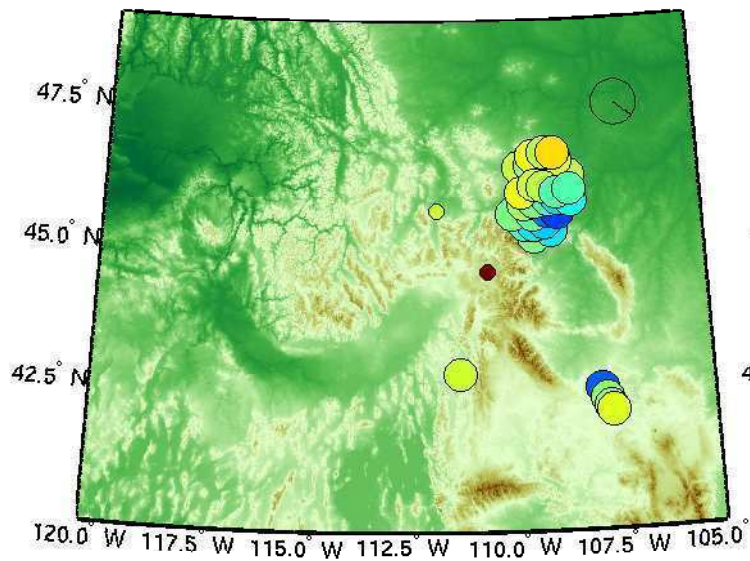
# Event 2000\_028\_14\_21\_07



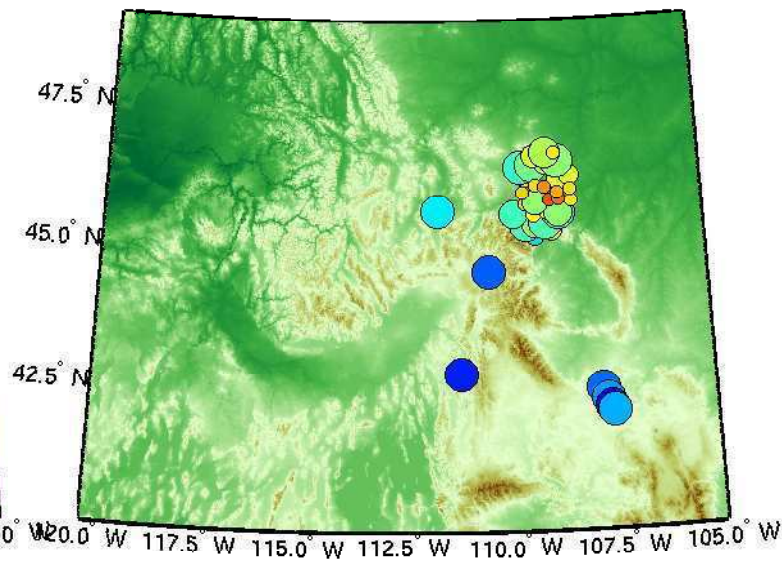
Baz = 310.5587  
 Mean xcor value = 0.86921  
 Range of  $t^*$  values is 1.0405  
 Median  $t^*$  err is 0.27077



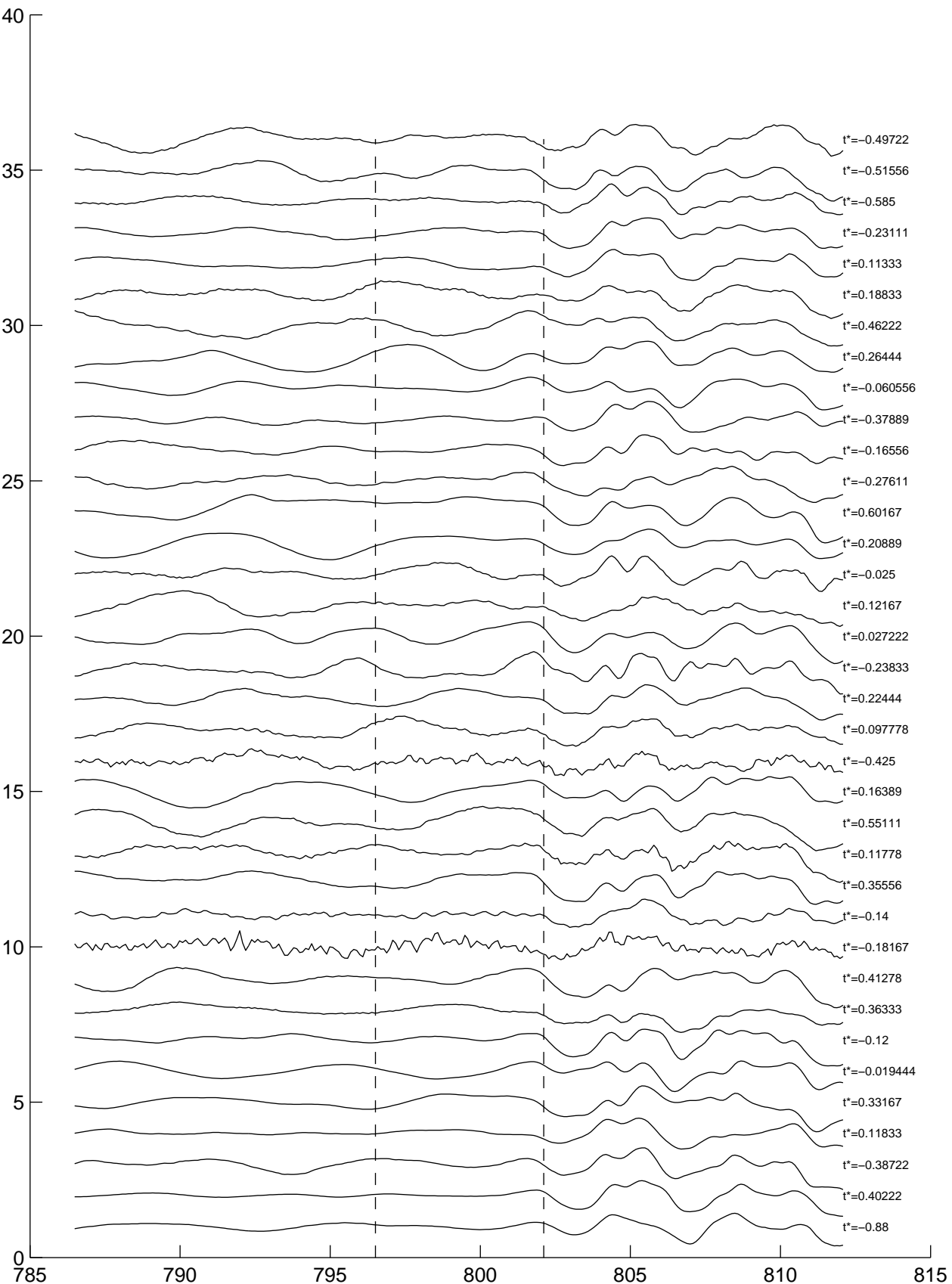
travel time residuals



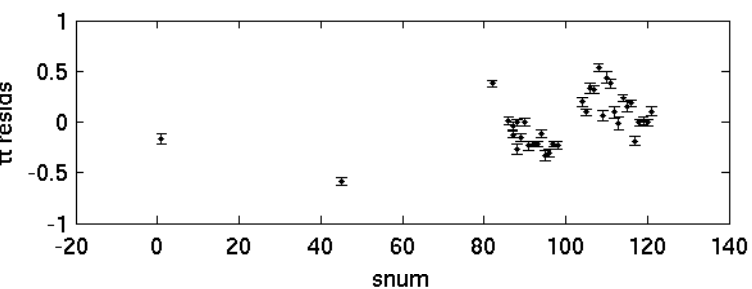
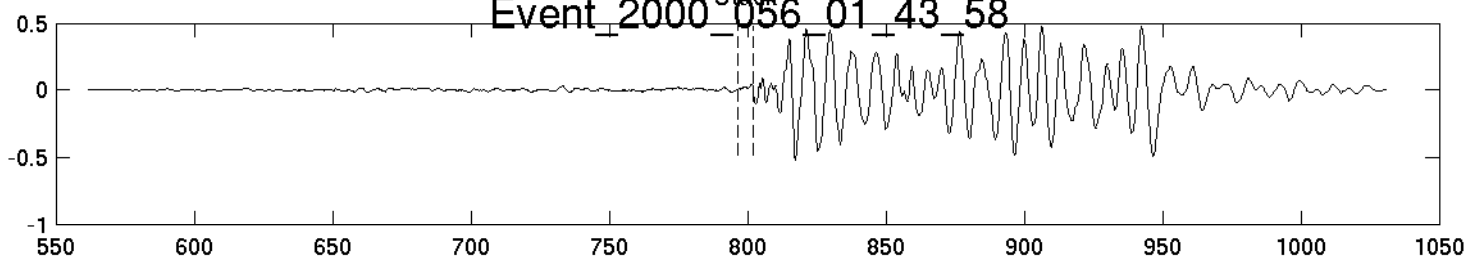
$t^*$  values



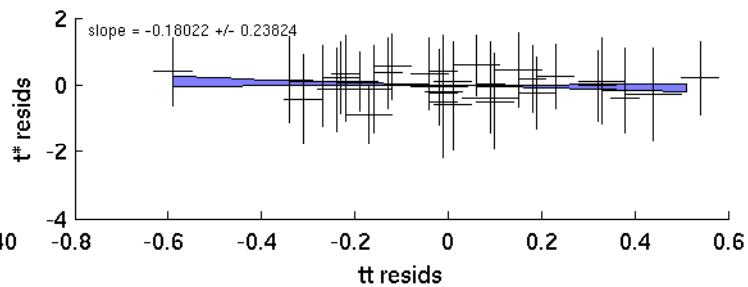
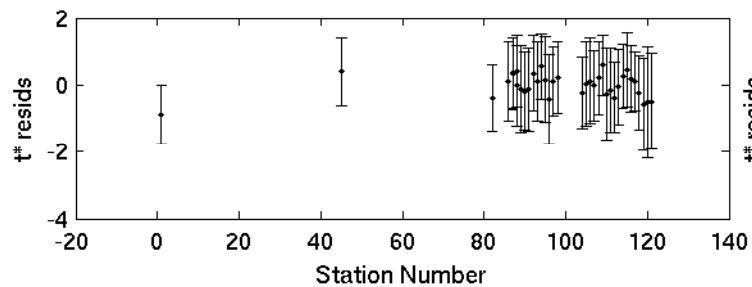
# Event\_2000\_056\_01\_43\_58



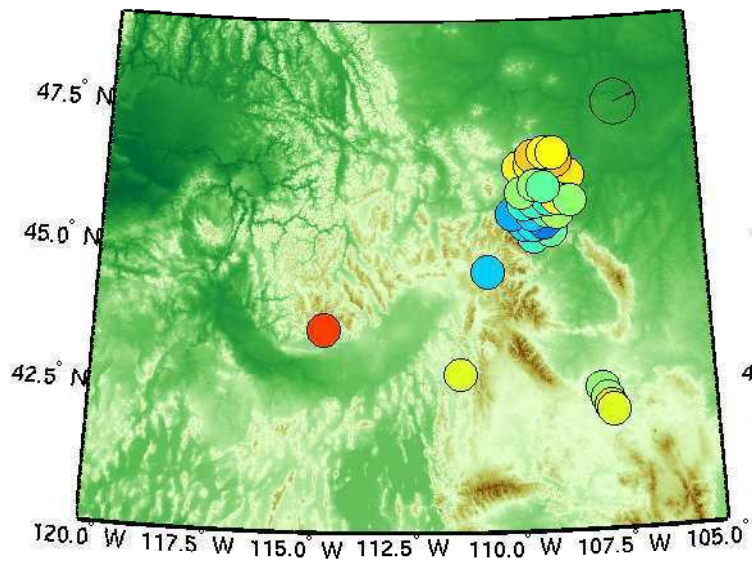
# Event 2000\_056\_01\_43\_58



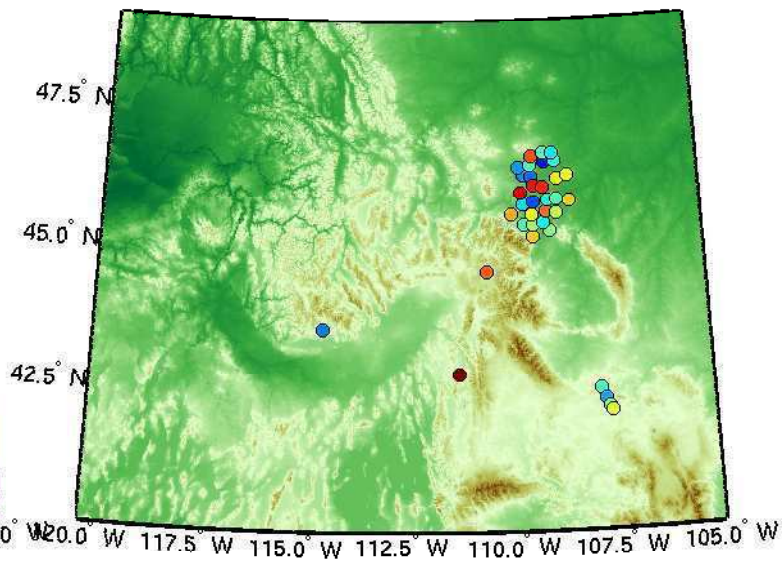
Baz = 247.3116  
 Mean xcor value = 0.86639  
 Range of  $t^*$  values is 1.4817  
 Median  $t^*$  err is 1.1112



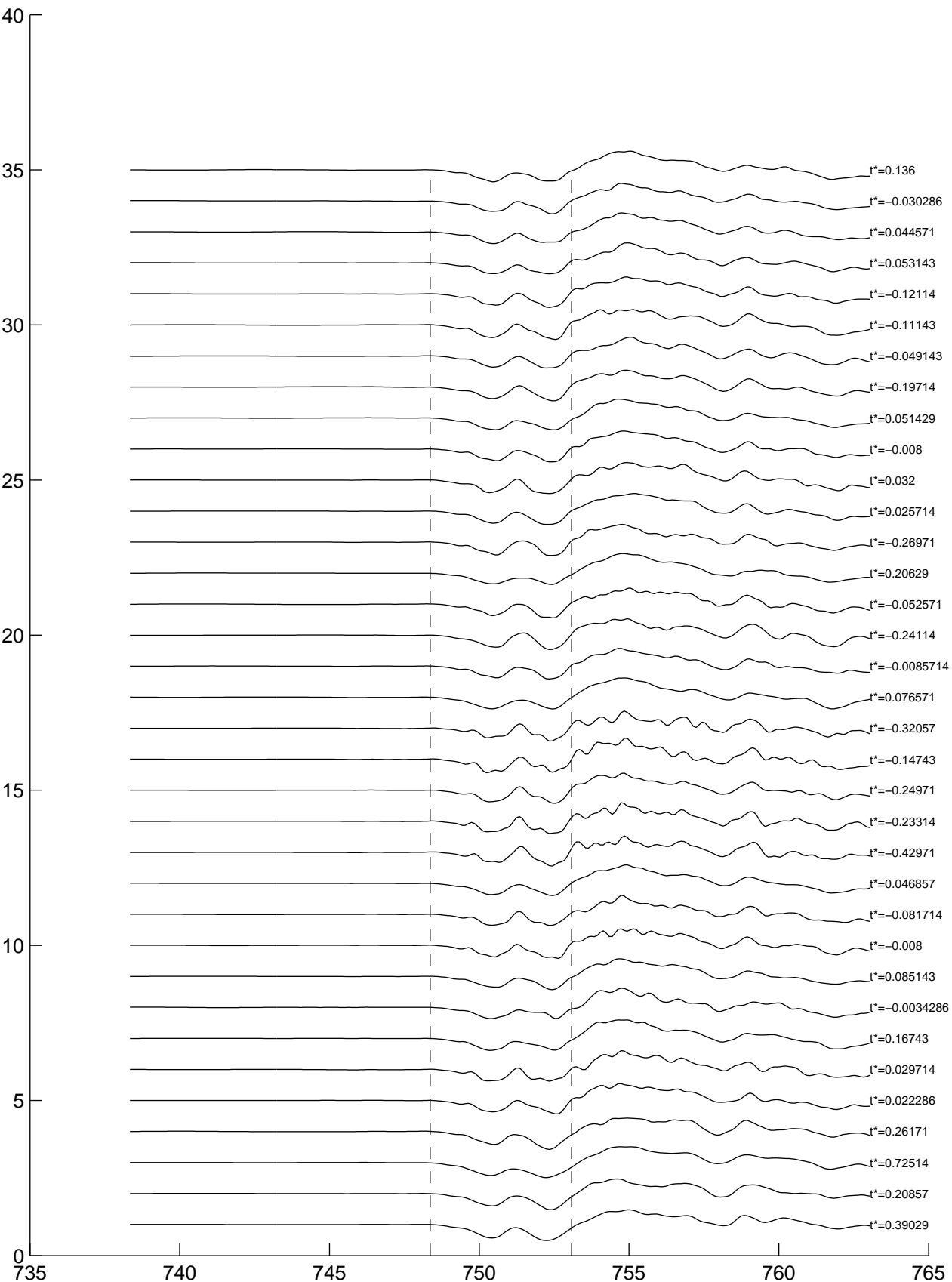
travel time residuals



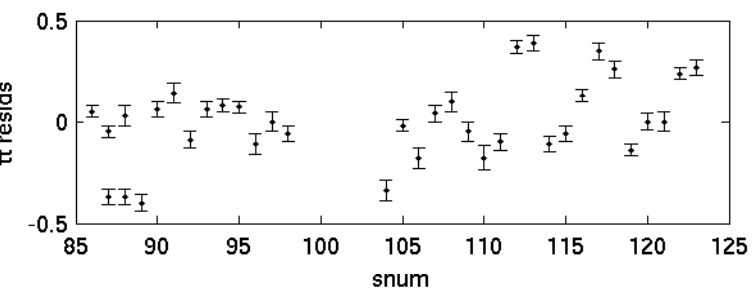
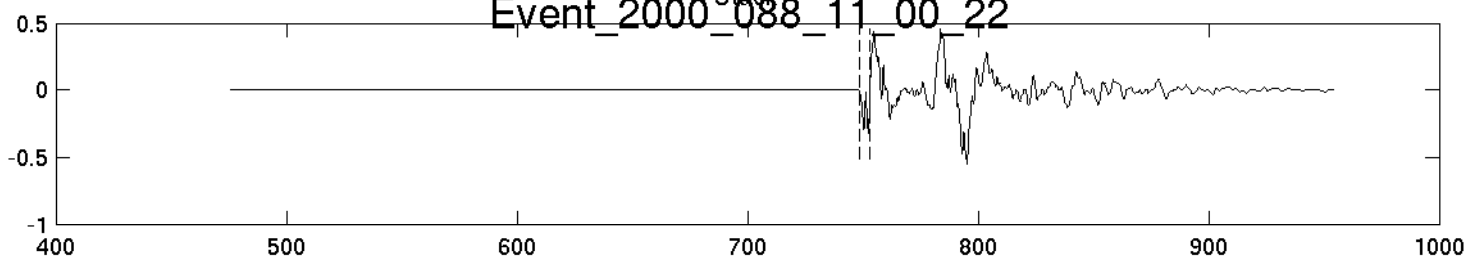
$t^*$  values



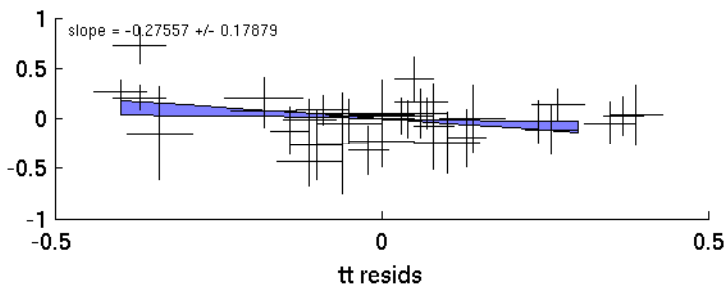
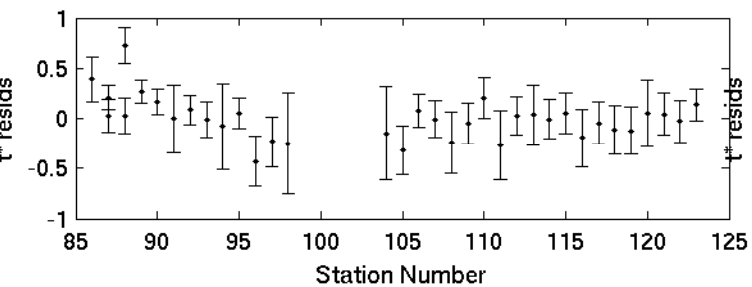
# Event\_2000\_088\_11\_00\_22



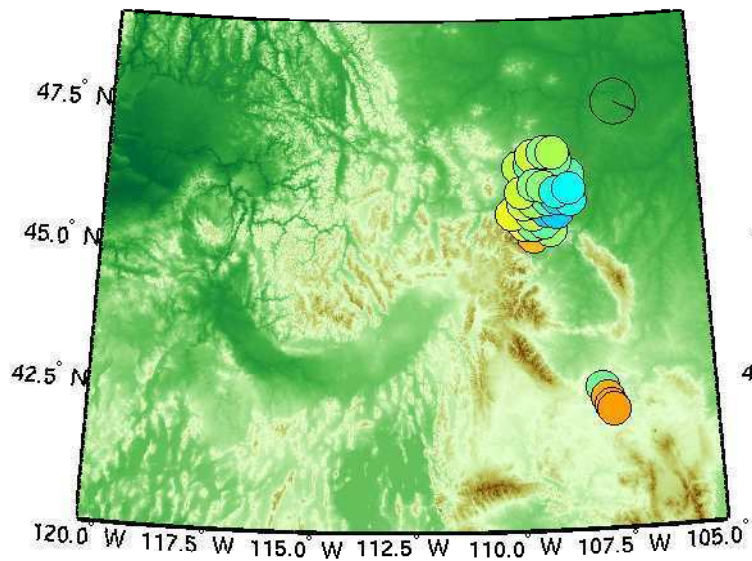
# Event\_2000\_088\_11\_00\_22



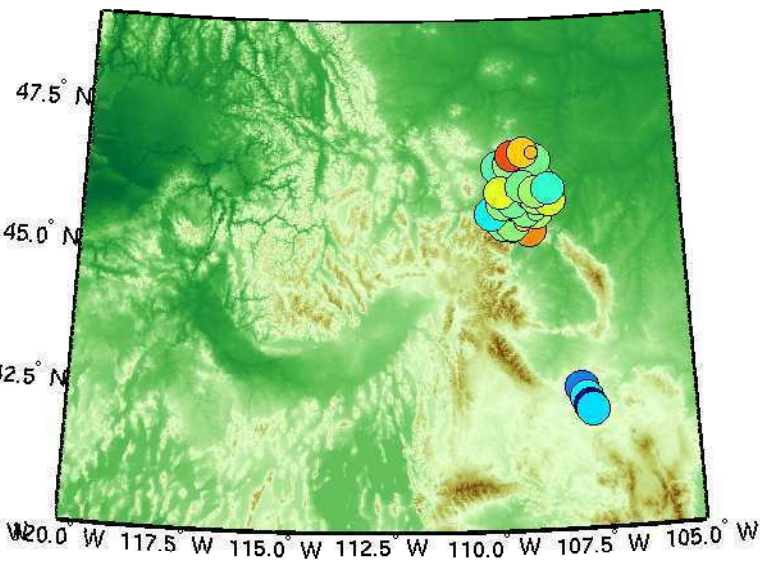
Baz = 297.7514  
Mean xcor value = 0.94429  
Range of t\* values is 1.1549  
Median t\* err is 0.20569



travel time residuals

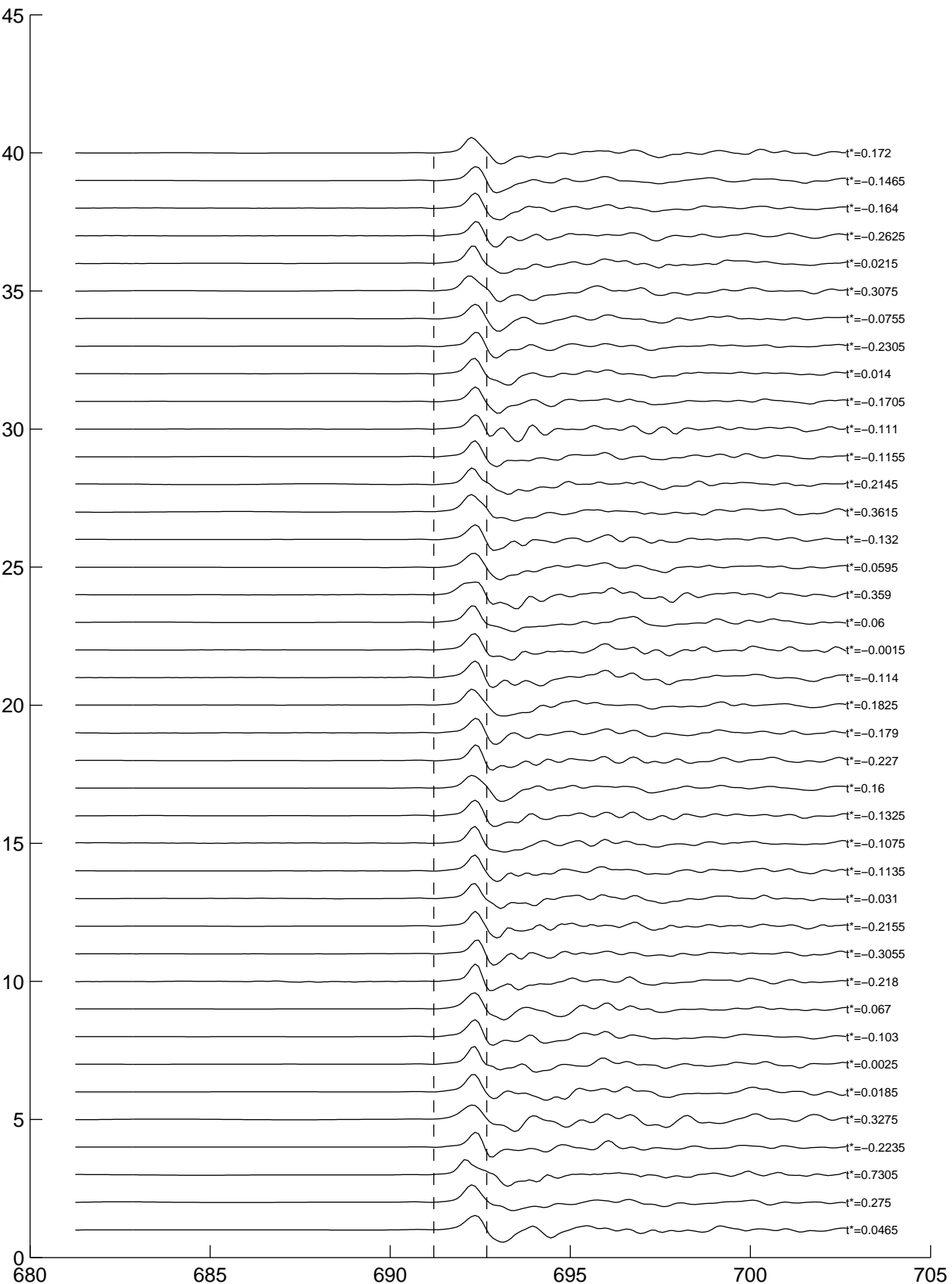


t\* values

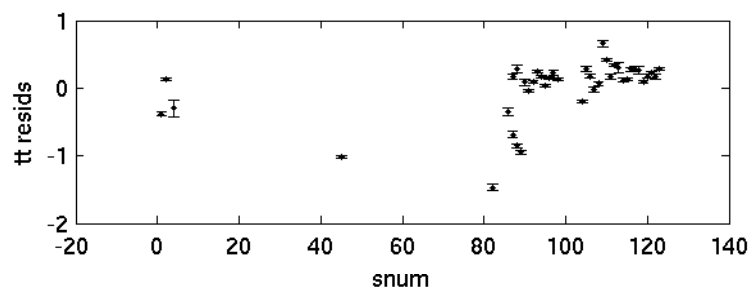
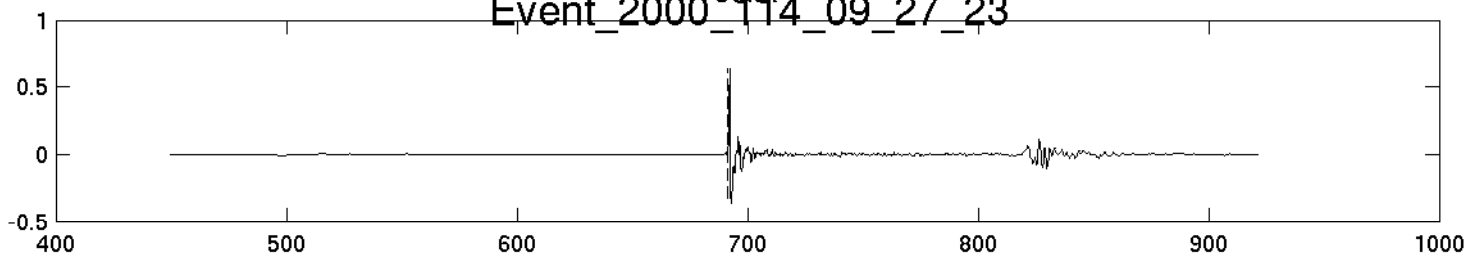




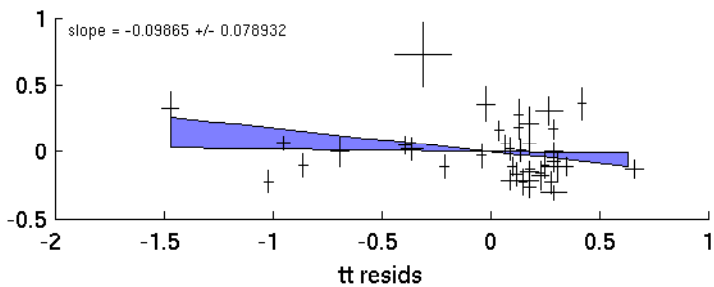
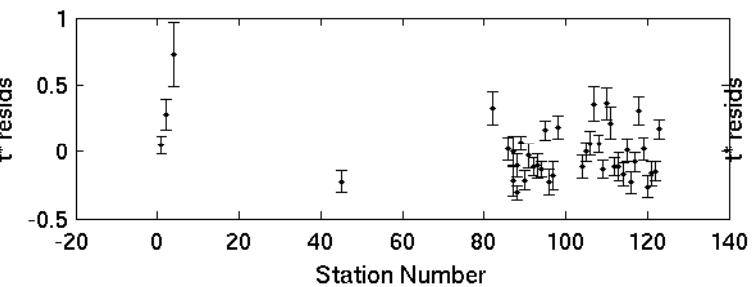
# Event\_2000\_114\_09\_27\_23



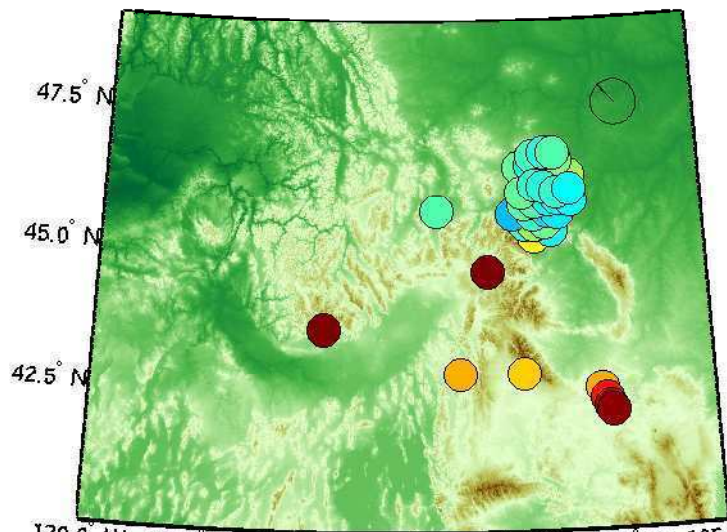
# Event\_2000\_114\_09\_27\_23<sup>Stack</sup>



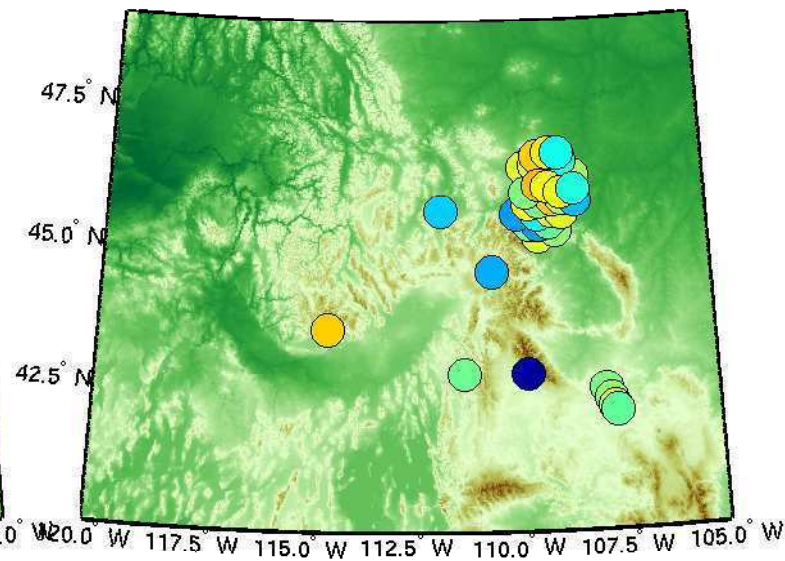
Baz = 140.3919  
Mean xcor value = 0.768  
Range of  $t^*$  values is 1.036  
Median  $t^*$  err is 0.08509



travel time residuals

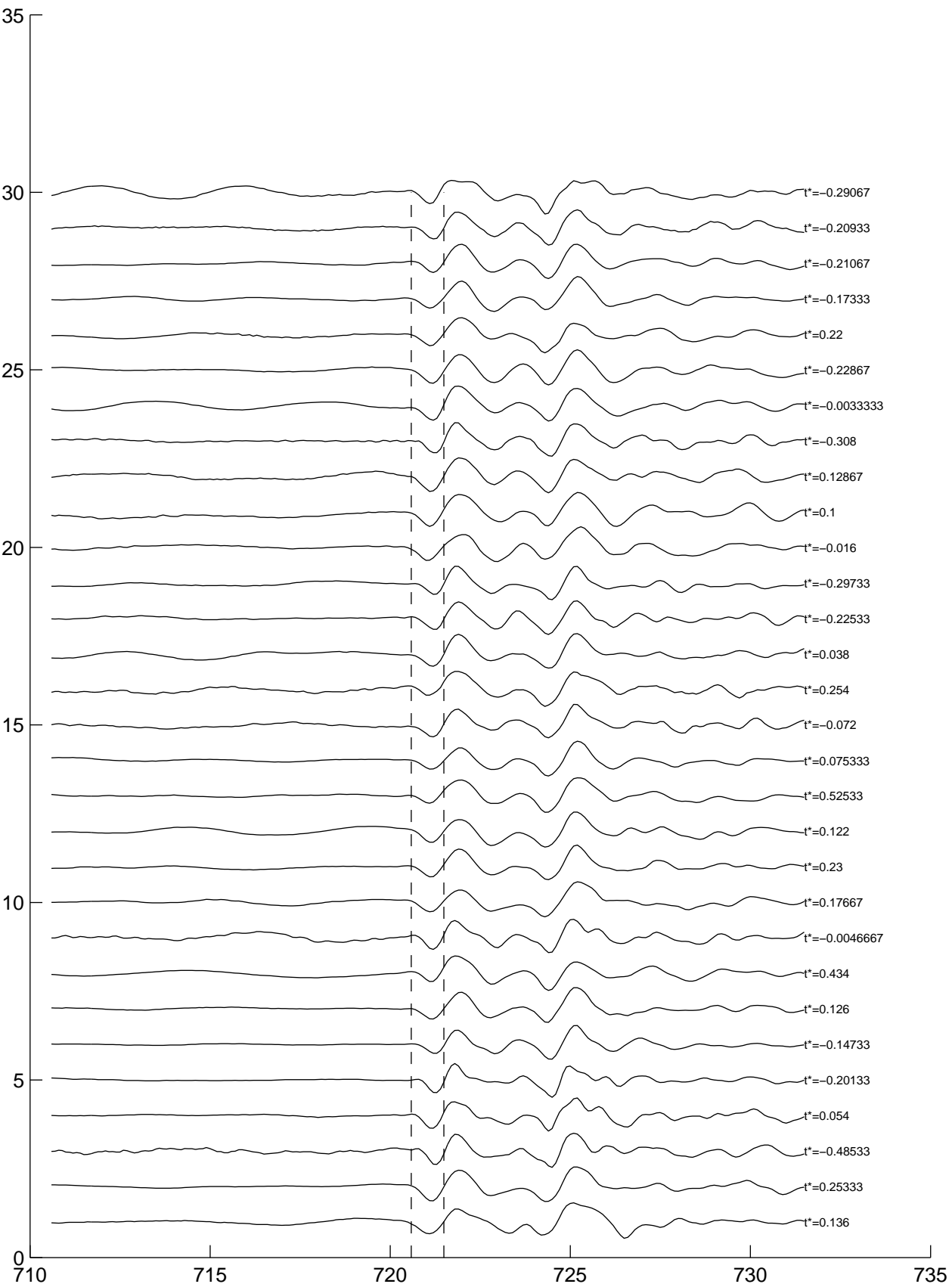


$t^*$  values

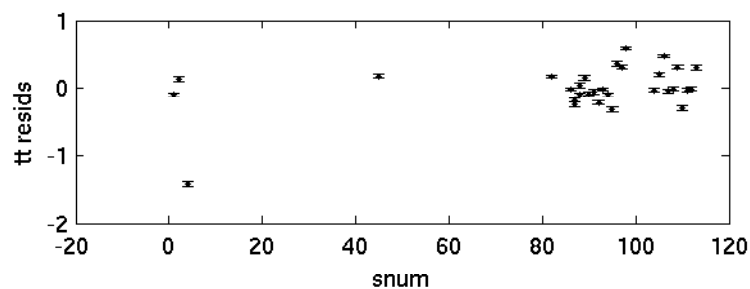
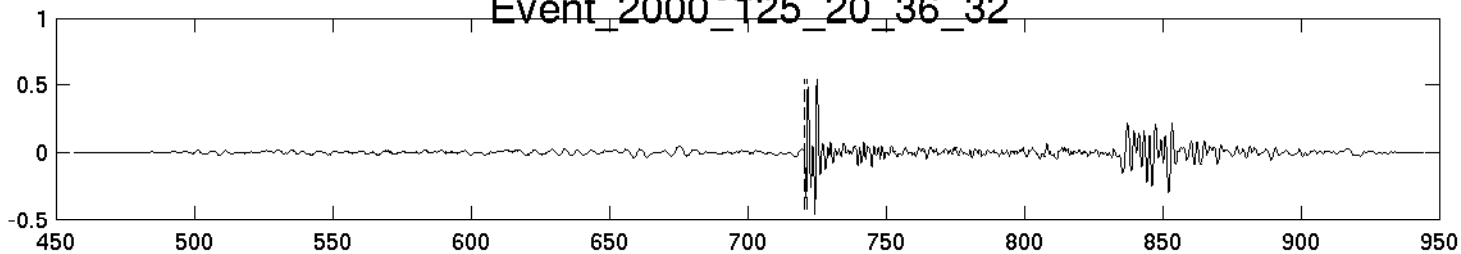




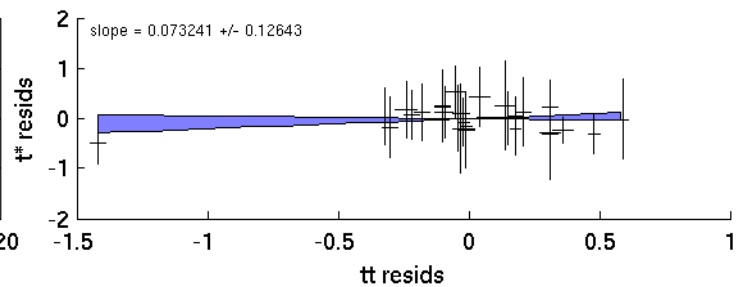
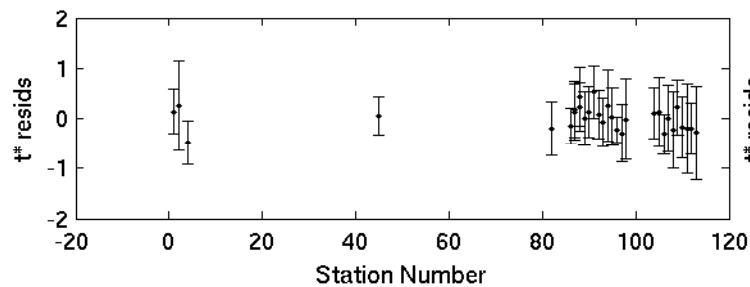
# Event\_2000\_125\_20\_36\_32



# Event\_2000\_125\_20\_36\_32

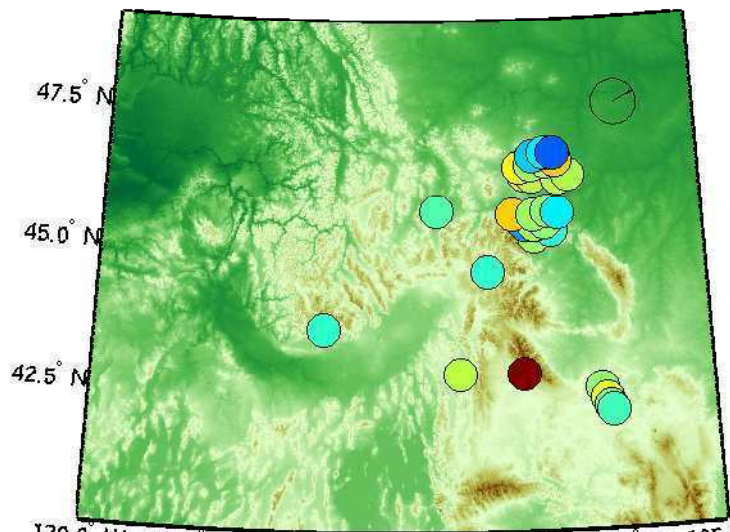


Baz = 242.9745  
 Mean xcor value = 0.68367  
 Range of  $t^*$  values is 1.0107  
 Median  $t^*$  err is 0.54416

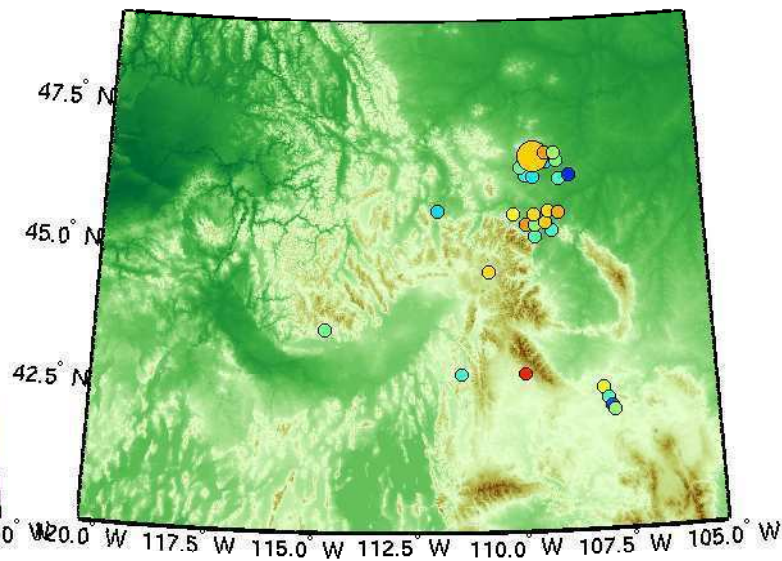


slope = 0.073241 +/- 0.12643

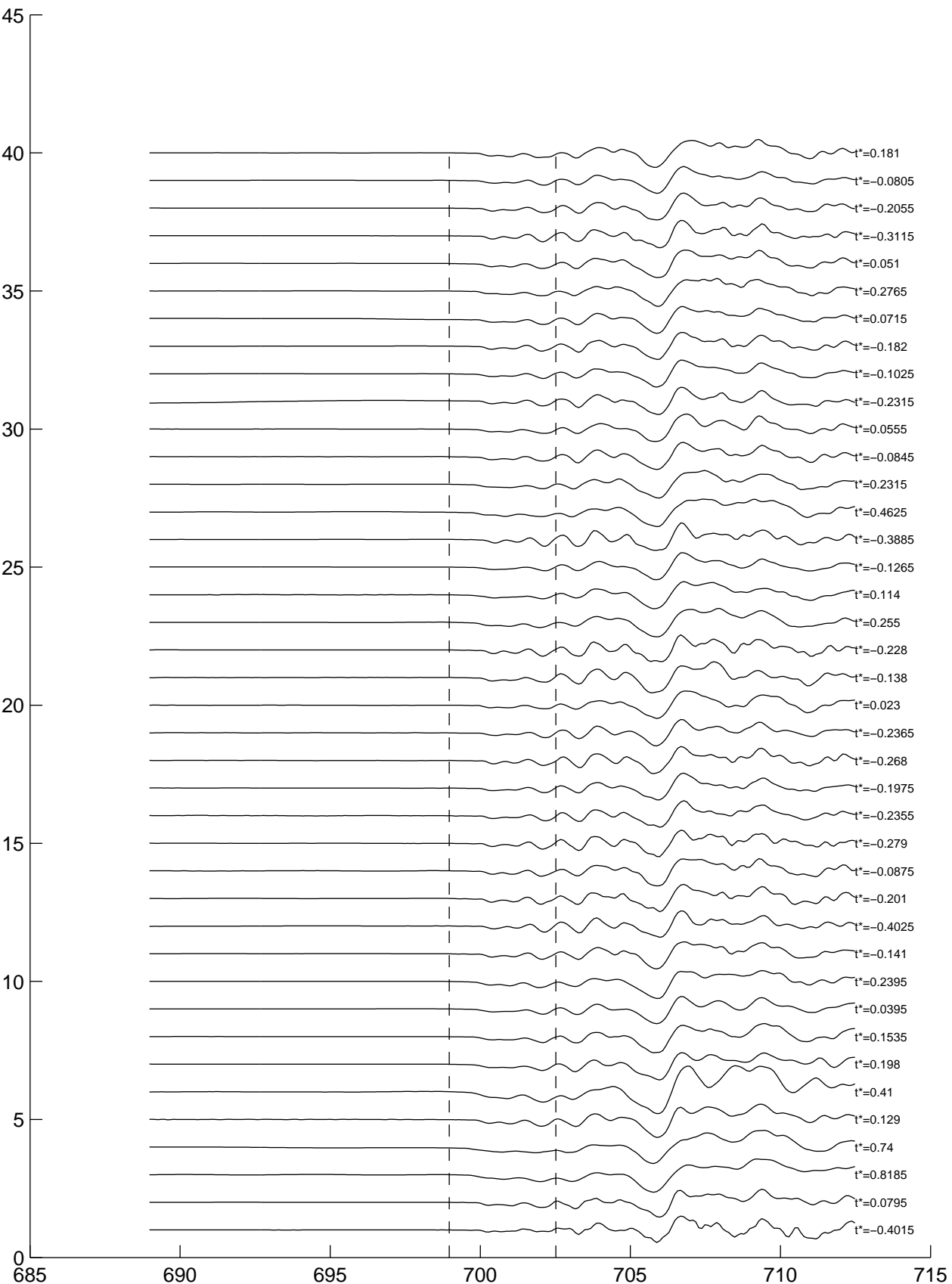
travel time residuals



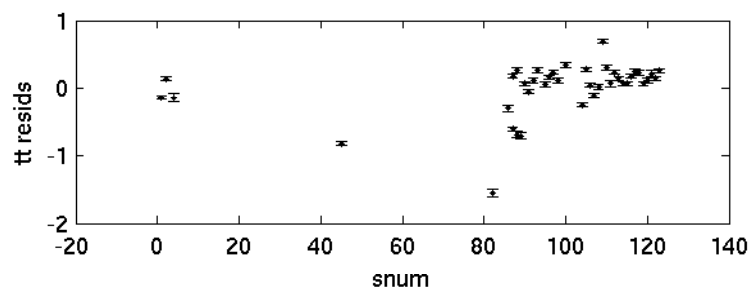
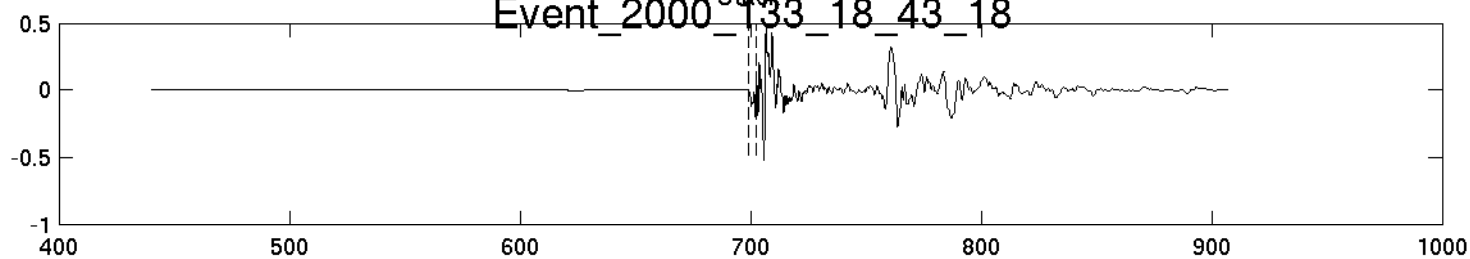
$t^*$  values



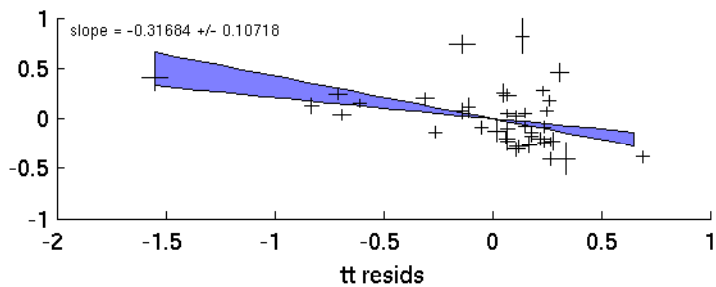
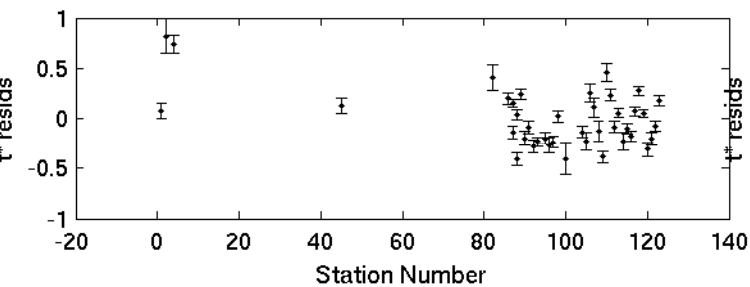
# Event\_2000\_133\_18\_43\_18



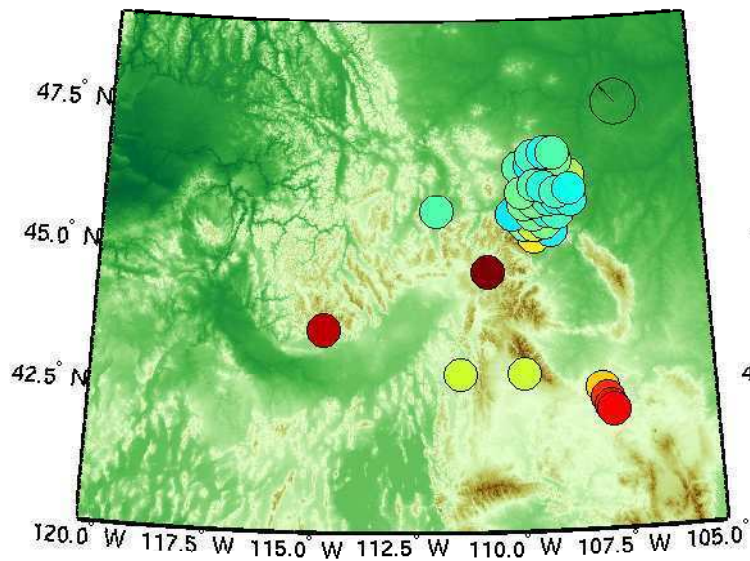
# Event\_2000\_133\_18\_43\_18



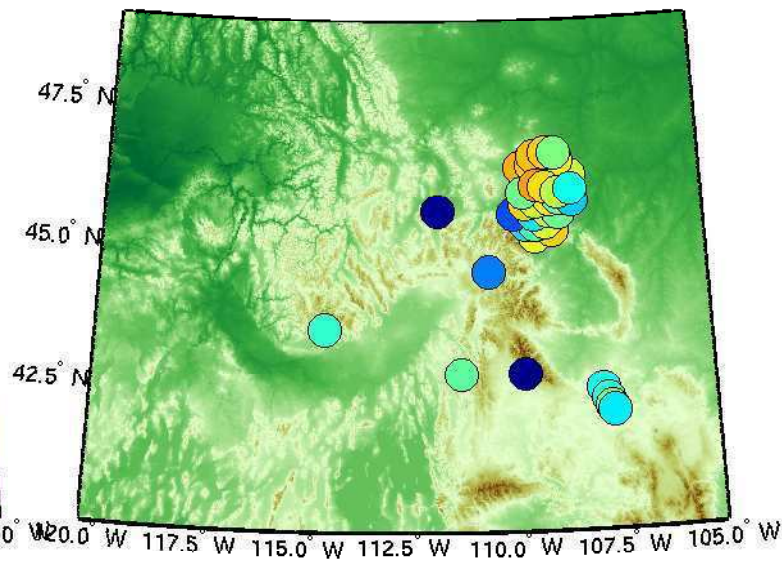
Baz = 140.7047  
 Mean xcor value = 0.8525  
 Range of  $t^*$  values is 1.221  
 Median  $t^*$  err is 0.061829



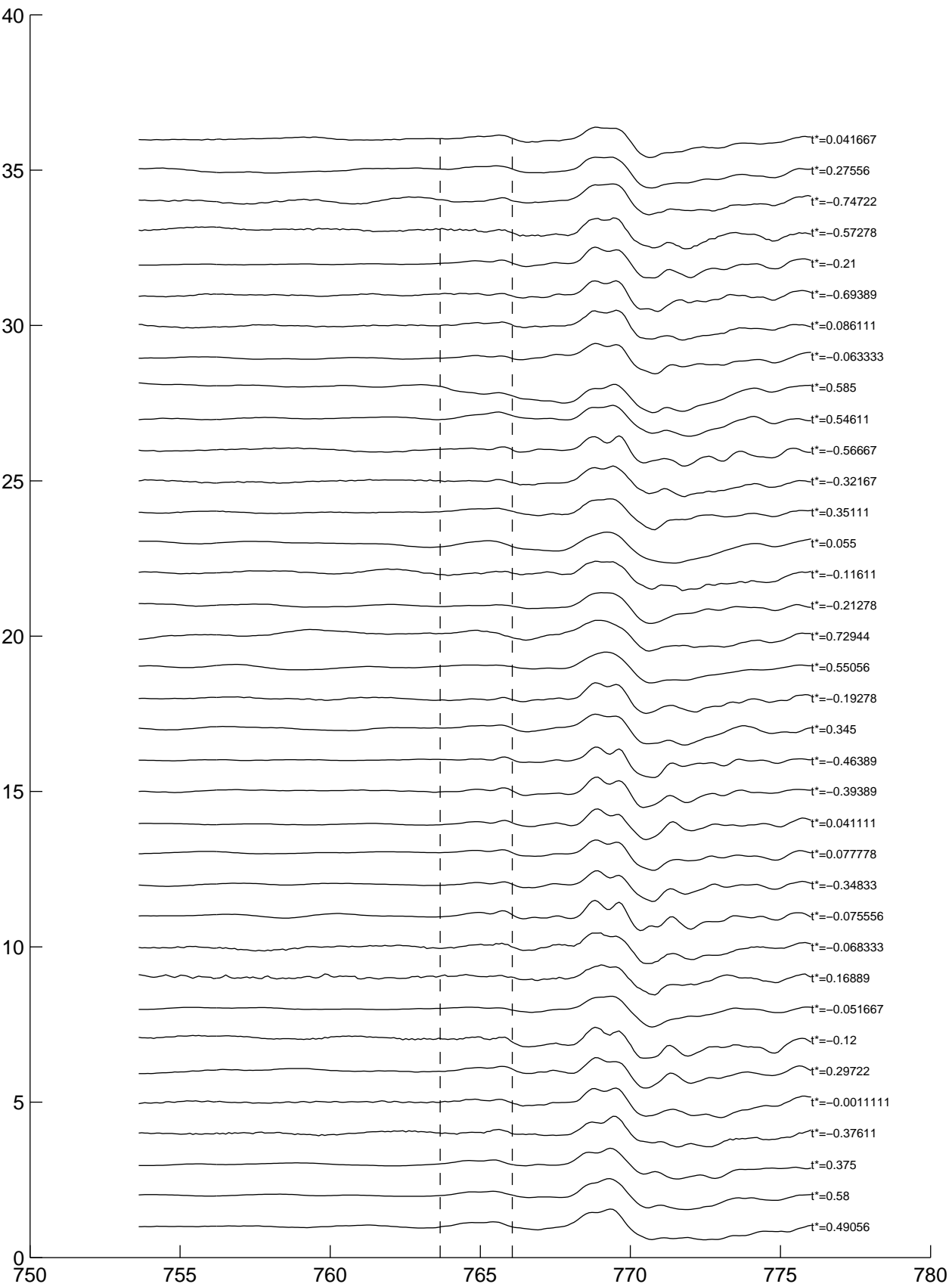
travel time residuals



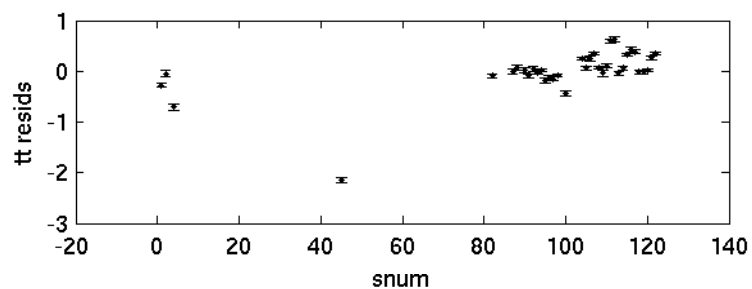
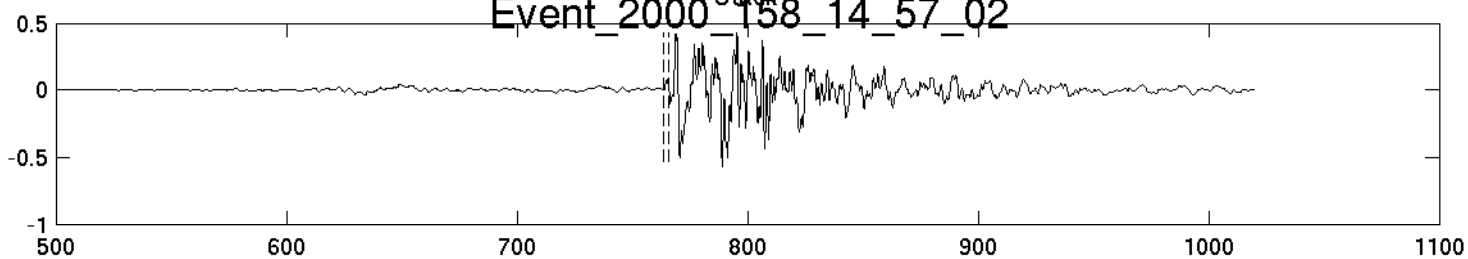
$t^*$  values



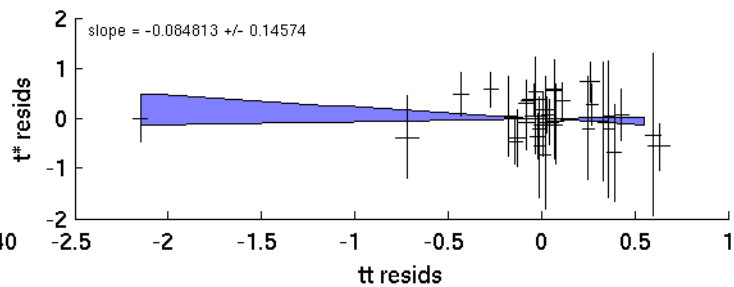
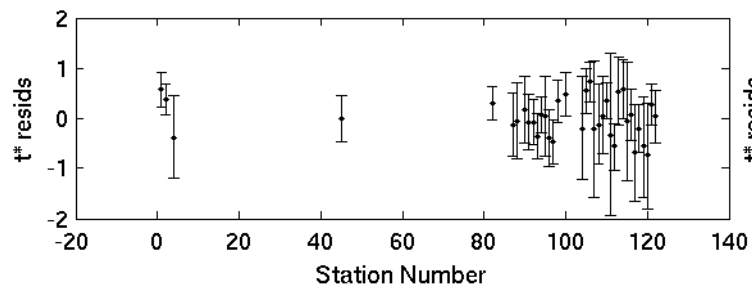
# Event\_2000\_158\_14\_57\_02



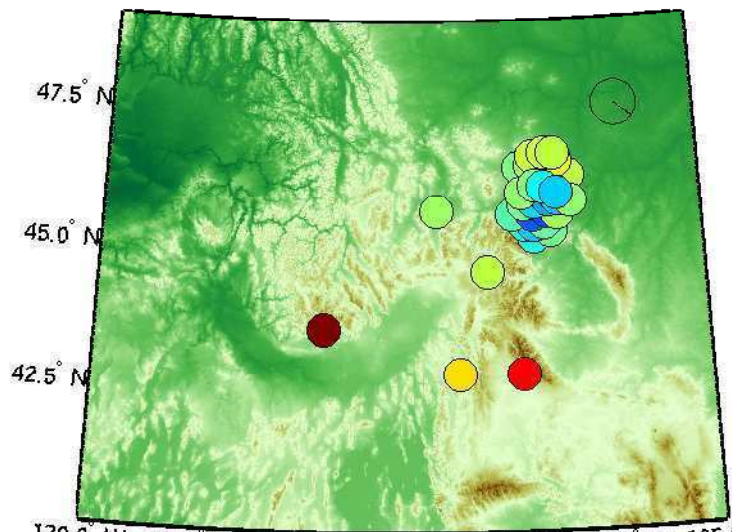
# Event\_2000\_158\_14\_57\_02



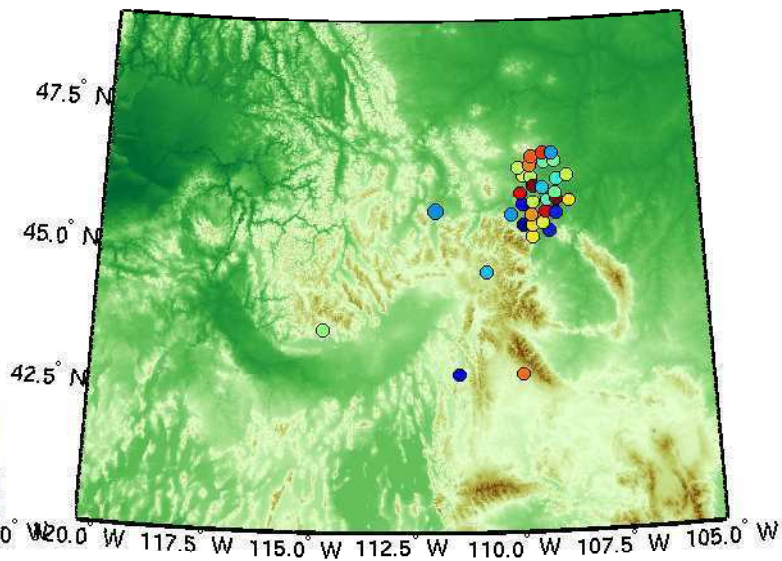
Baz = 310.4633  
 Mean xcor value = 0.83083  
 Range of  $t^*$  values is 1.4767  
 Median  $t^*$  err is 0.53925



travel time residuals

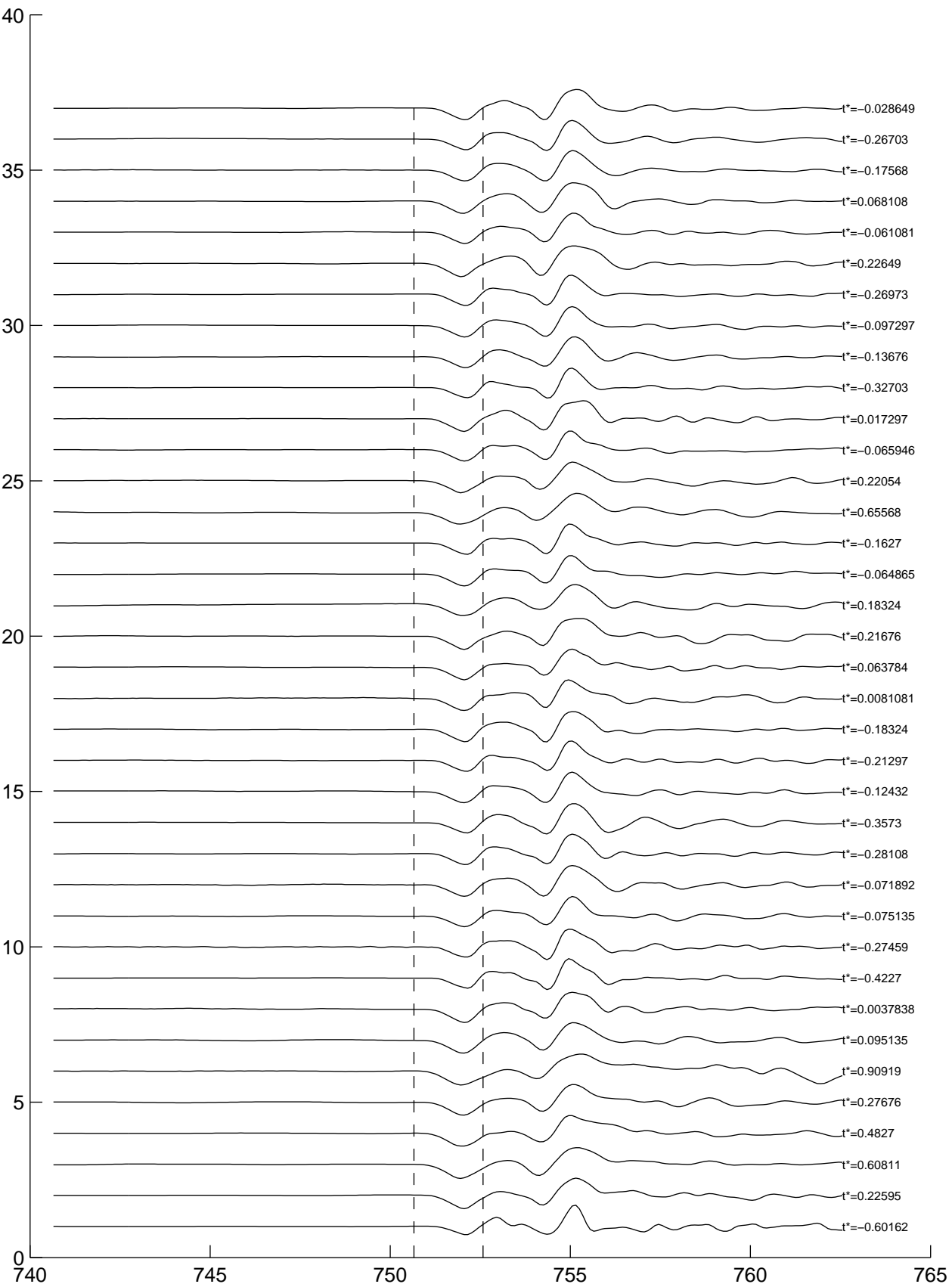


$t^*$  values

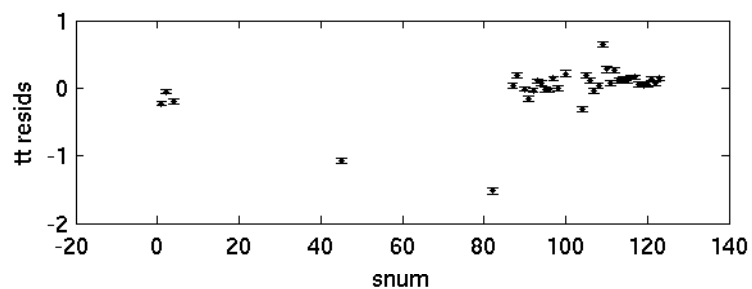
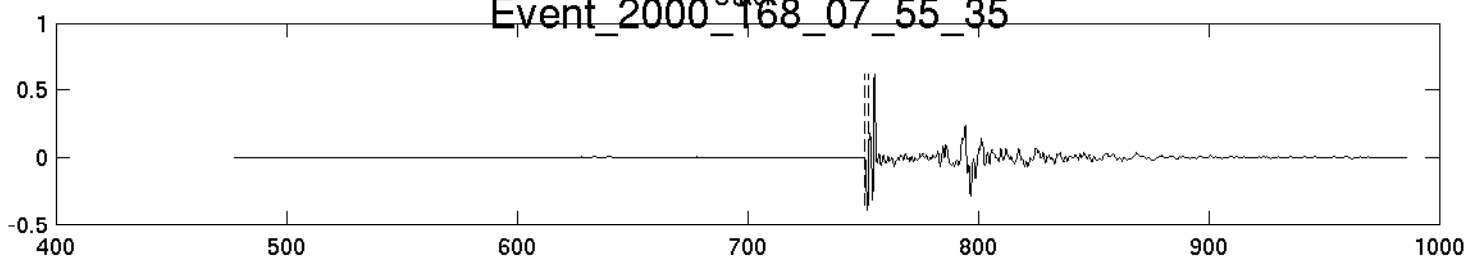




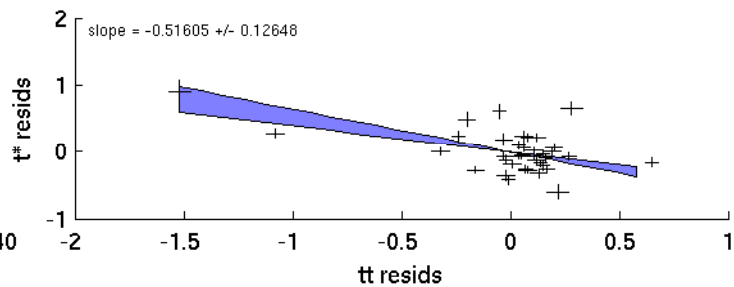
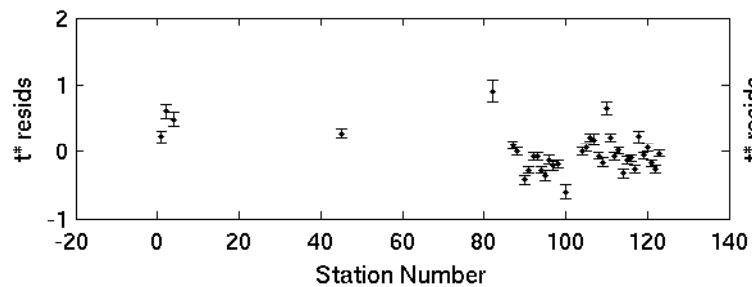
# Event\_2000\_168\_07\_55\_35



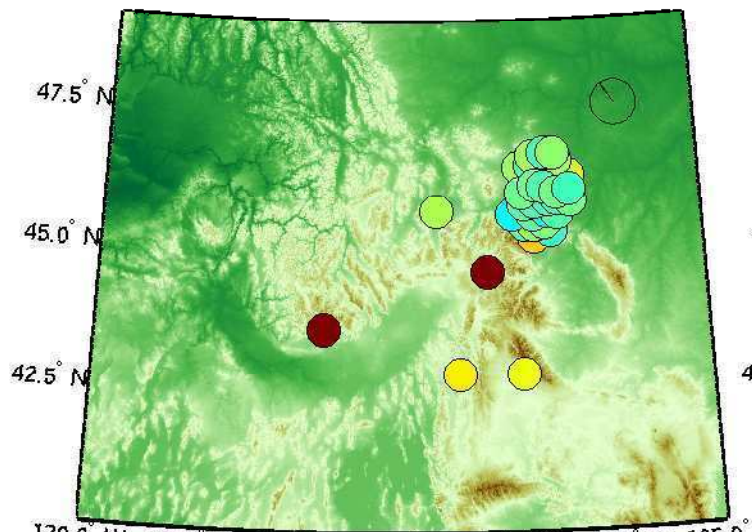
# Event\_2000\_168\_07\_55\_35



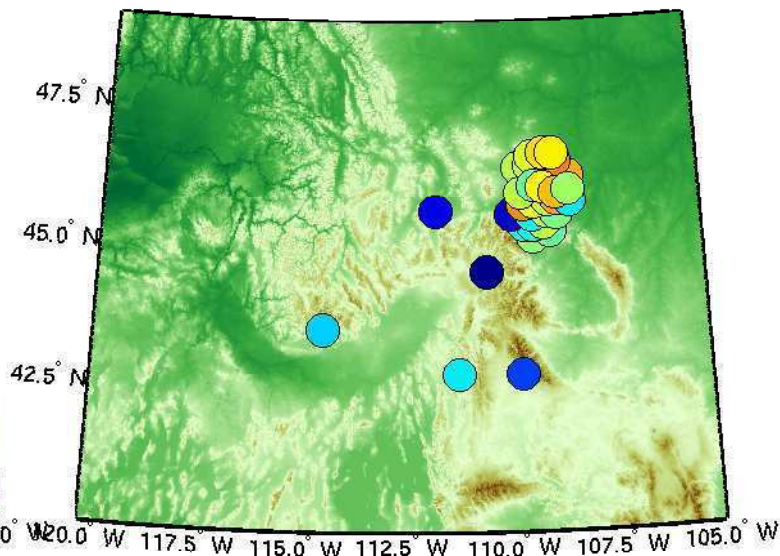
Baz = 148.2873  
Mean xcor value = 0.84757  
Range of  $t^*$  values is 1.5108  
Median  $t^*$  err is 0.06013



travel time residuals

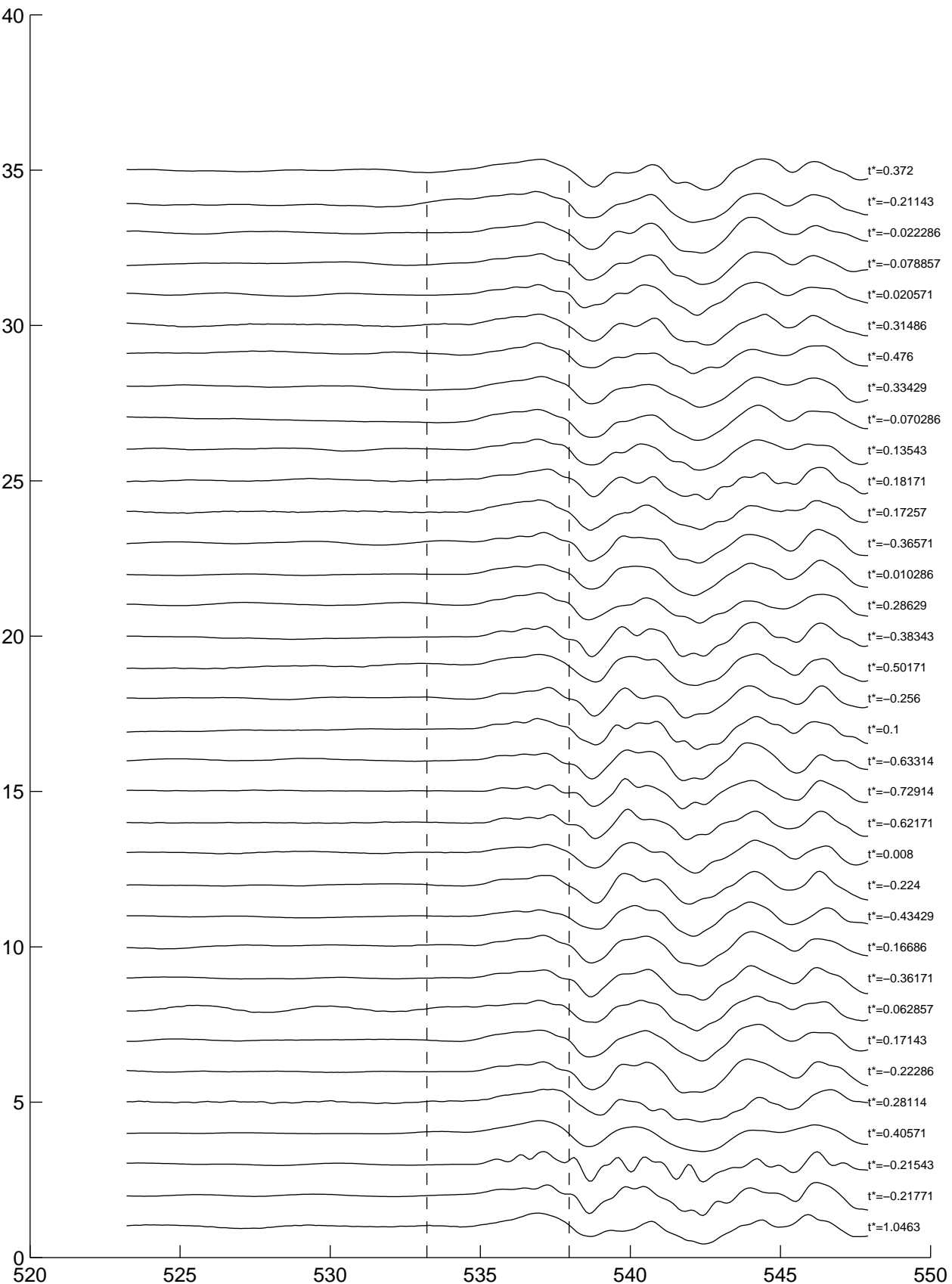


$t^*$  values

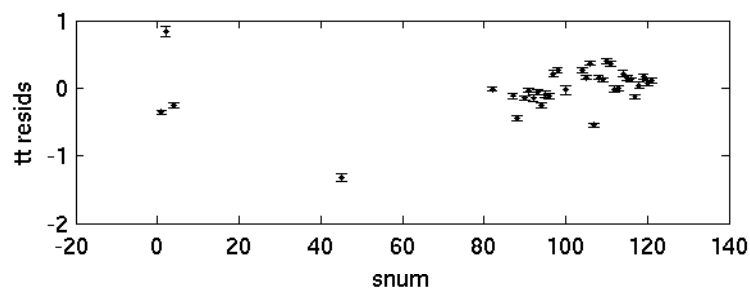
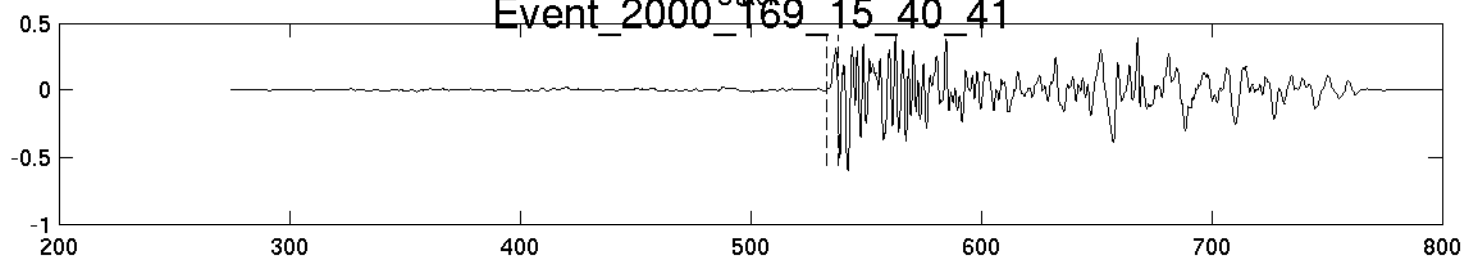




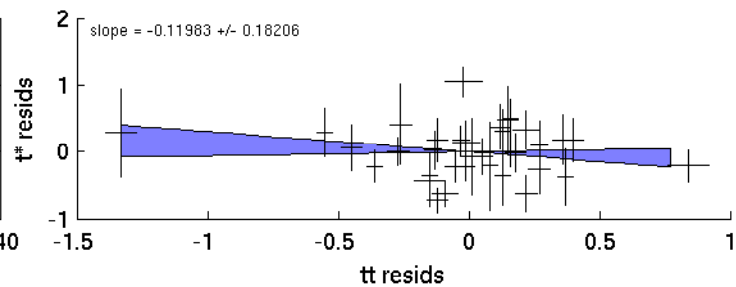
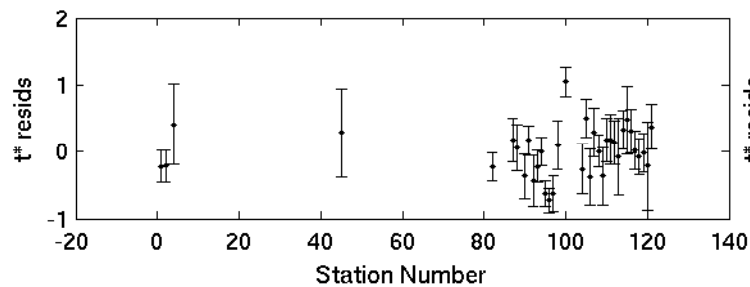
# Event\_2000\_169\_15\_40\_41



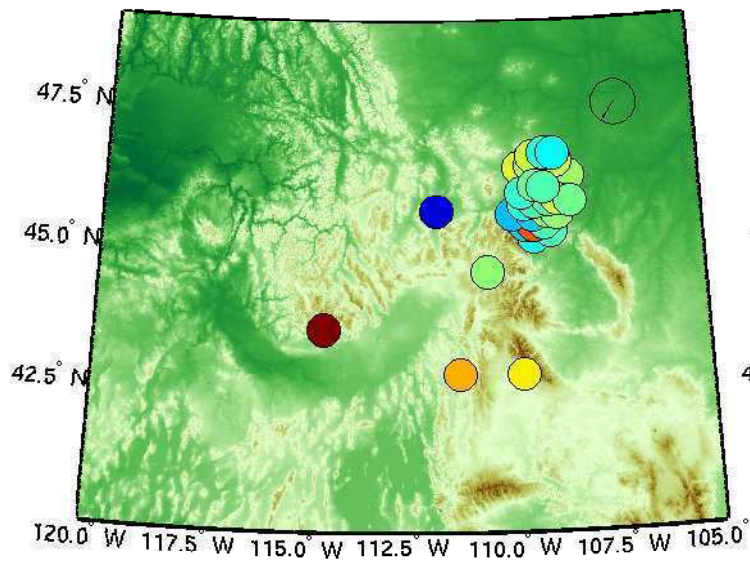
# Event\_2000\_169 15 40 41



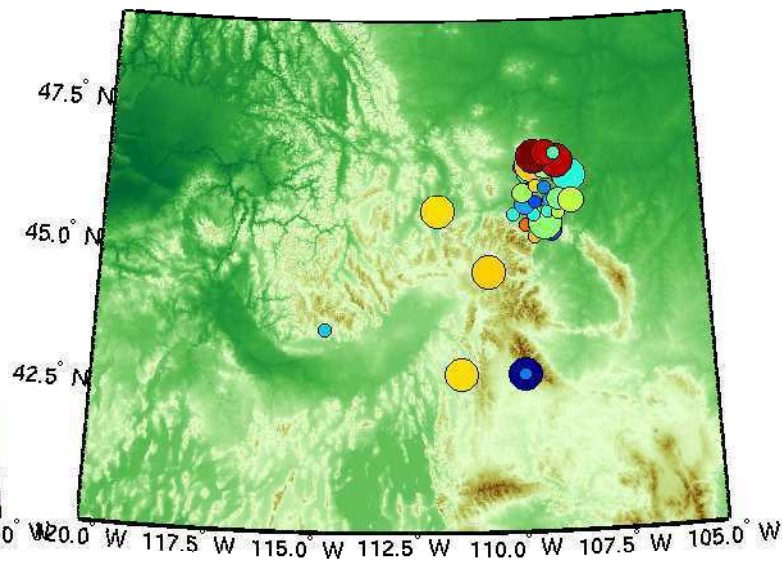
Baz = 35.1956  
 Mean xcor value = 0.81457  
 Range of  $t^*$  values is 1.7754  
 Median  $t^*$  err is 0.3255



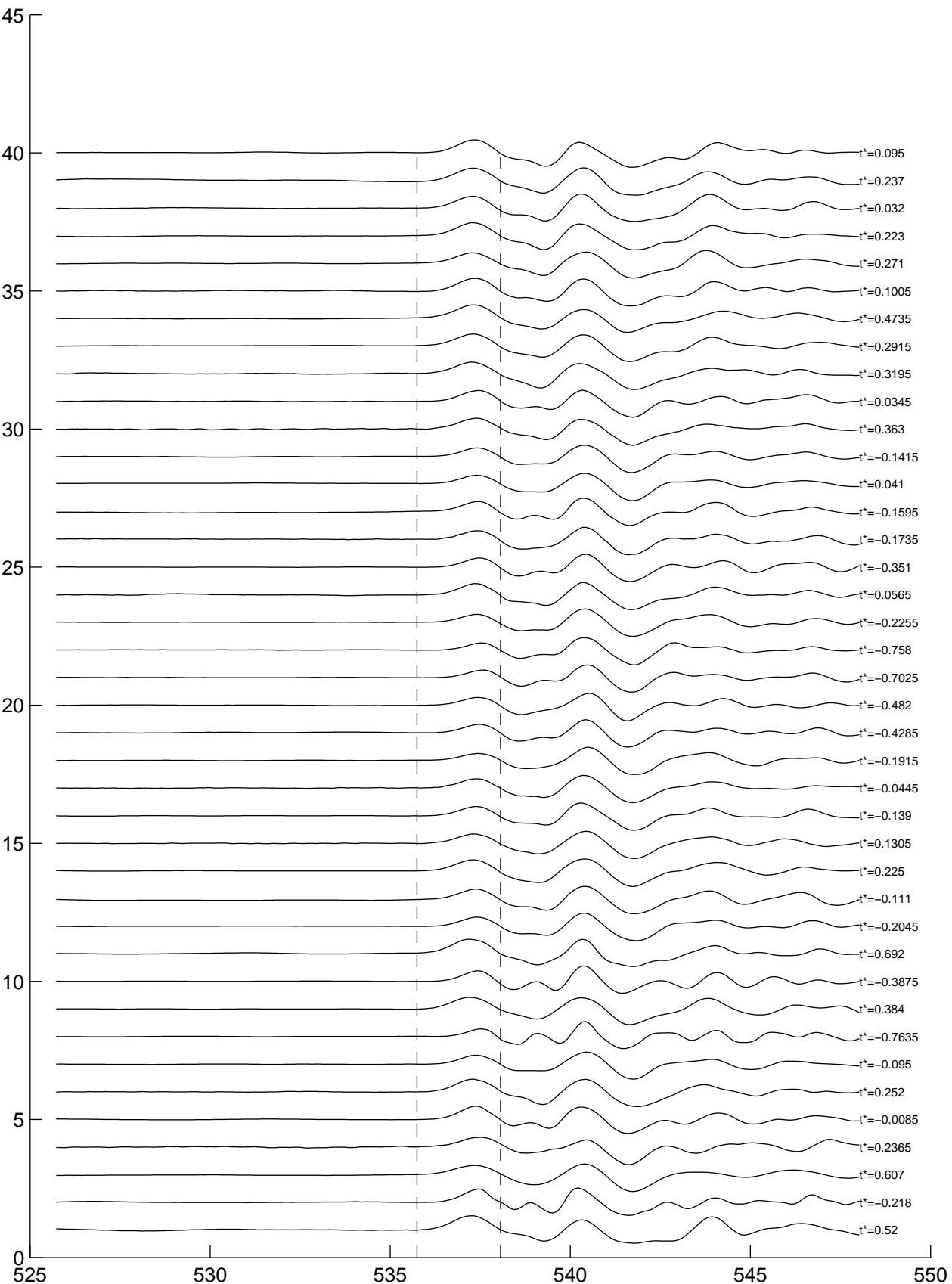
travel time residuals



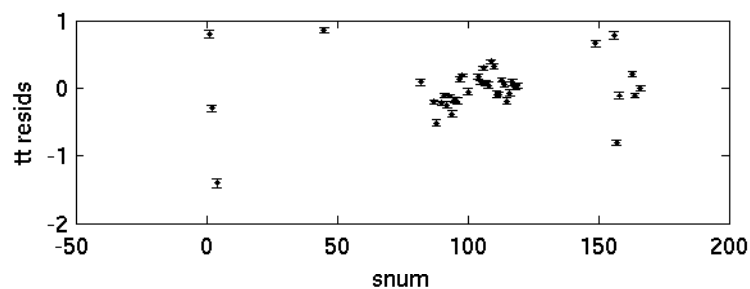
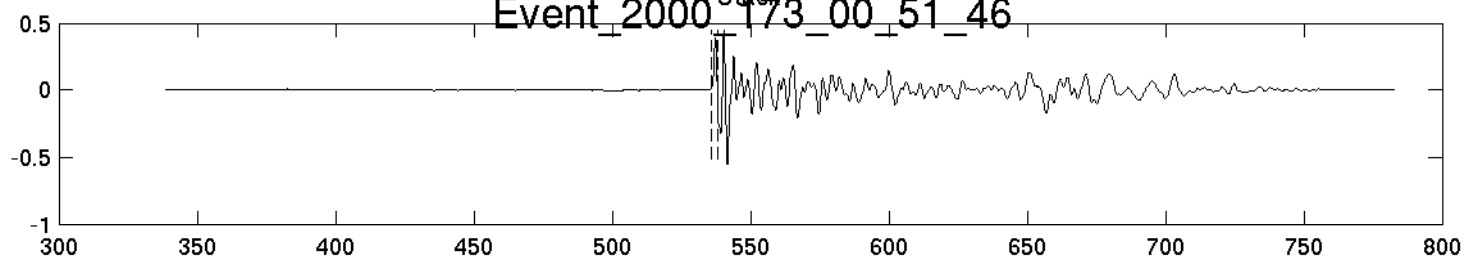
$t^*$  values



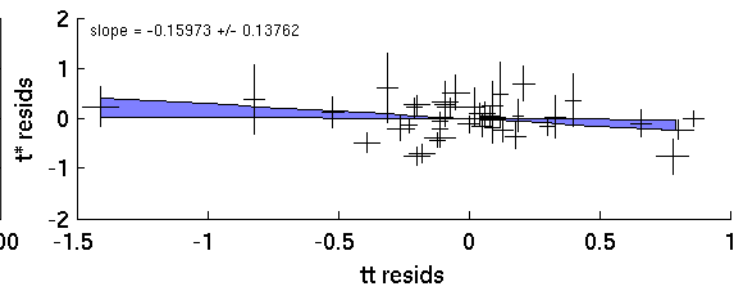
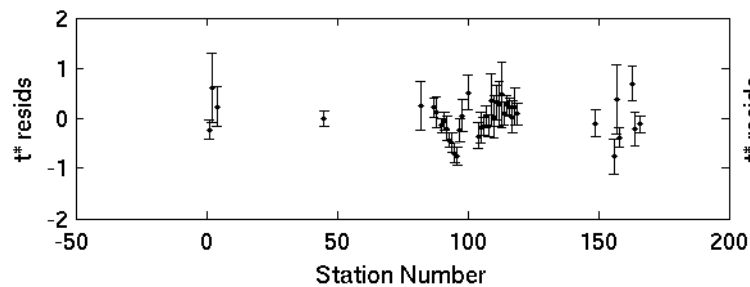
# Event\_2000\_173\_00\_51\_46



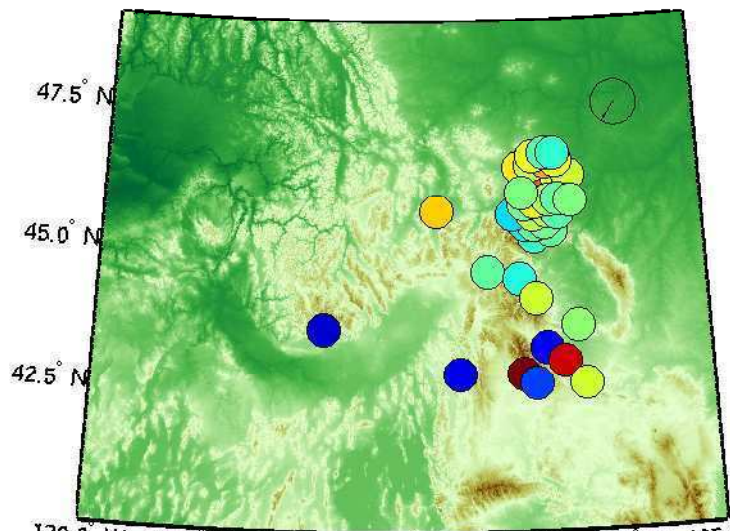
# Event\_2000\_173\_00\_51\_46



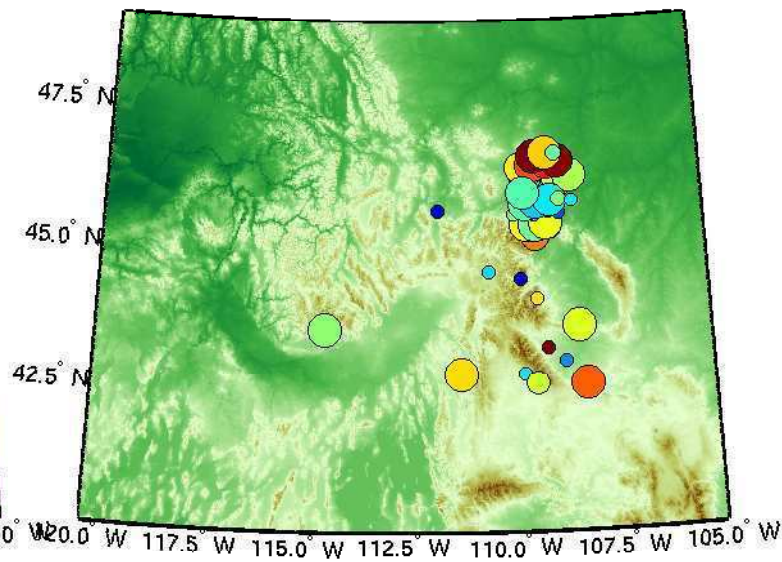
Baz = 35.0874  
Mean xcor value = 0.78725  
Range of  $t^*$  values is 1.4555  
Median  $t^*$  err is 0.25522



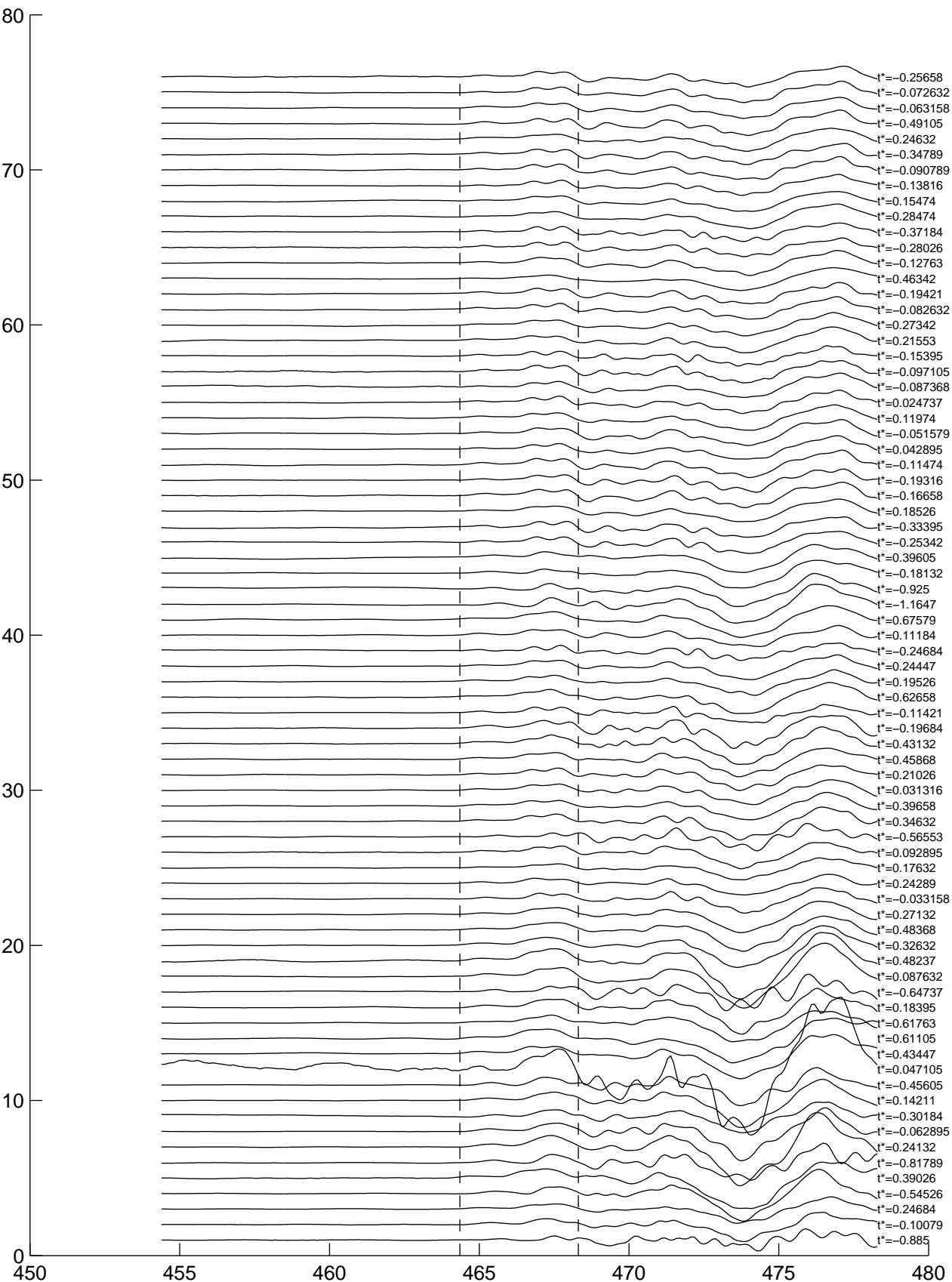
travel time residuals



$t^*$  values

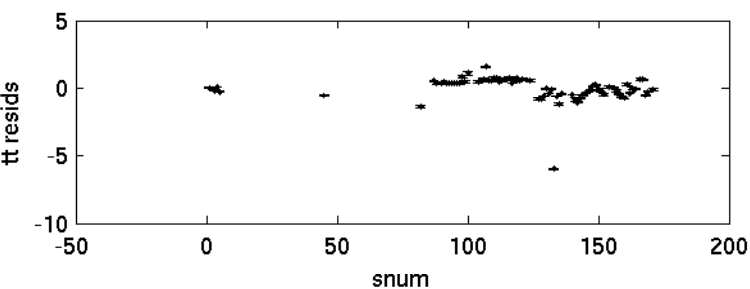
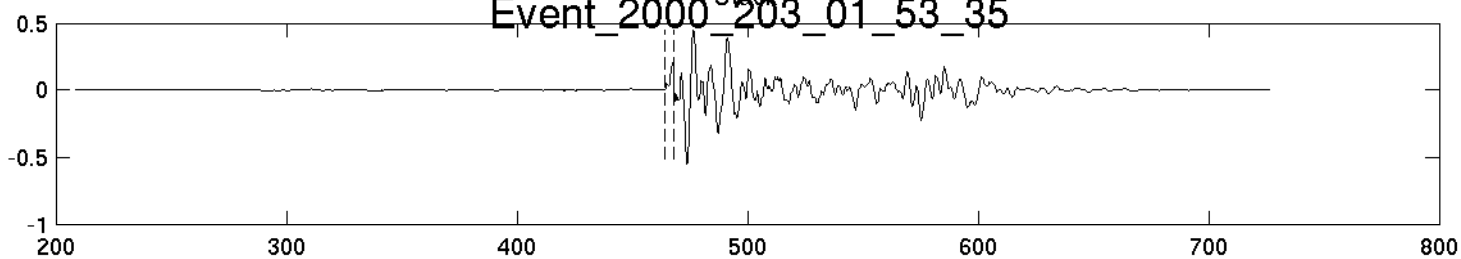


# Event\_2000\_203\_01\_53\_35

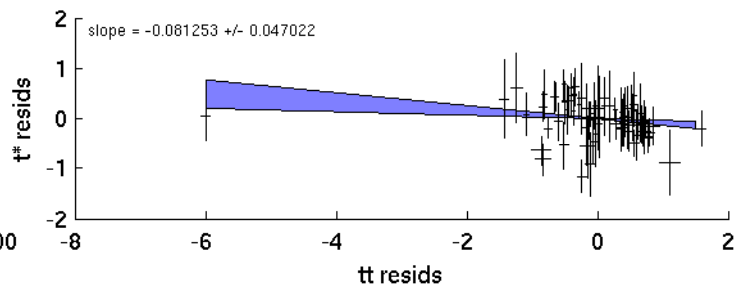
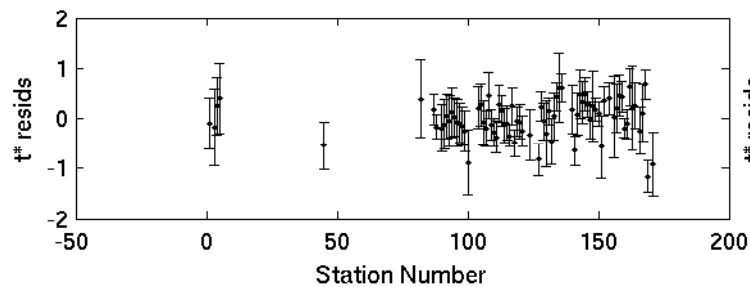




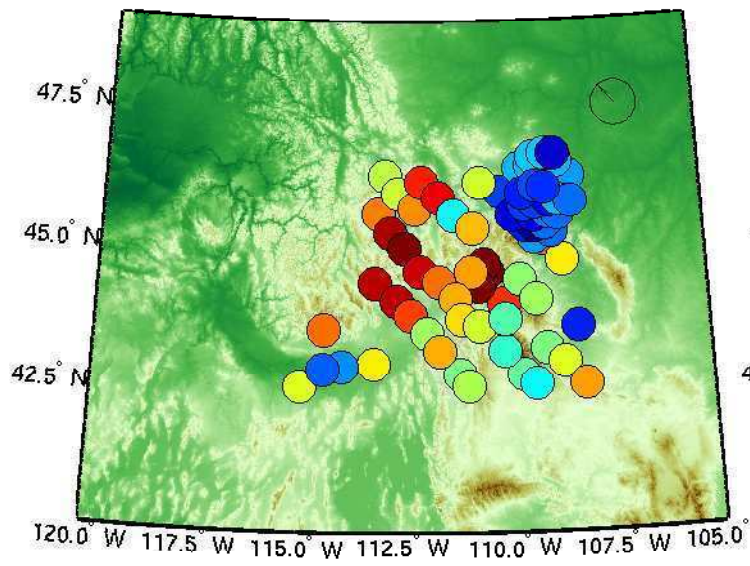
Event\_2000\_203\_01\_53\_35



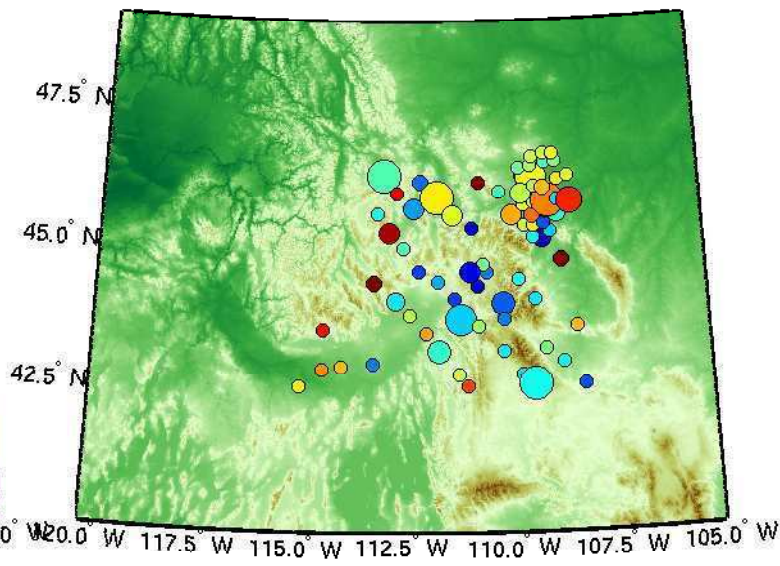
Baz = 141.0761  
Mean xcor value = 0.84921  
Range of  $t^*$  values is 1.8405  
Median  $t^*$  err is 0.3868



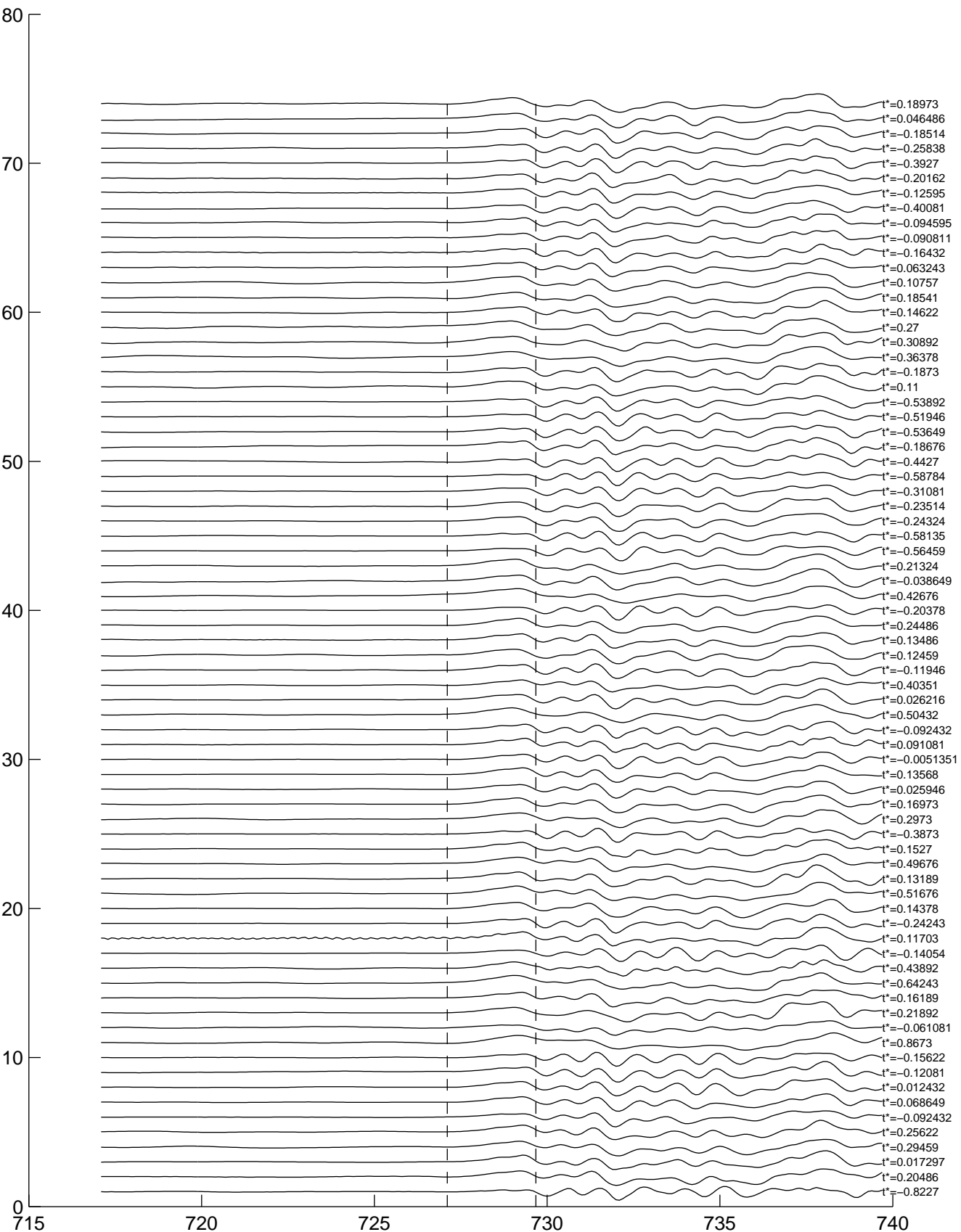
travel time residuals



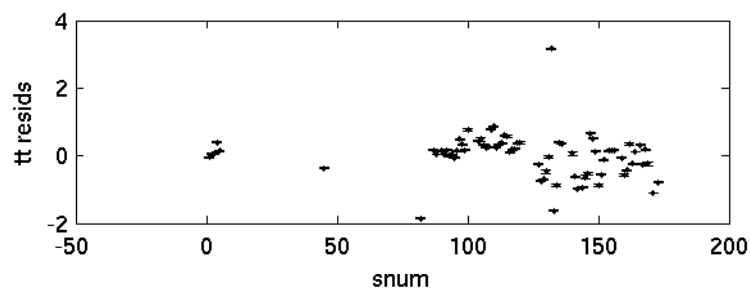
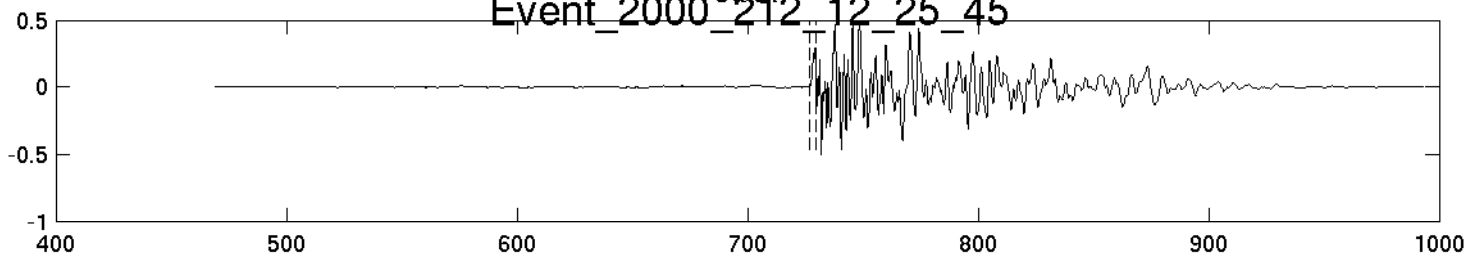
$t^*$  values



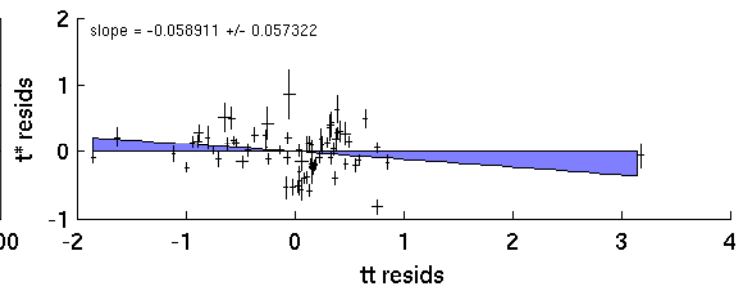
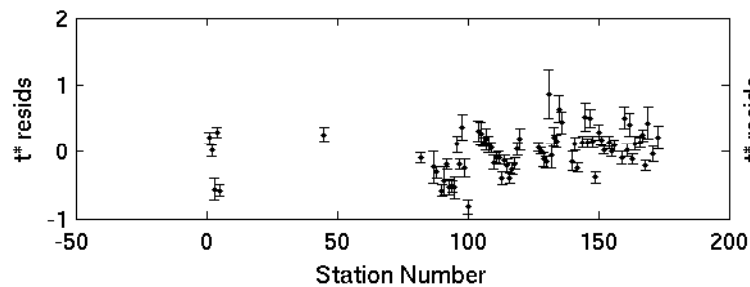
# Event\_2000\_212\_12\_25\_45



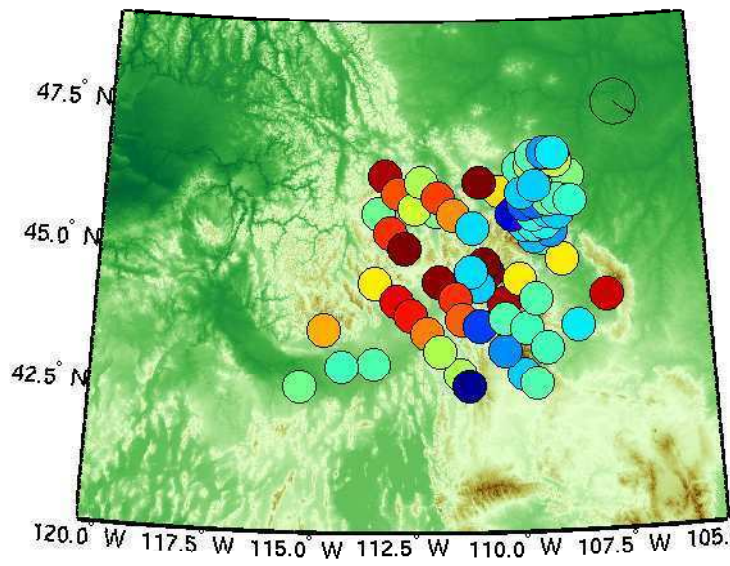
Event\_2000\_212\_12\_25\_45



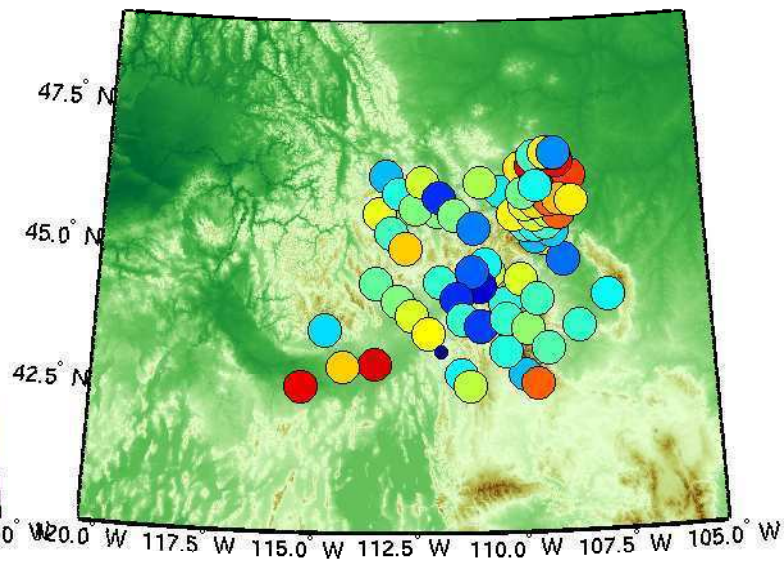
Baz = 307.6059  
Mean xcor value = 0.76784  
Range of  $t^*$  values is 1.69  
Median  $t^*$  err is 0.096633



travel time residuals

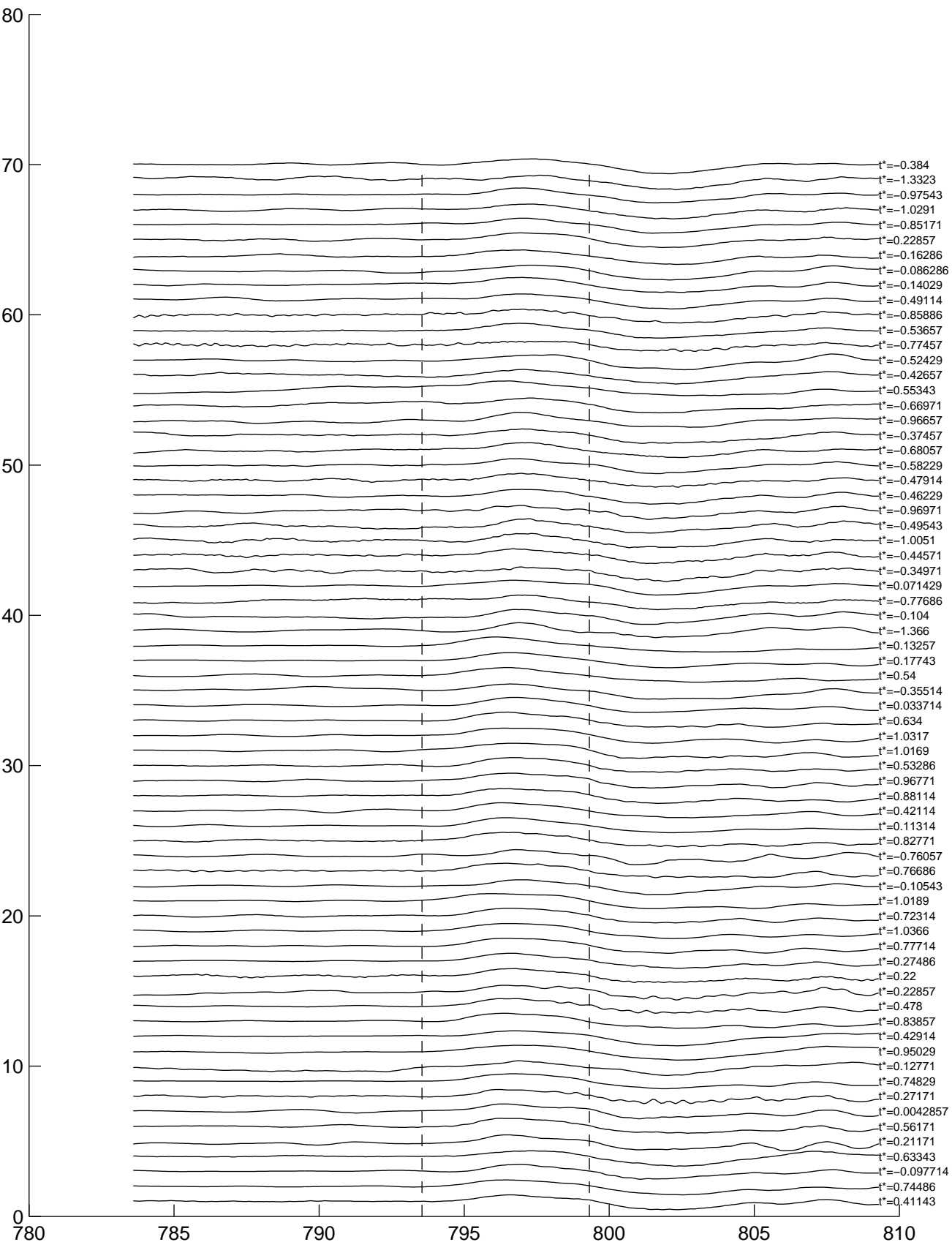


$t^*$  values

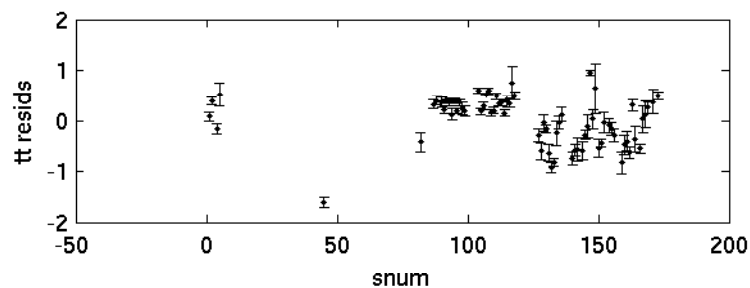
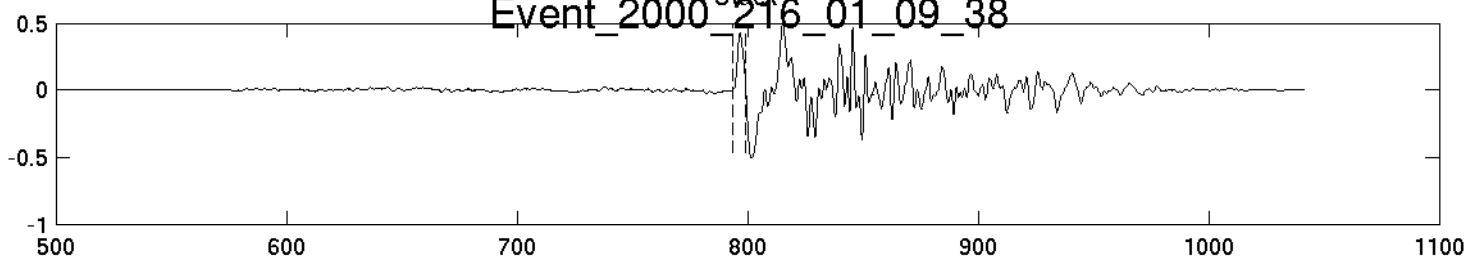




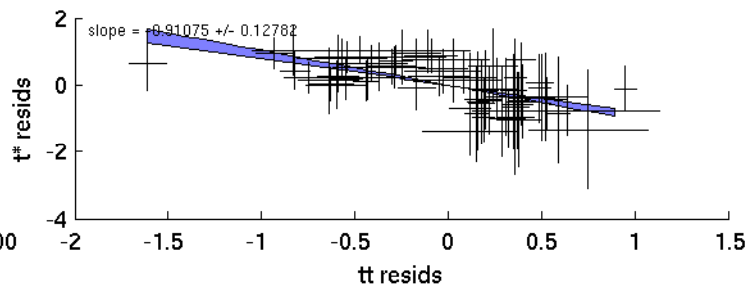
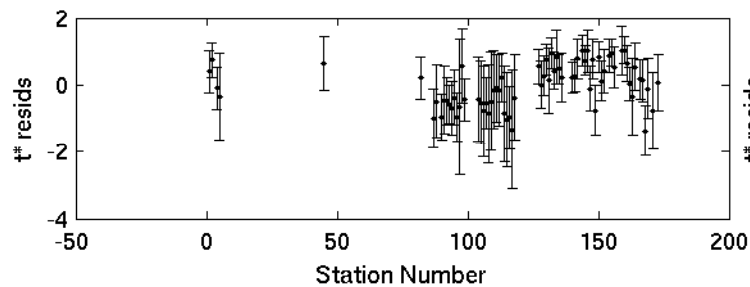
# Event\_2000\_216\_01\_09\_38



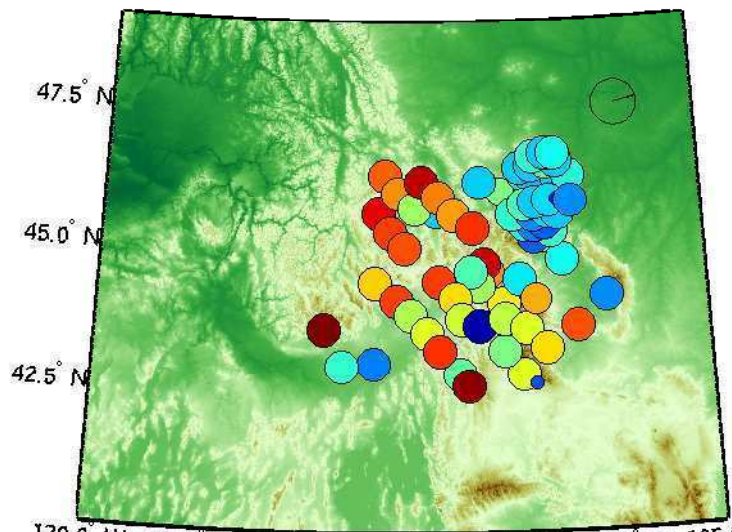
Event\_2000\_216\_01\_09\_38



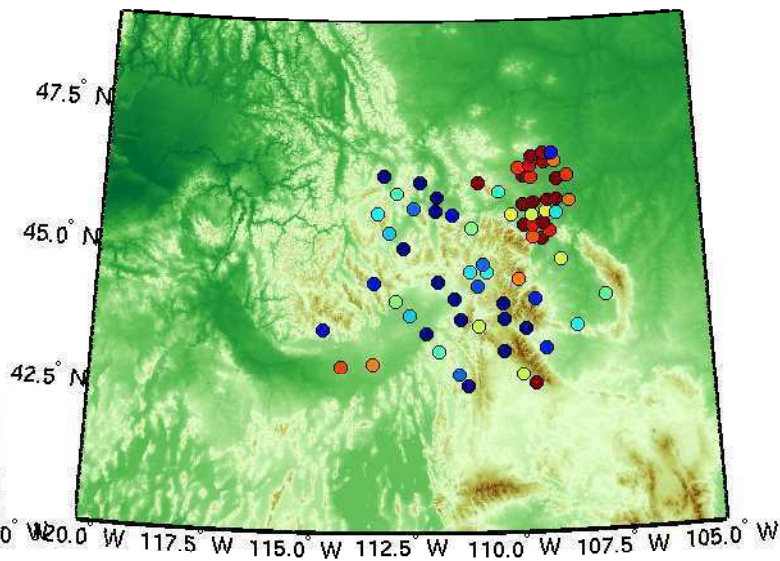
Baz = 256.8483  
Mean xcor value = 0.77343  
Range of  $t^*$  values is 2.4026  
Median  $t^*$  err is 0.71394



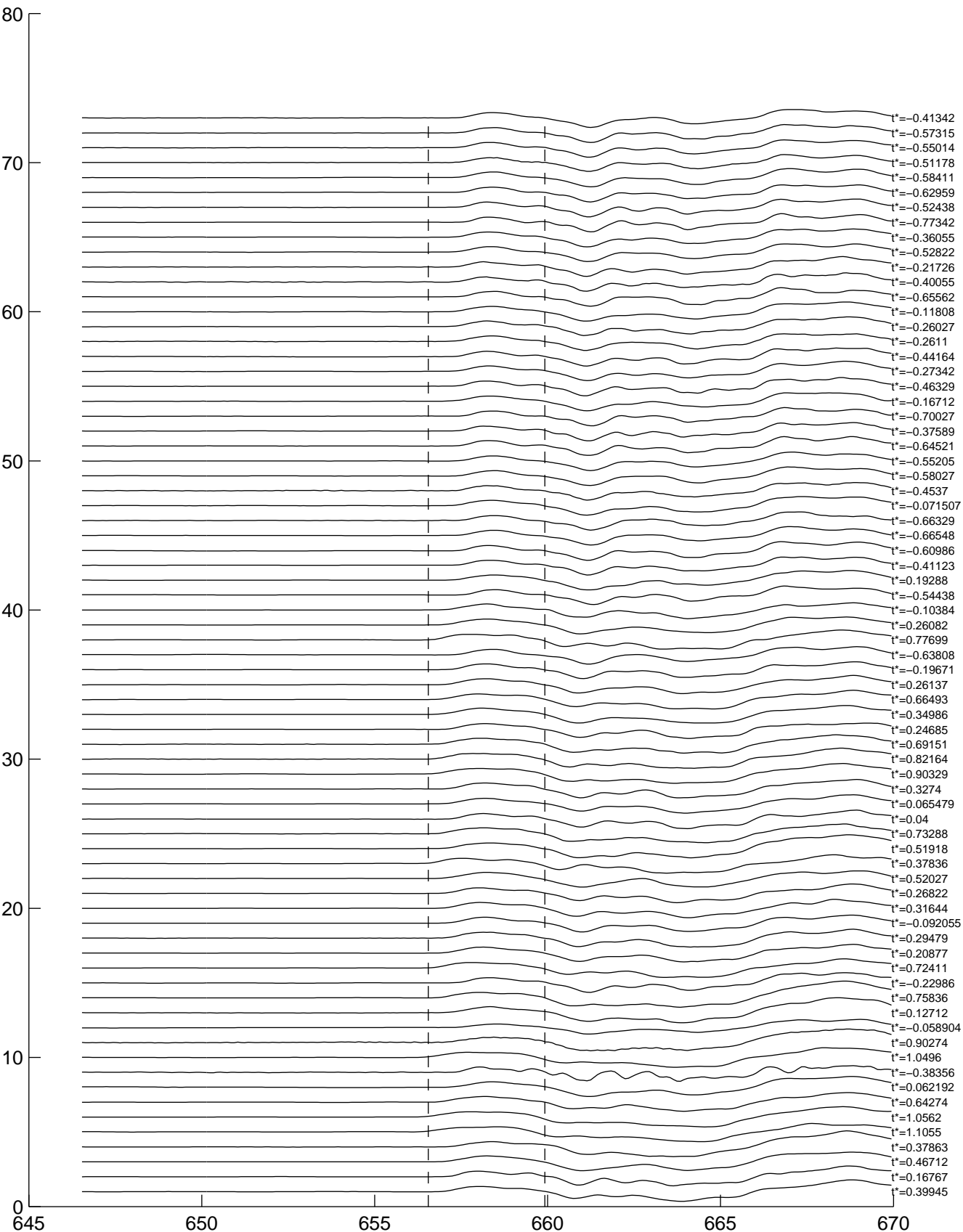
travel time residuals



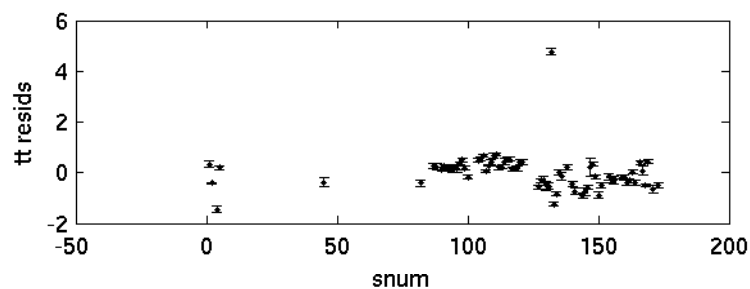
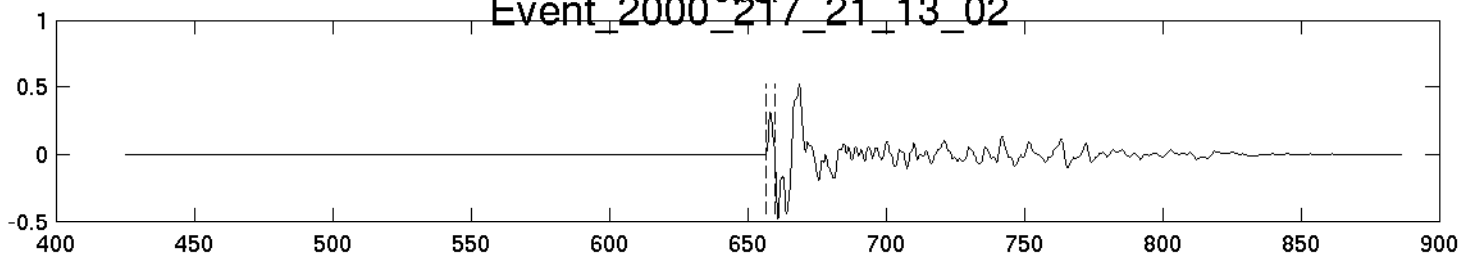
$t^*$  values



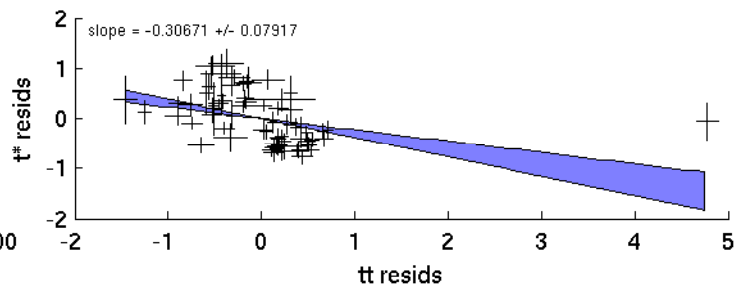
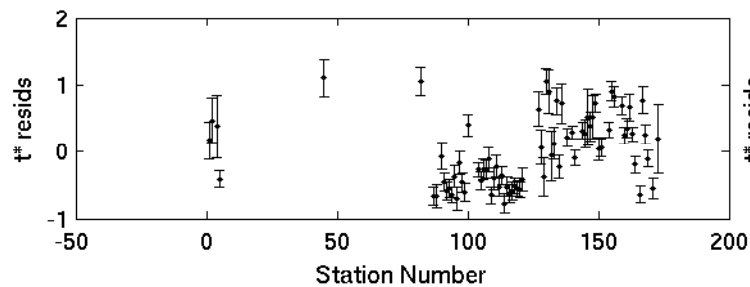
Event\_2000\_217\_21\_13\_02



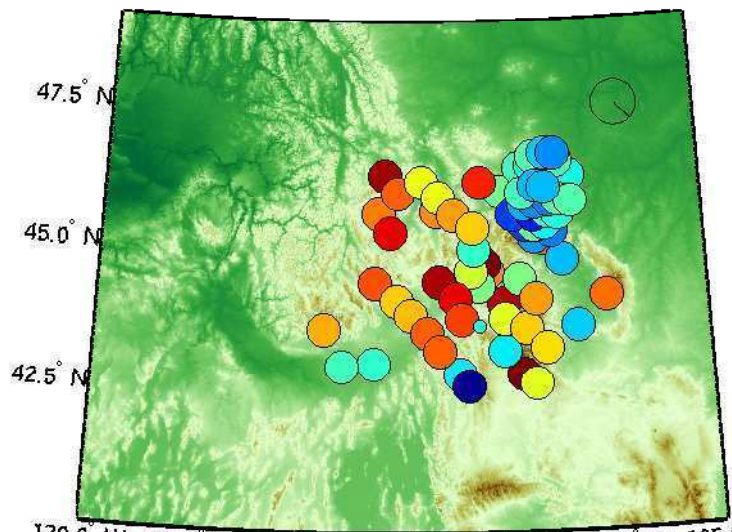
# Event\_2000\_217\_21\_13\_02



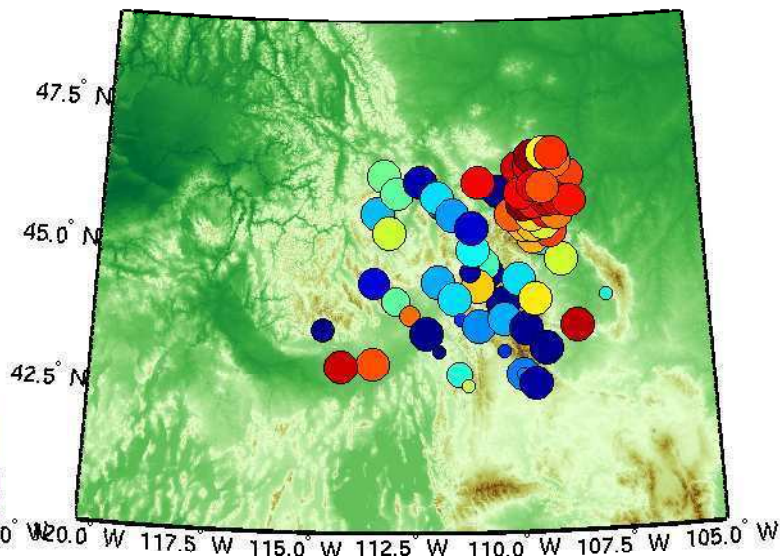
Baz = 317.0004  
 Mean xcor value = 0.87973  
 Range of  $t^*$  values is 1.8789  
 Median  $t^*$  err is 0.15023



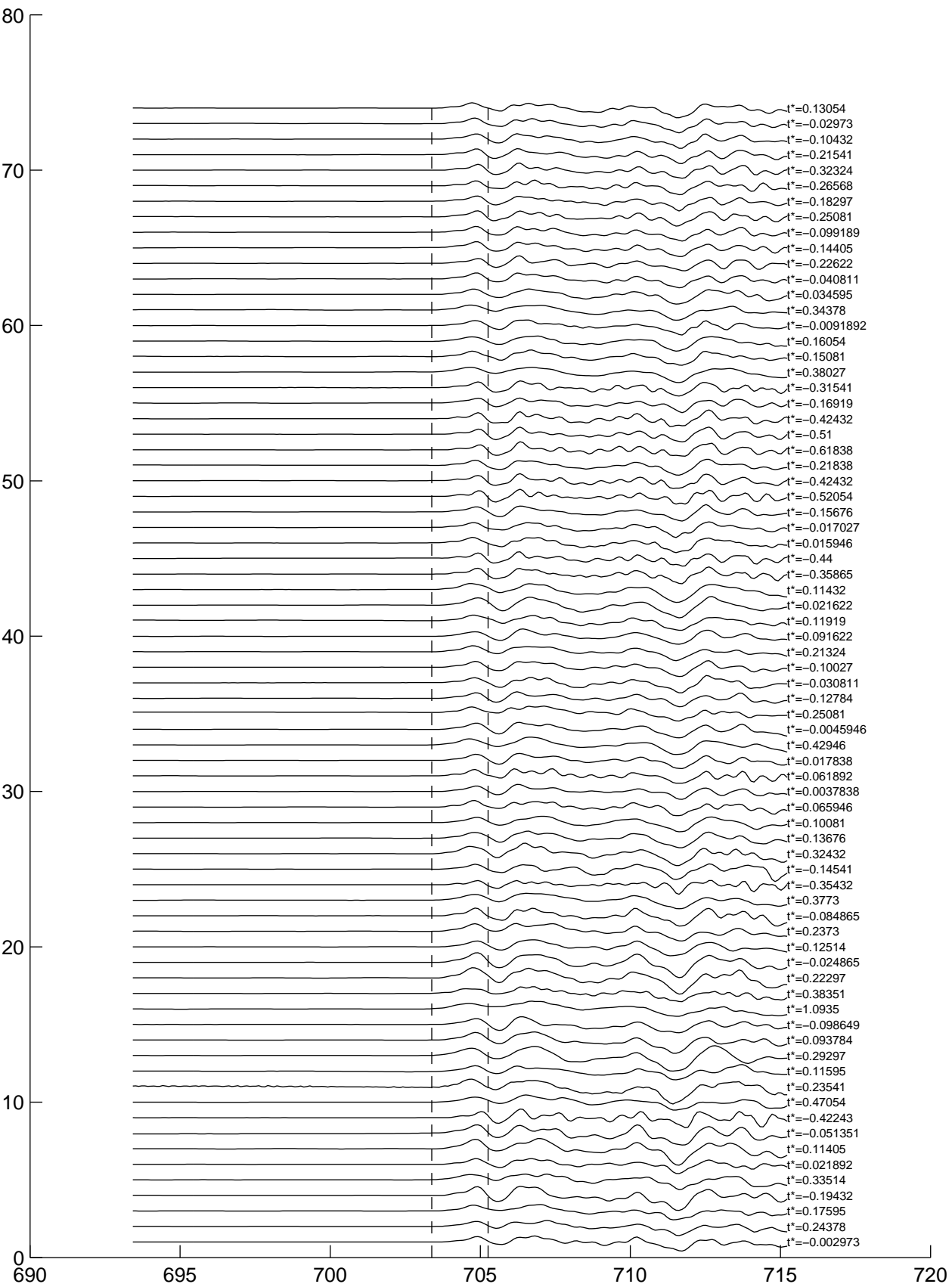
travel time residuals



$t^*$  values

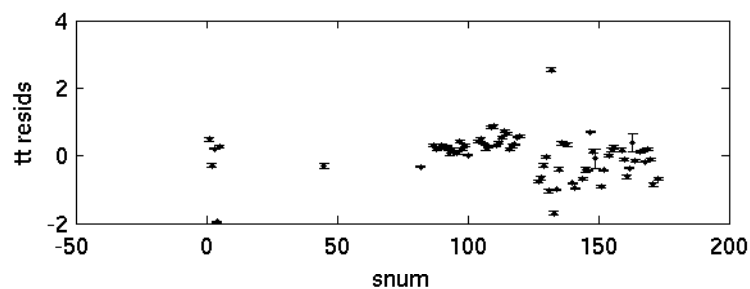
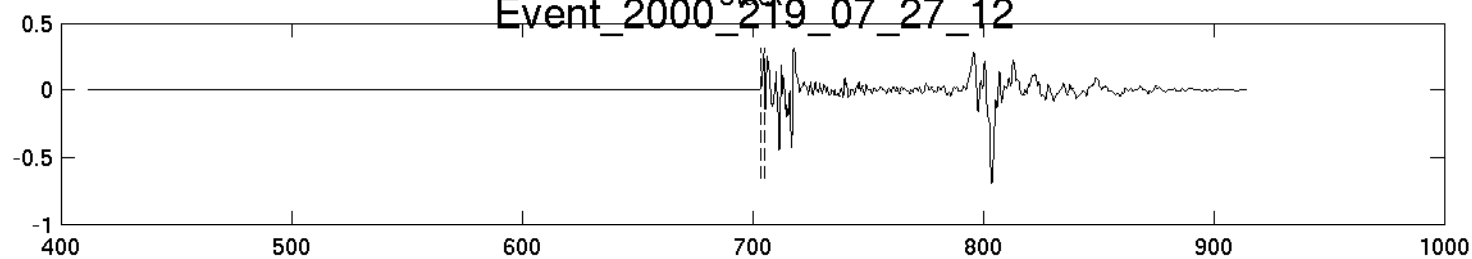


# Event\_2000\_219\_07\_27\_12

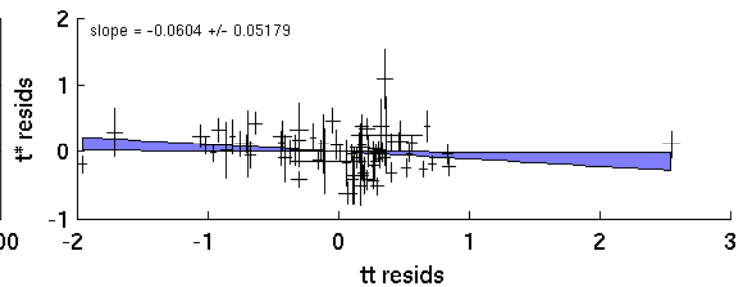
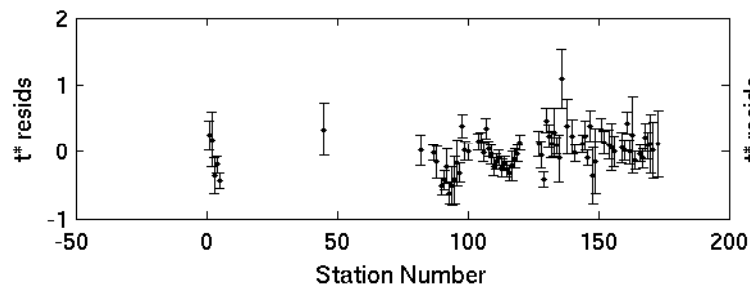




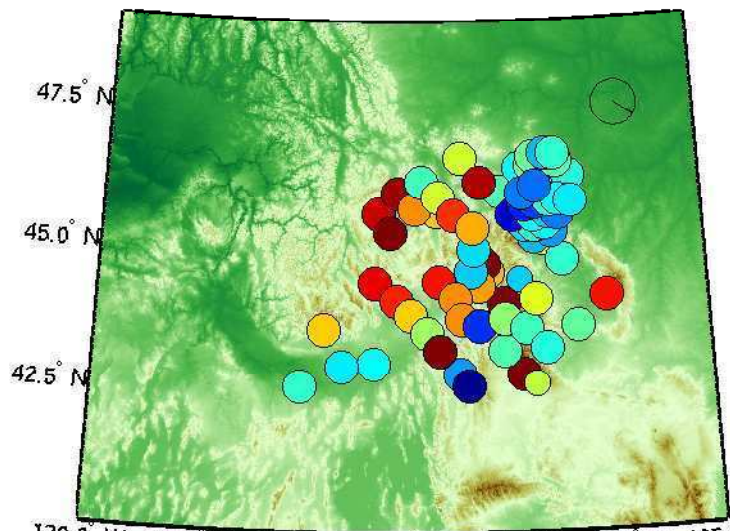
# Event\_2000\_219\_07\_27\_12



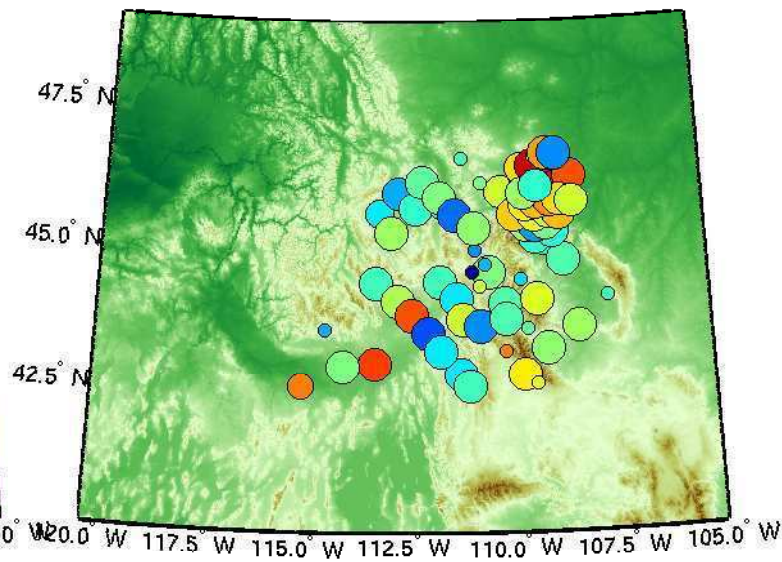
Baz = 304.0866  
 Mean xcor value = 0.75568  
 Range of  $t^*$  values is 1.7119  
 Median  $t^*$  err is 0.17133



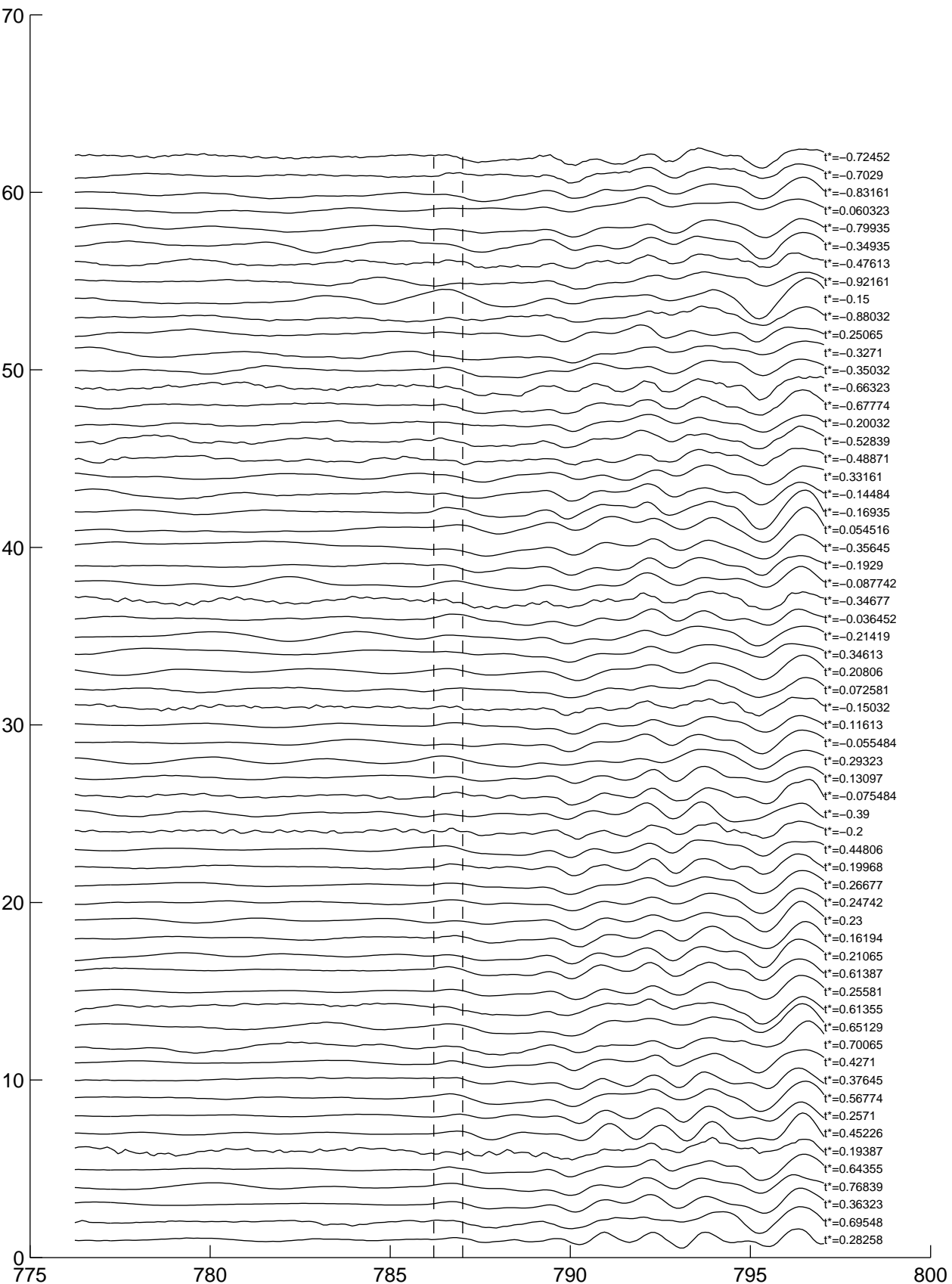
travel time residuals



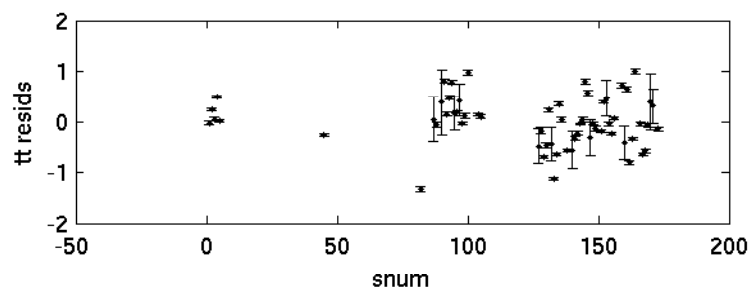
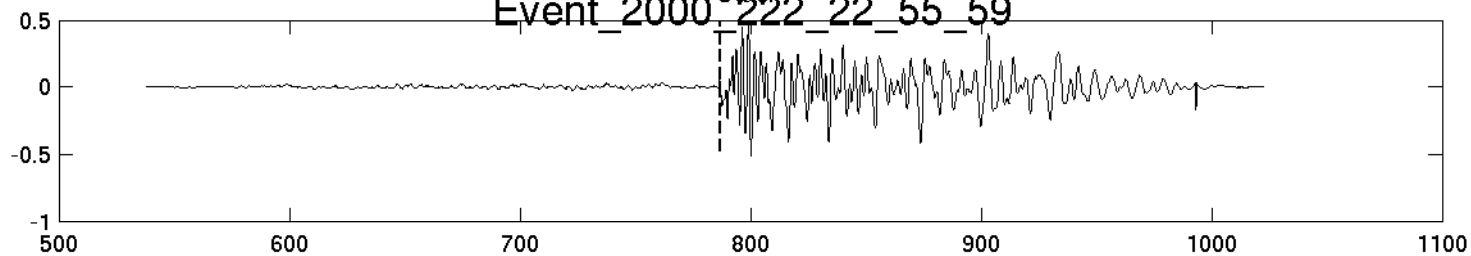
$t^*$  values



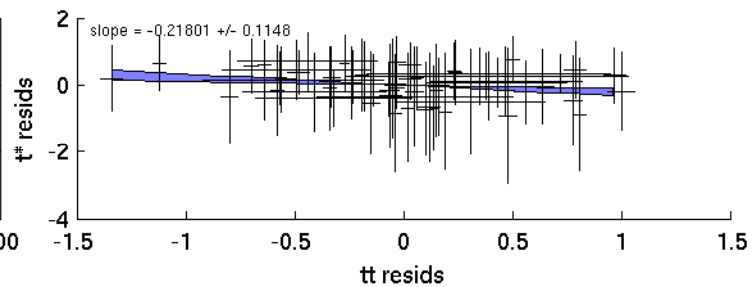
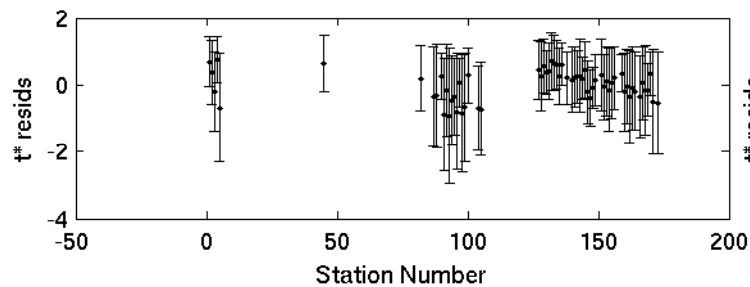
# Event\_2000\_222\_22\_55\_59



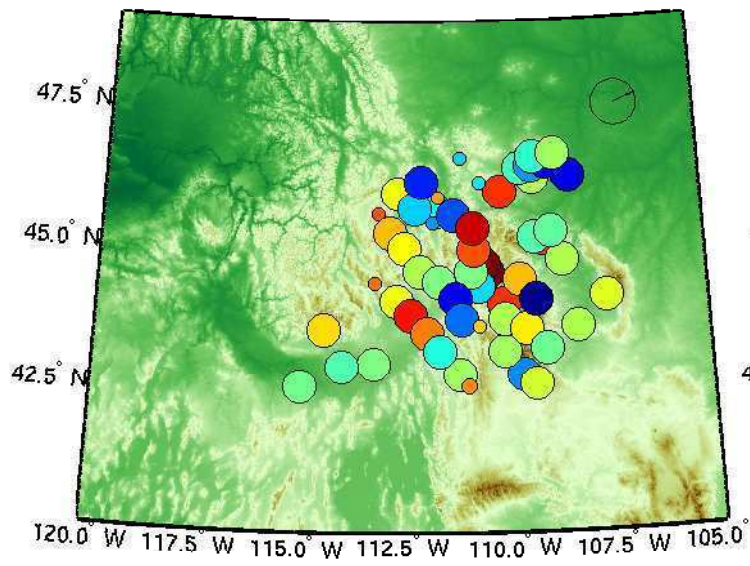
Event\_2000\_222\_22\_55\_59



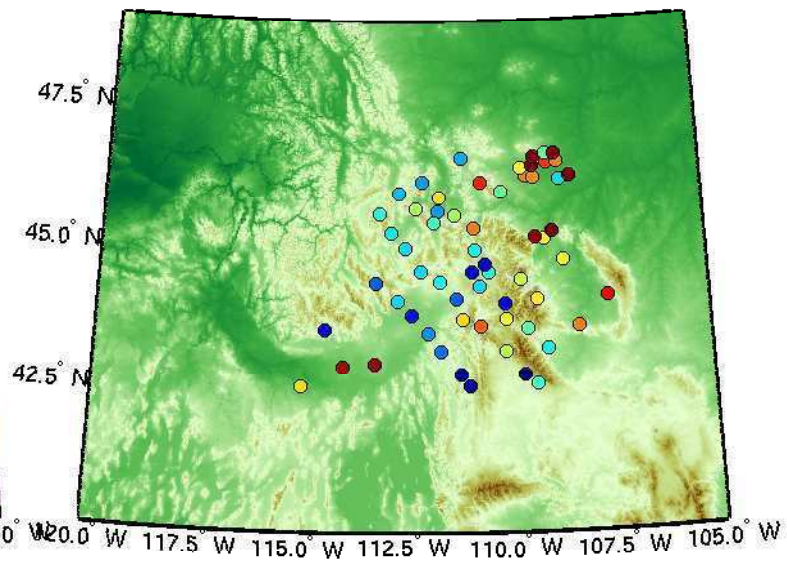
Baz = 247.9847  
Mean xcor value = 0.71097  
Range of  $t^*$  values is 1.69  
Median  $t^*$  err is 0.97961



travel time residuals

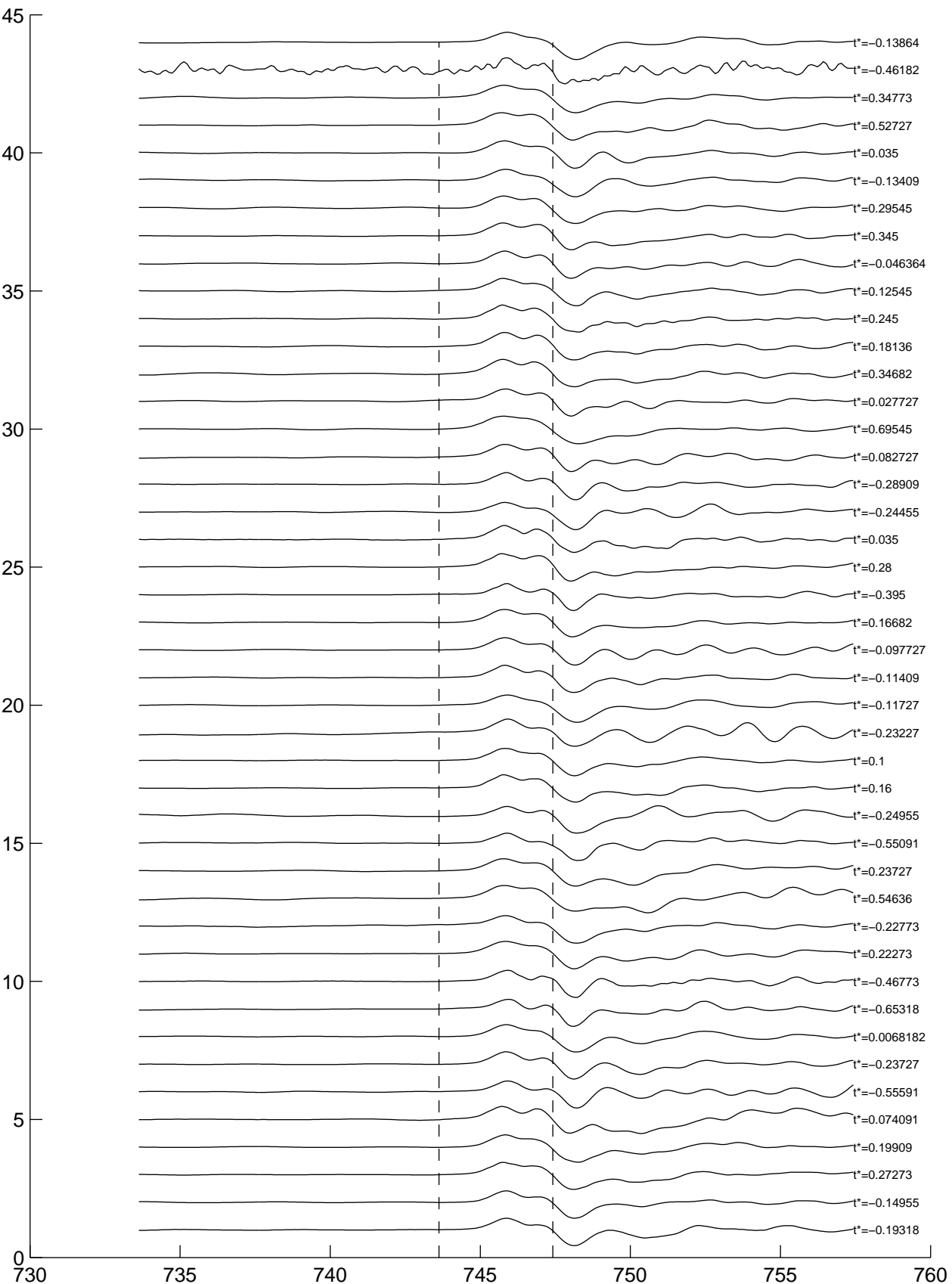


$t^*$  values

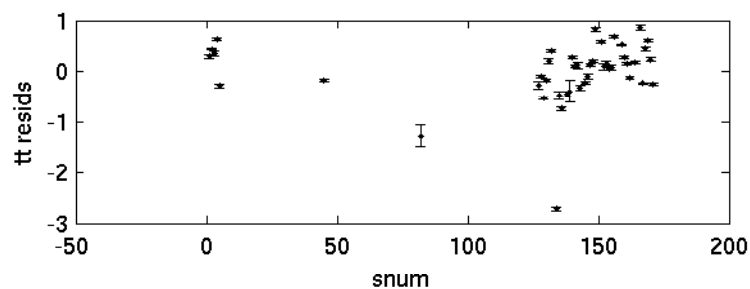
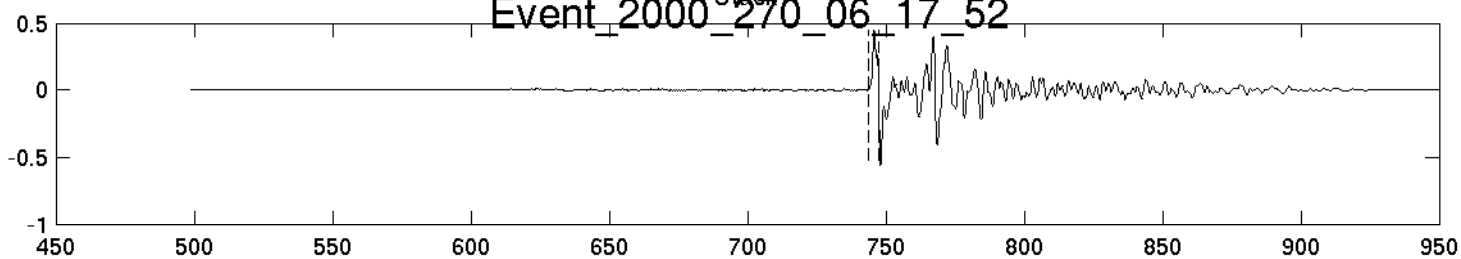




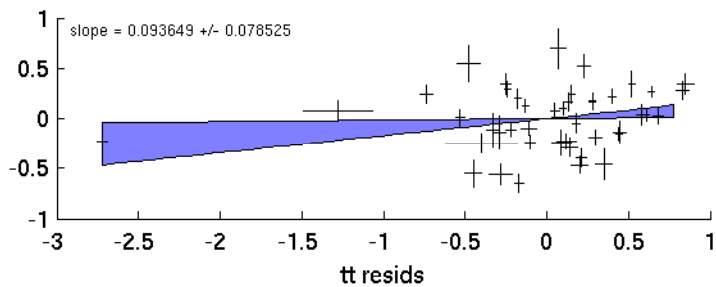
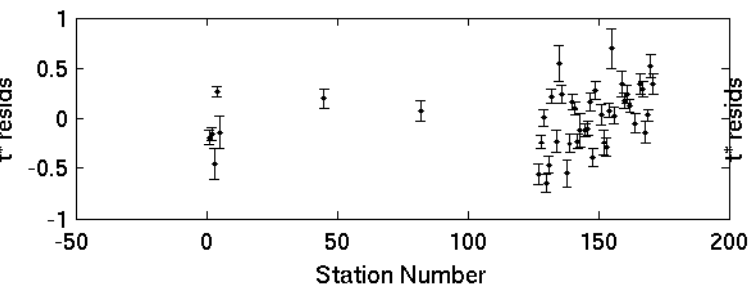
# Event\_2000\_270\_06\_17\_52



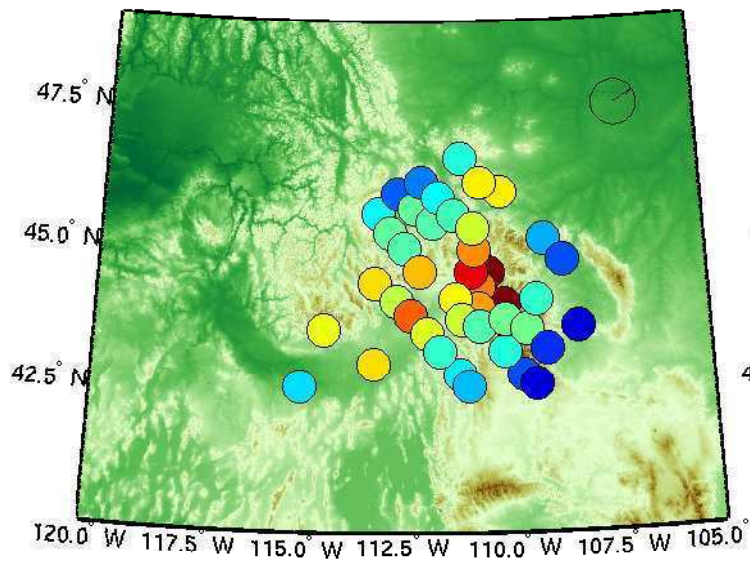
# Event 2000\_270\_06\_17\_52



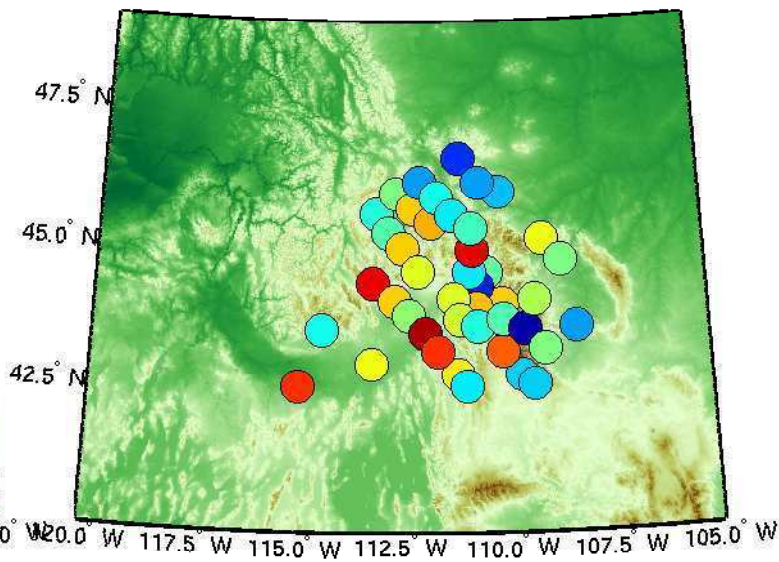
Baz = 238.6518  
 Mean xcor value = 0.82159  
 Range of  $t^*$  values is 1.3486  
 Median  $t^*$  err is 0.089501



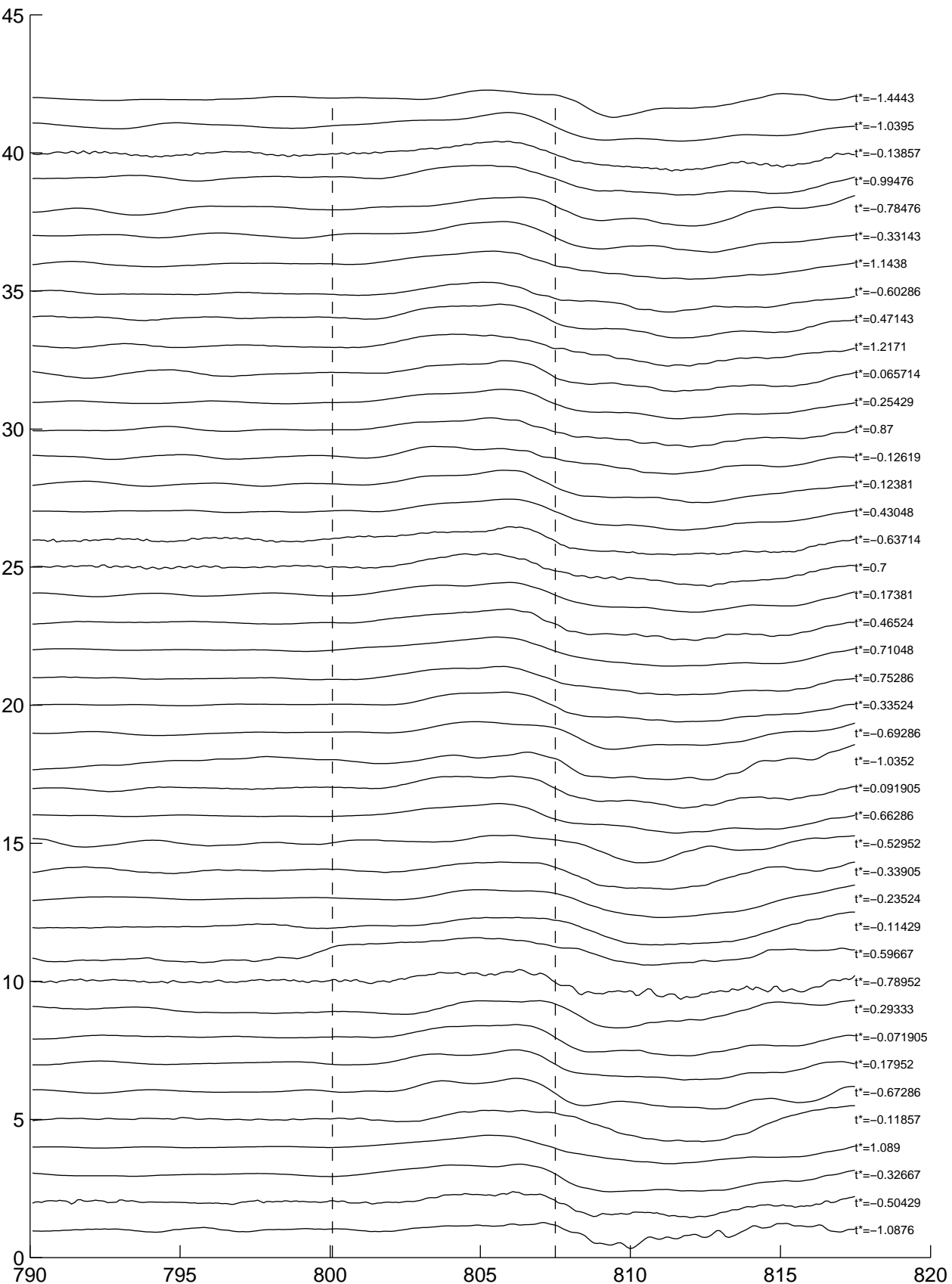
travel time residuals



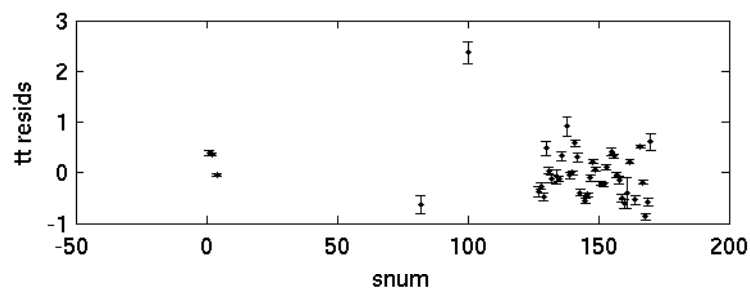
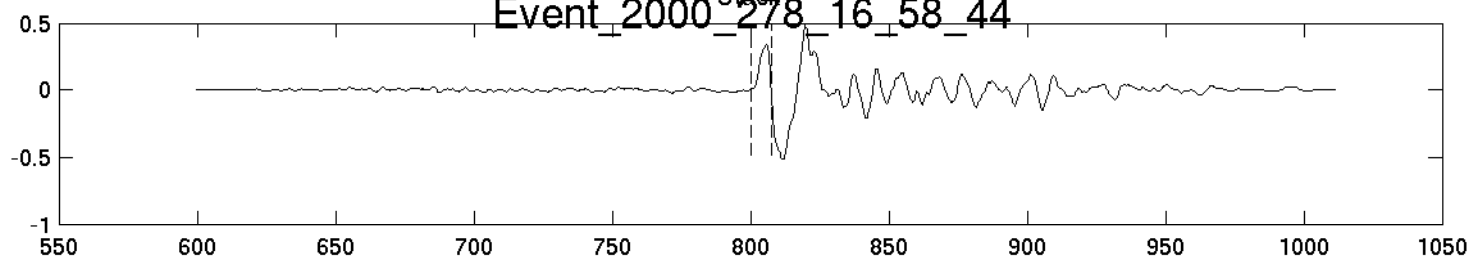
$t^*$  values



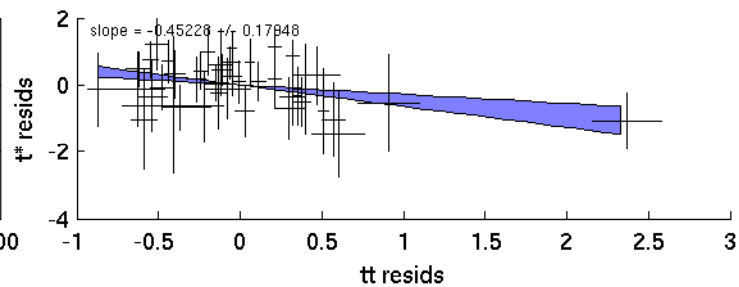
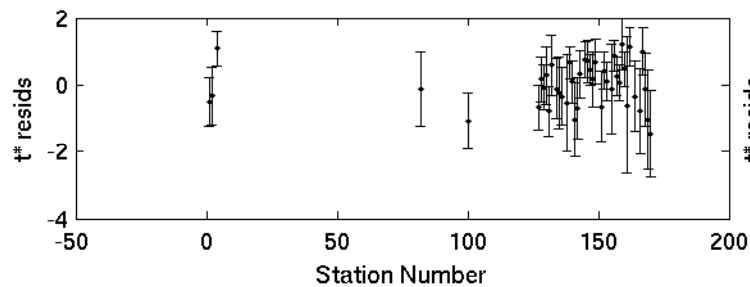
# Event\_2000\_278\_16\_58\_44



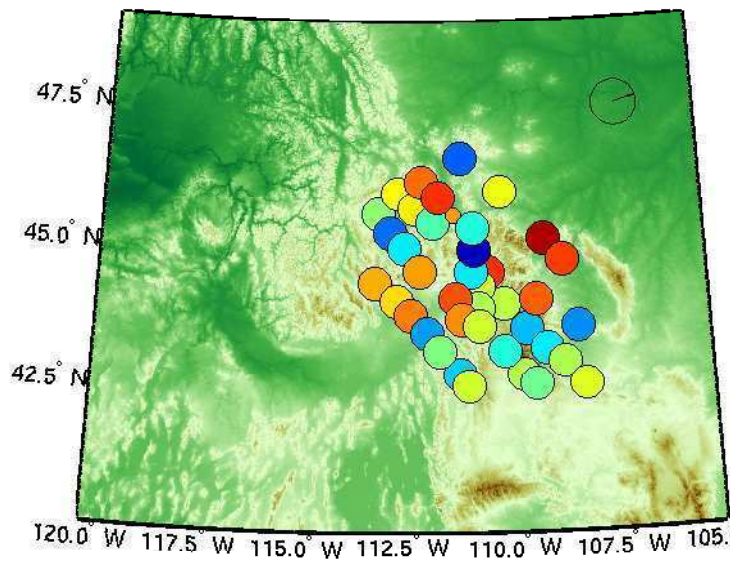
# Event\_2000\_278\_16\_58\_44



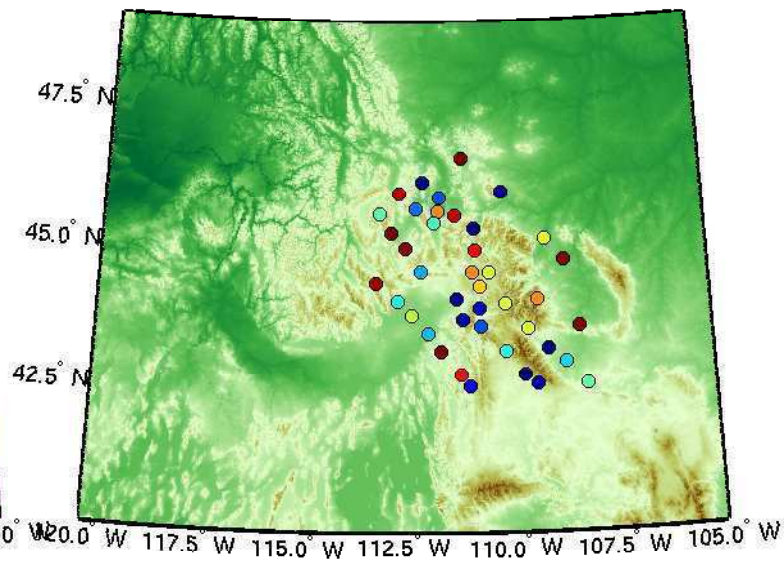
Baz = 253.4899  
 Mean xcor value = 0.8219  
 Range of  $t^*$  values is 2.6614  
 Median  $t^*$  err is 0.75796



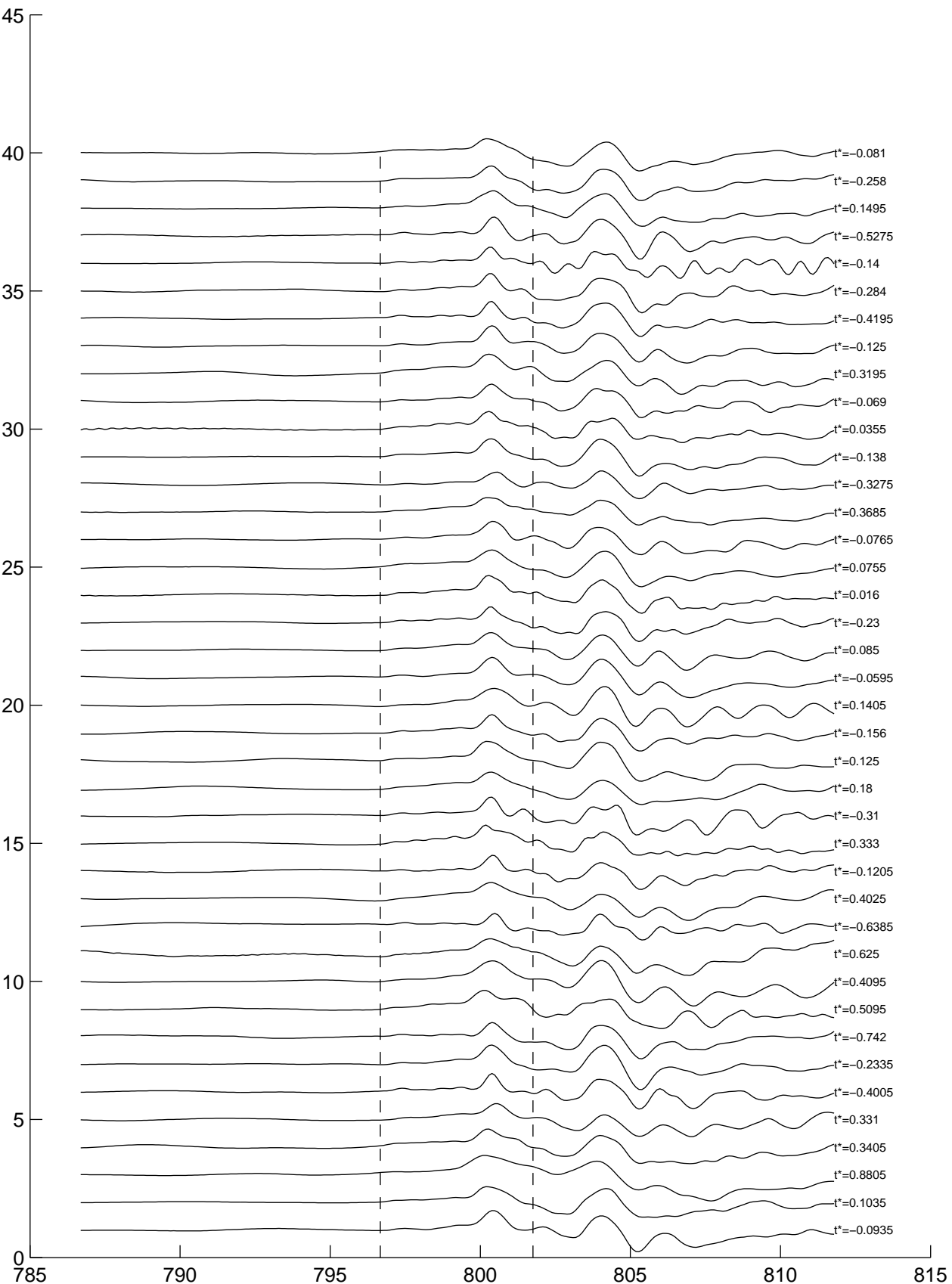
travel time residuals



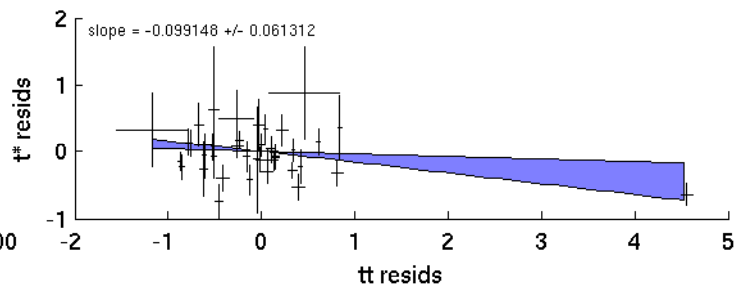
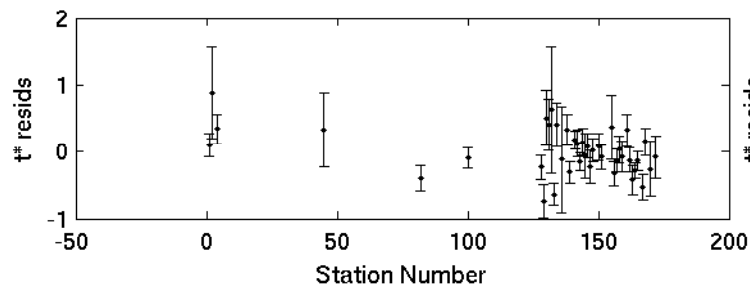
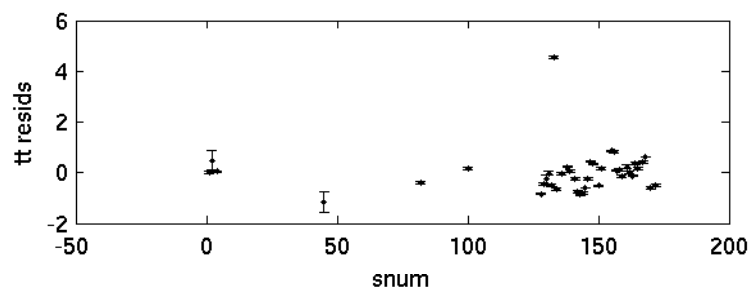
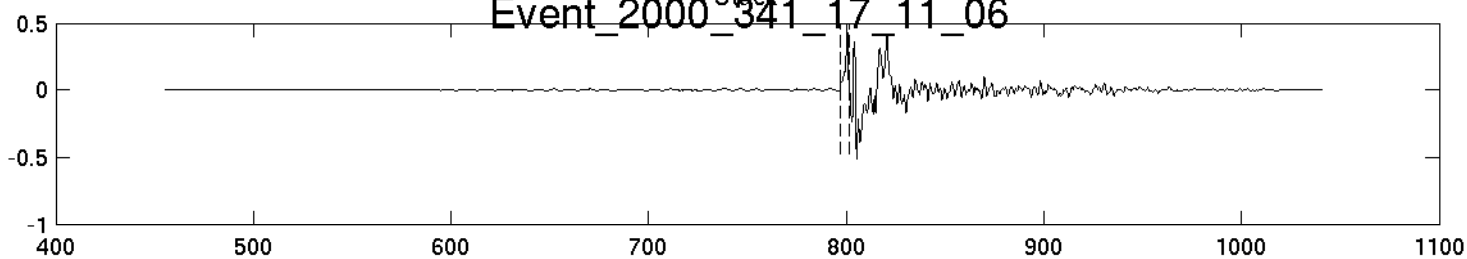
$t^*$  values



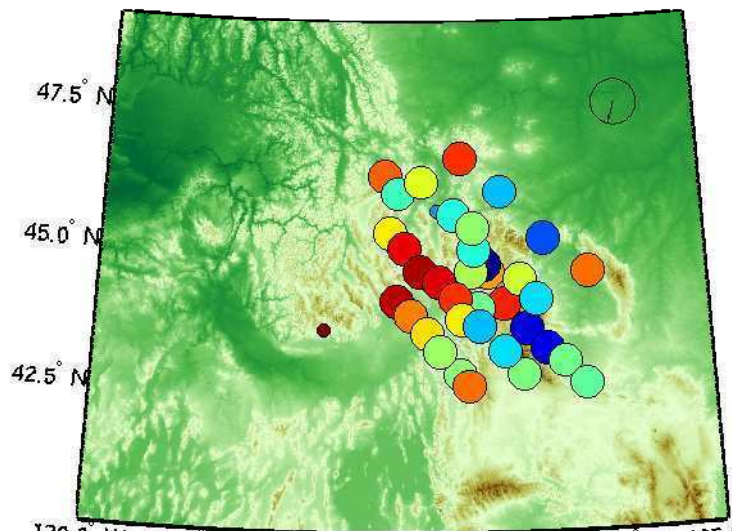
# Event\_2000\_341\_17\_11\_06



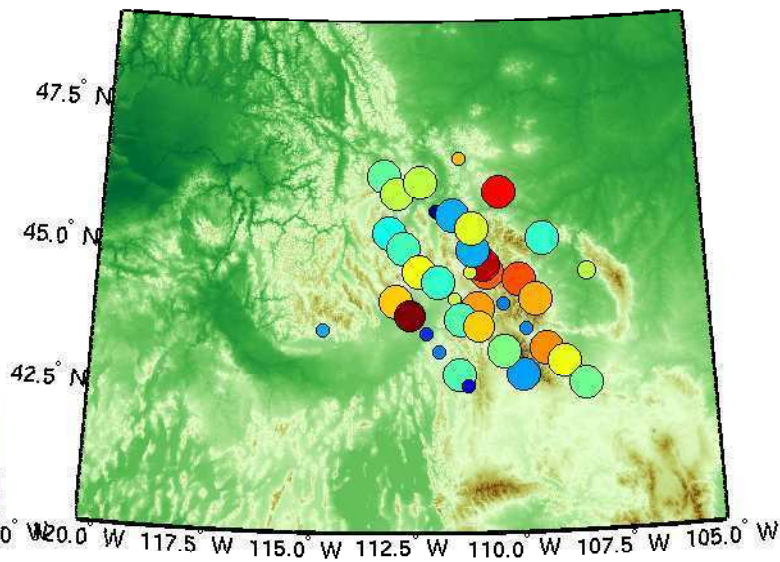
# Event\_2000\_341\_17\_11\_06



travel time residuals

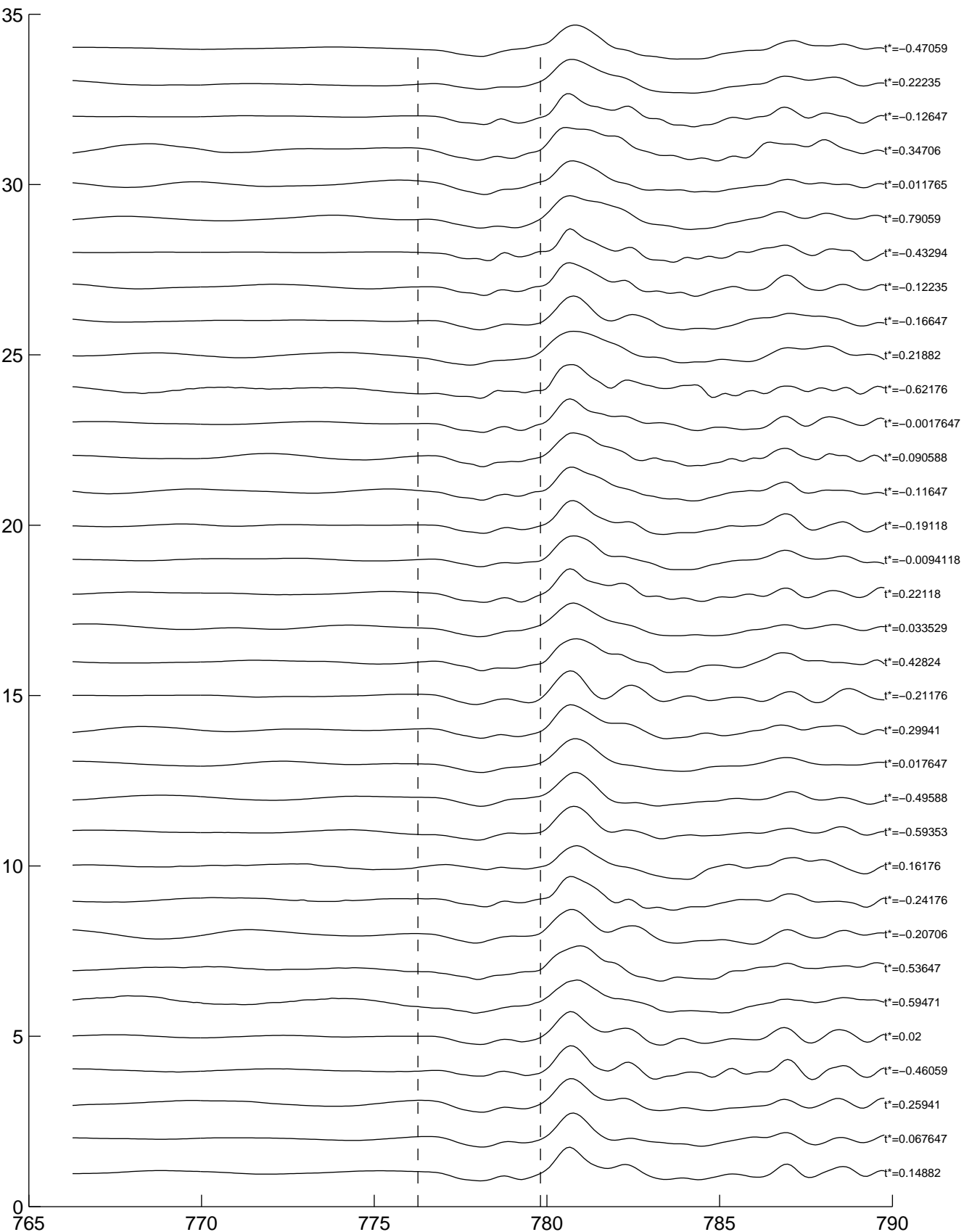


$t^*$  values

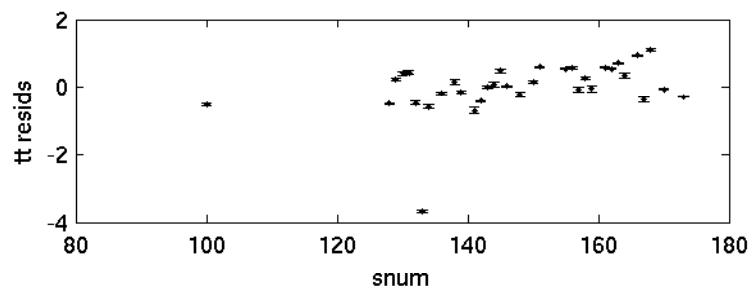
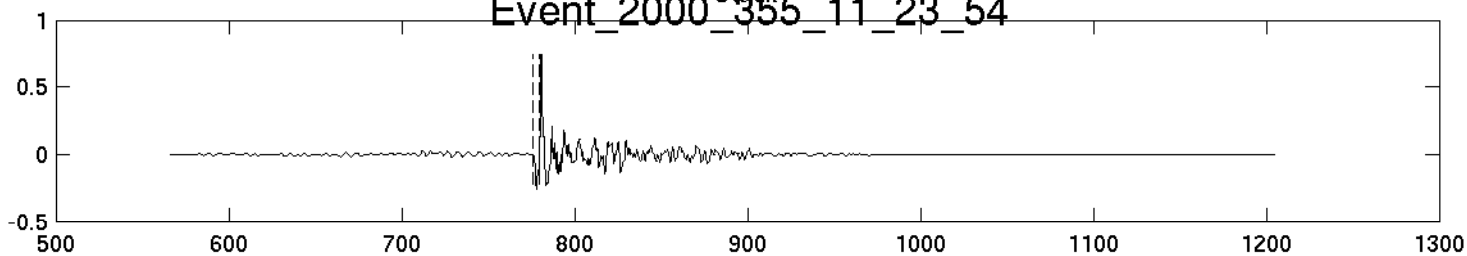




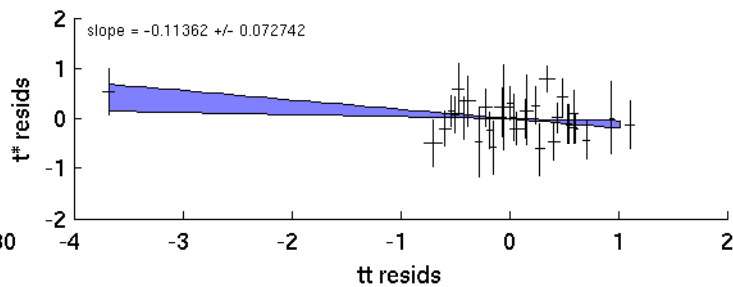
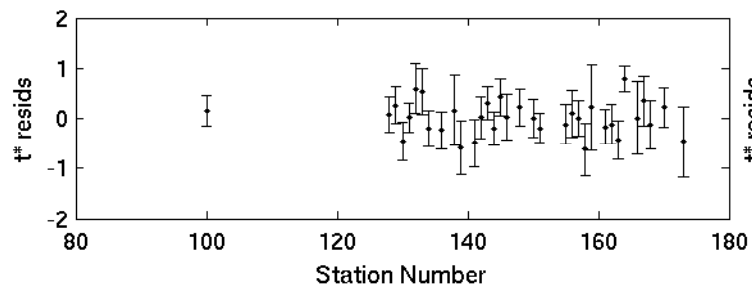
# Event\_2000\_355\_11\_23\_54



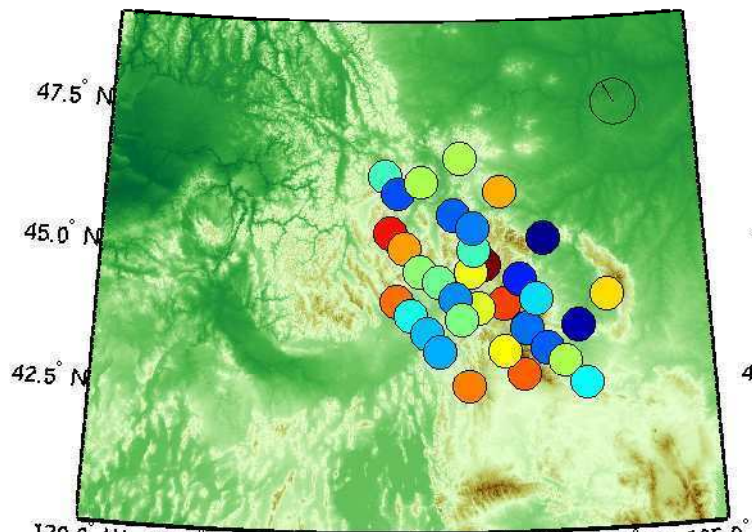
# Event\_2000\_355\_11\_23\_54



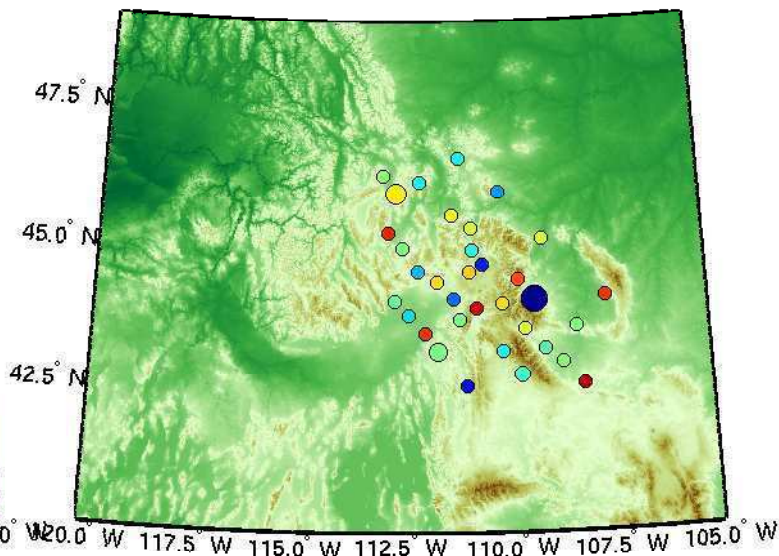
Baz = 152.6194  
 Mean xcor value = 0.81588  
 Range of  $t^*$  values is 1.4124  
 Median  $t^*$  err is 0.39211



travel time residuals

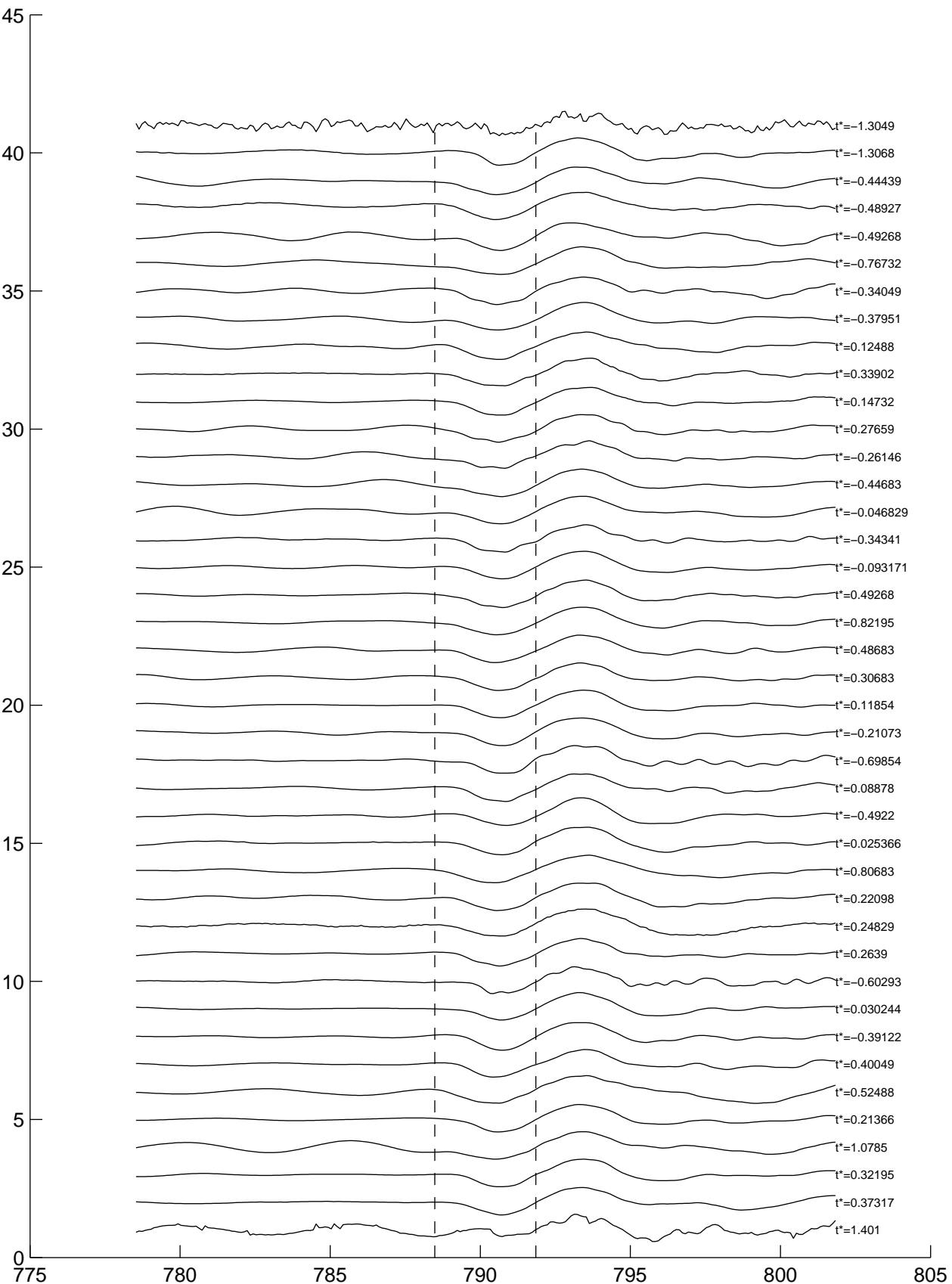


$t^*$  values



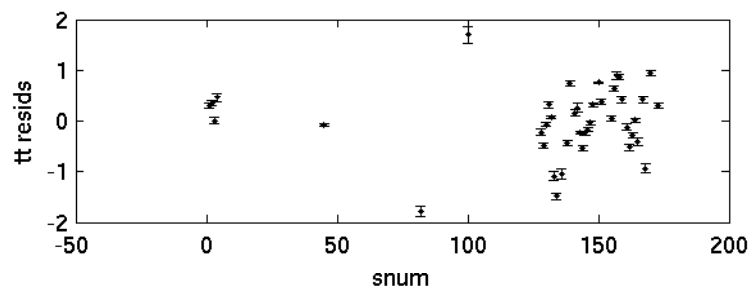
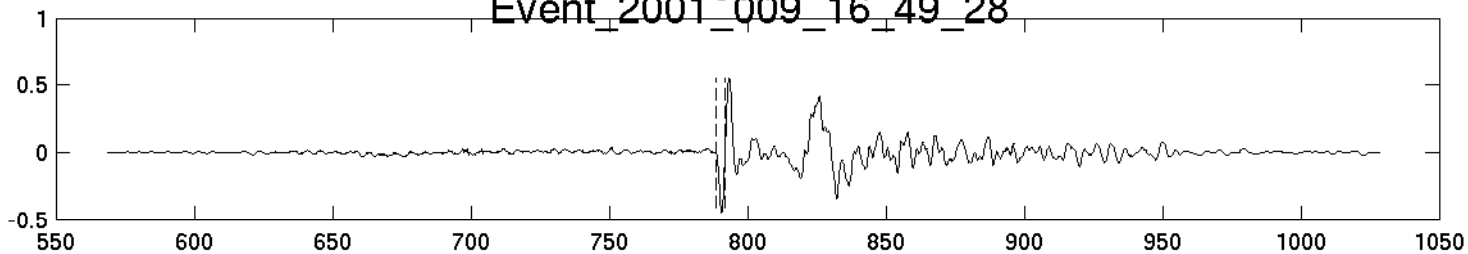


# Event\_2001\_009\_16\_49\_28

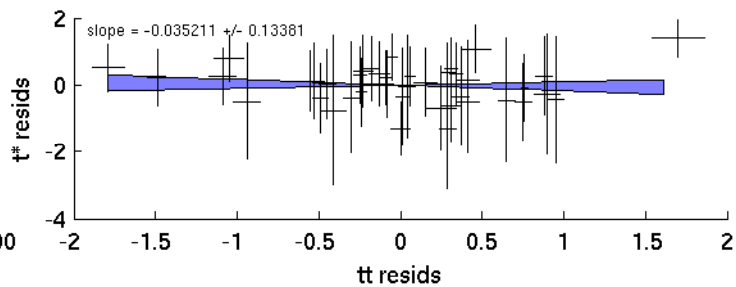
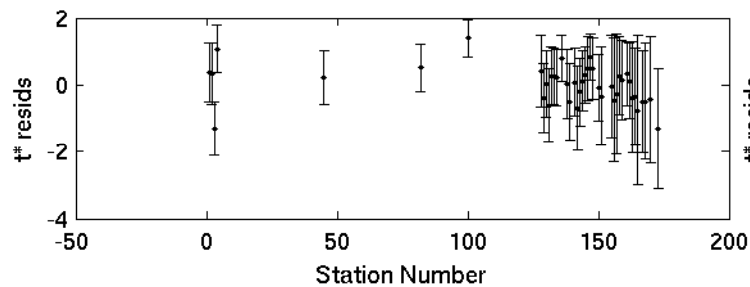


# Event 2001\_009\_16\_49\_28

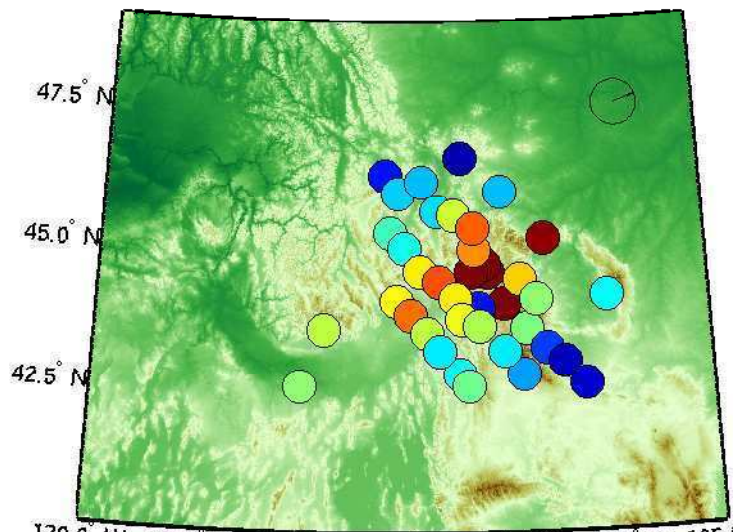
Stack



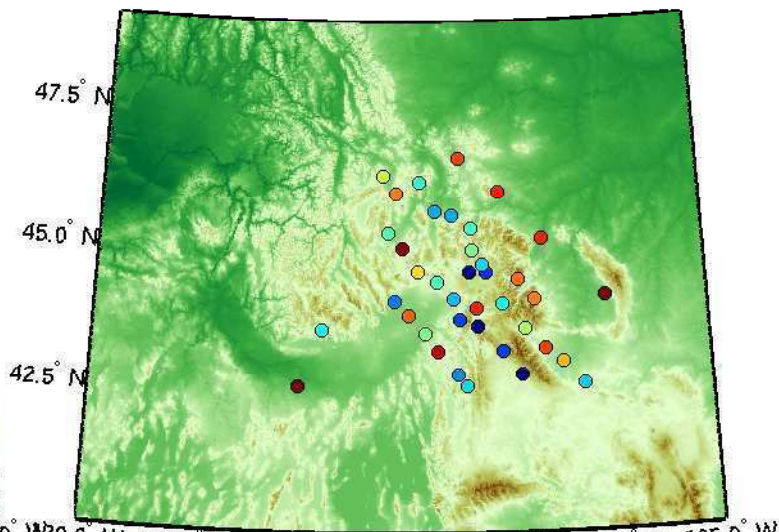
Baz = 250.5612  
Mean xcor value = 0.82878  
Range of  $t^*$  values is 2.7078  
Median  $t^*$  err is 1.0167



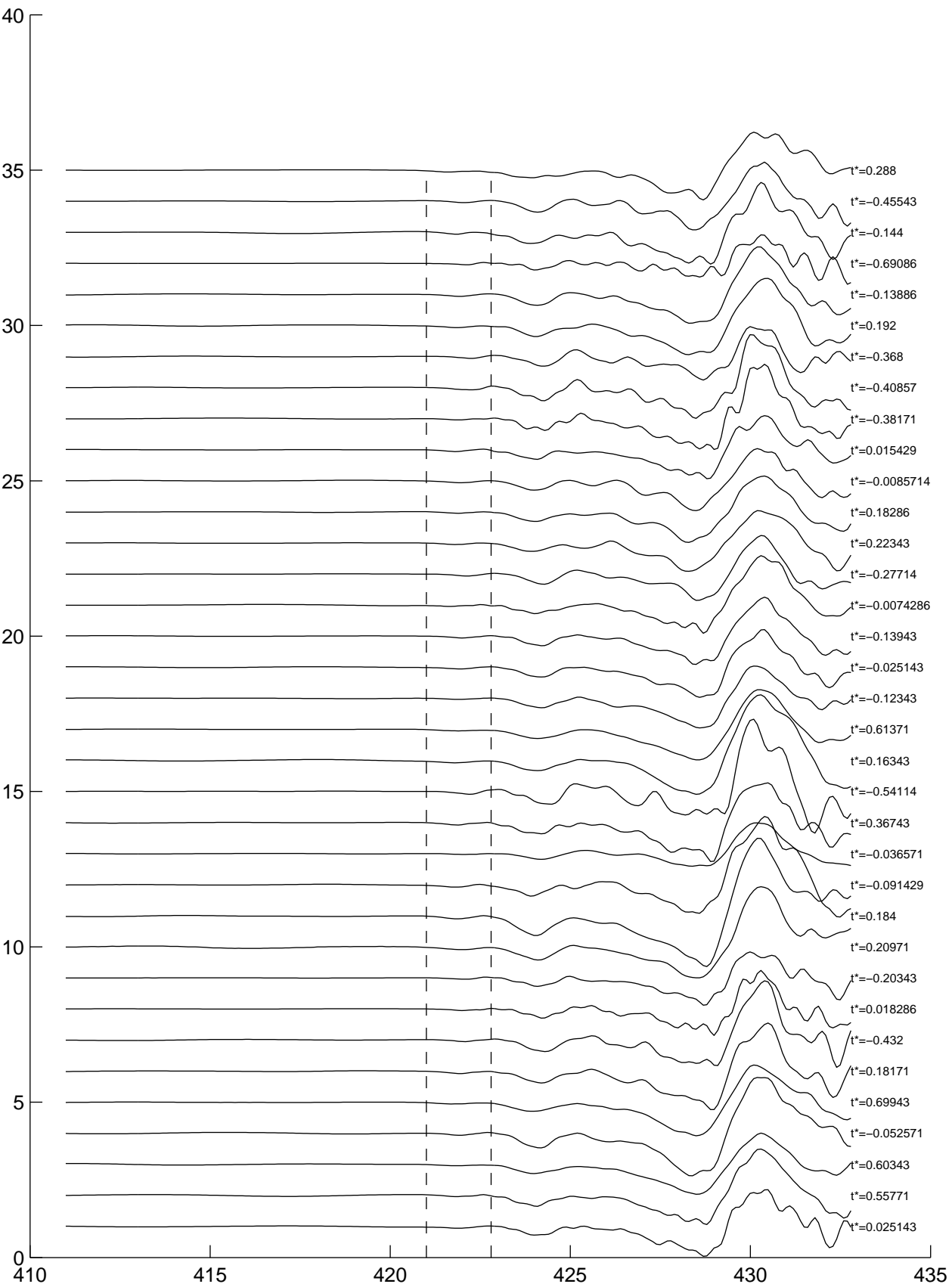
travel time residuals



$t^*$  values

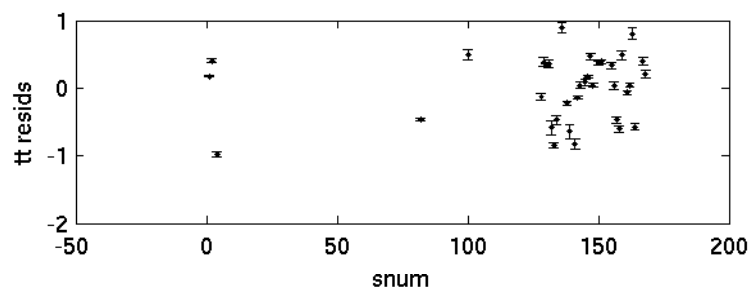
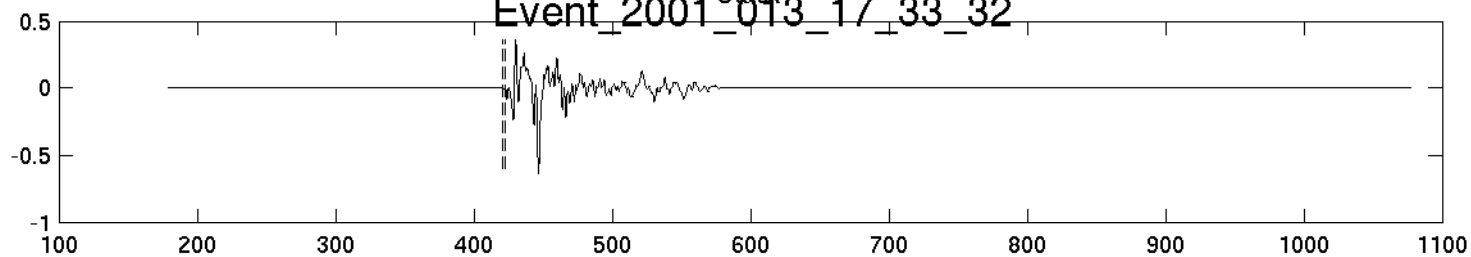


# Event\_2001\_013\_17\_33\_32

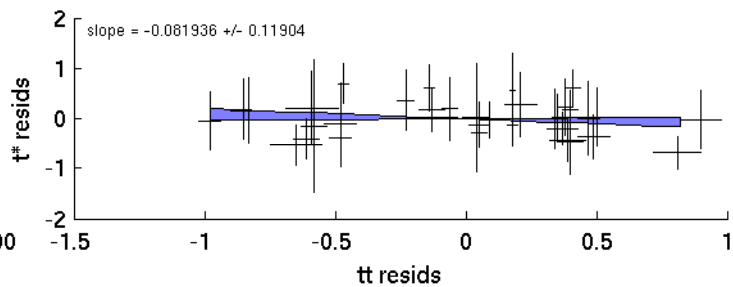
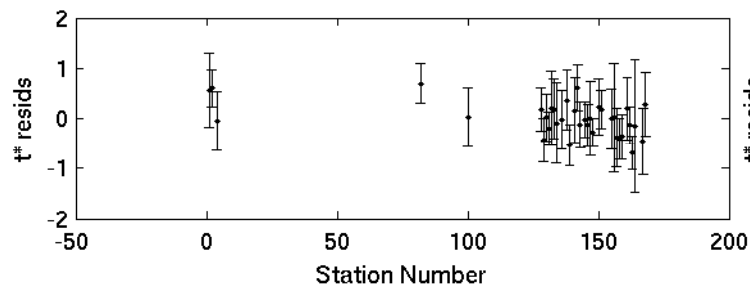


# Event 2001\_013\_17\_33\_32

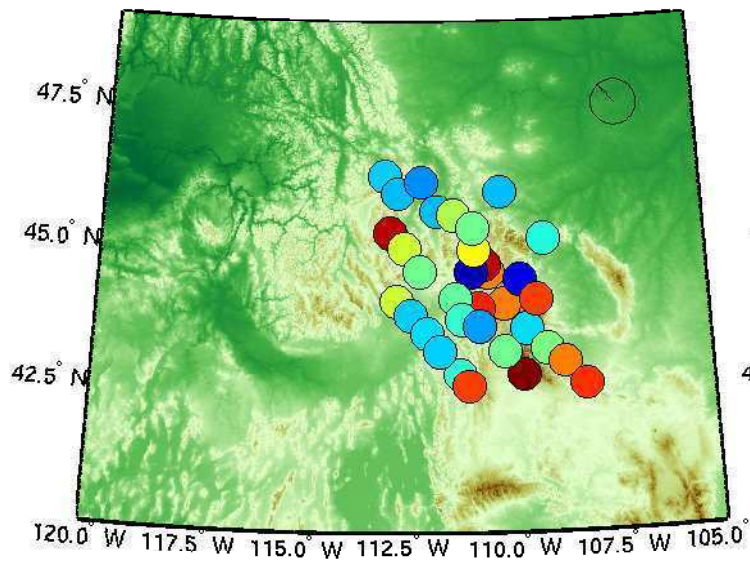
Stack



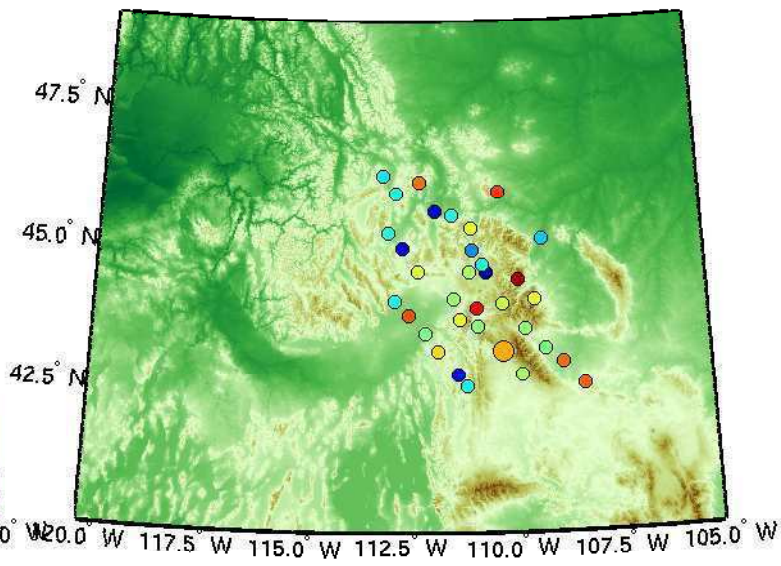
Baz = 141.9137  
Mean xcor value = 0.81343  
Range of  $t^*$  values is 1.3903  
Median  $t^*$  err is 0.5539



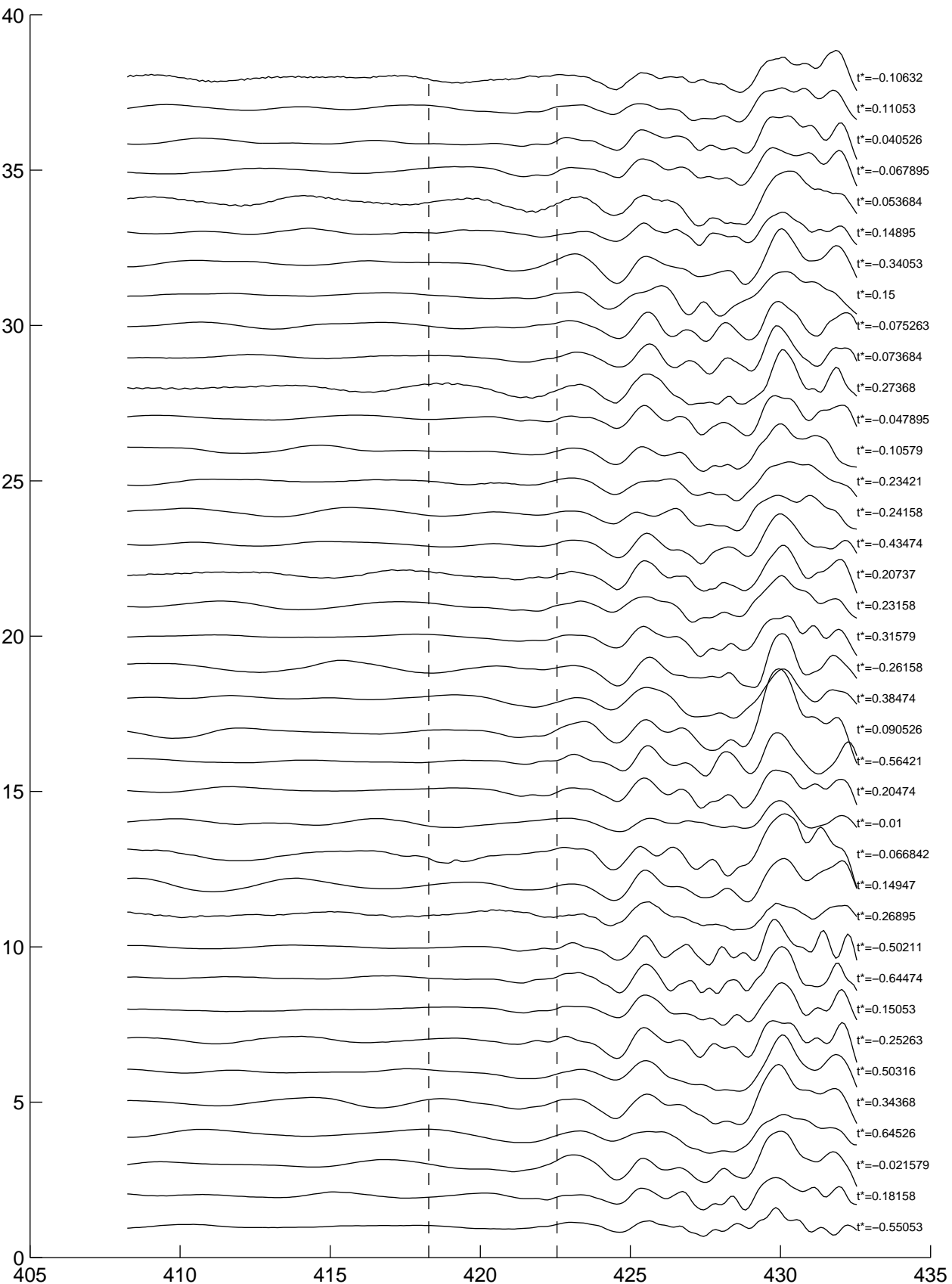
travel time residuals



$t^*$  values

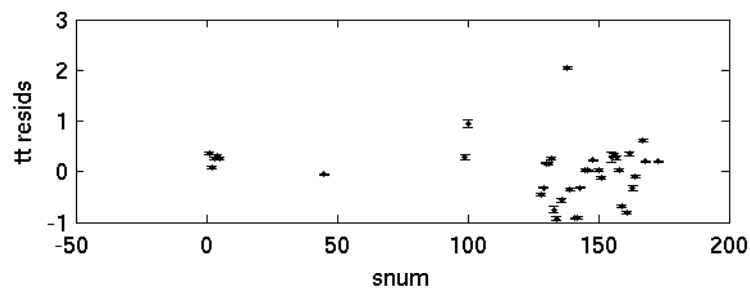
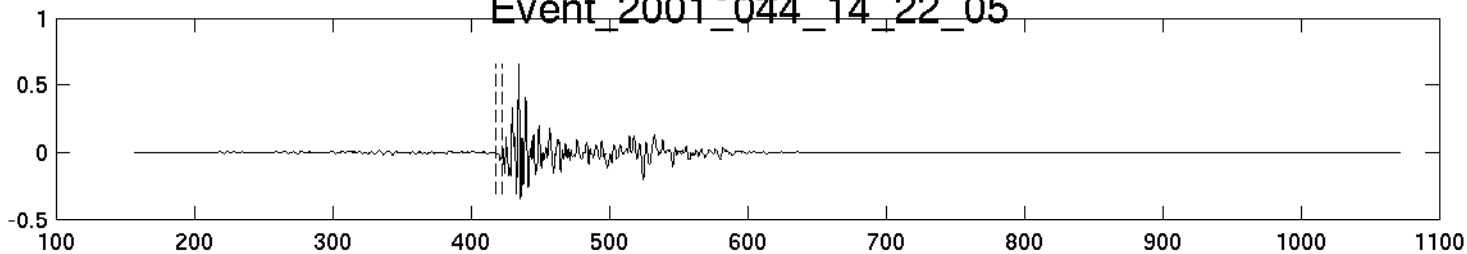


# Event\_2001\_044\_14\_22\_05

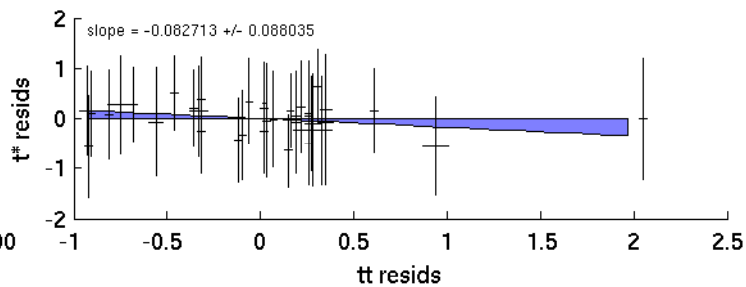
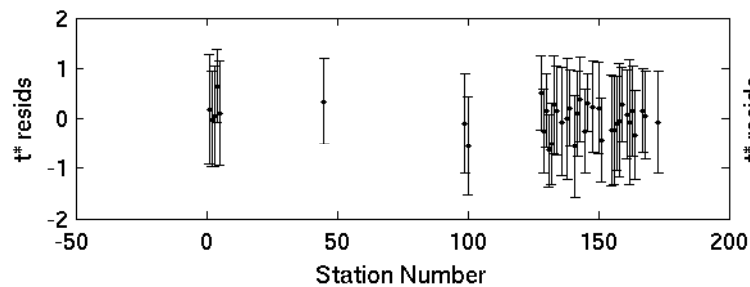


# Event 2001\_044\_14\_22\_05

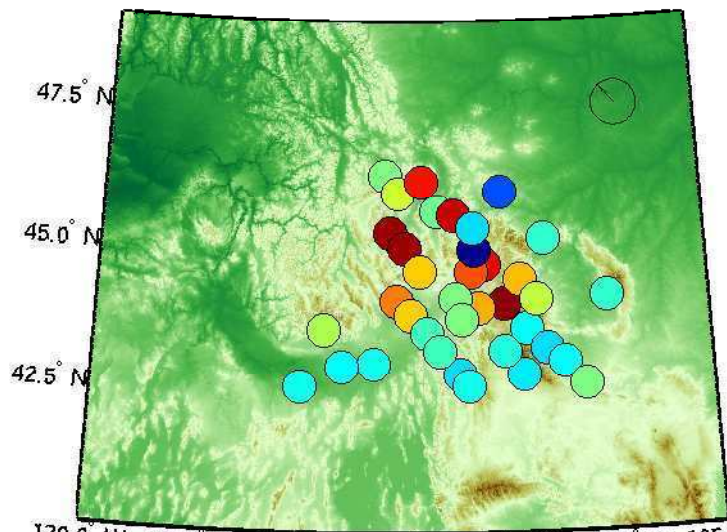
Stack



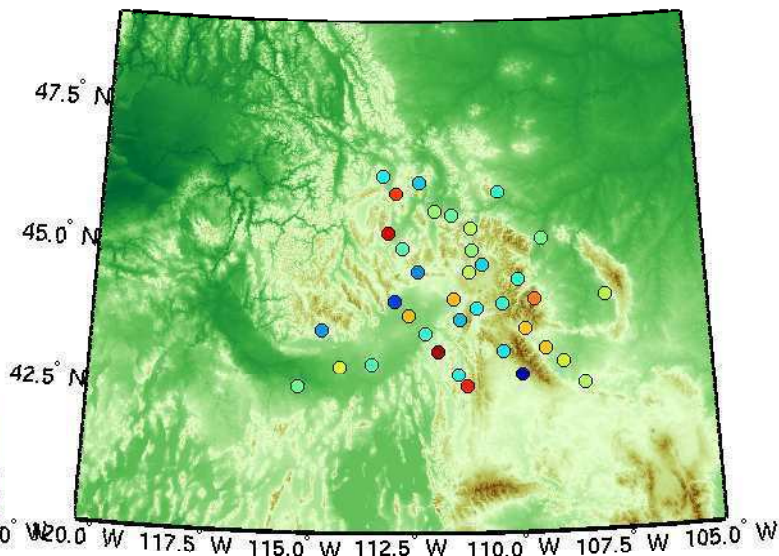
Baz = 141.2045  
Mean xcor value = 0.79263  
Range of  $t^*$  values is 1.29  
Median  $t^*$  err is 0.69671



travel time residuals

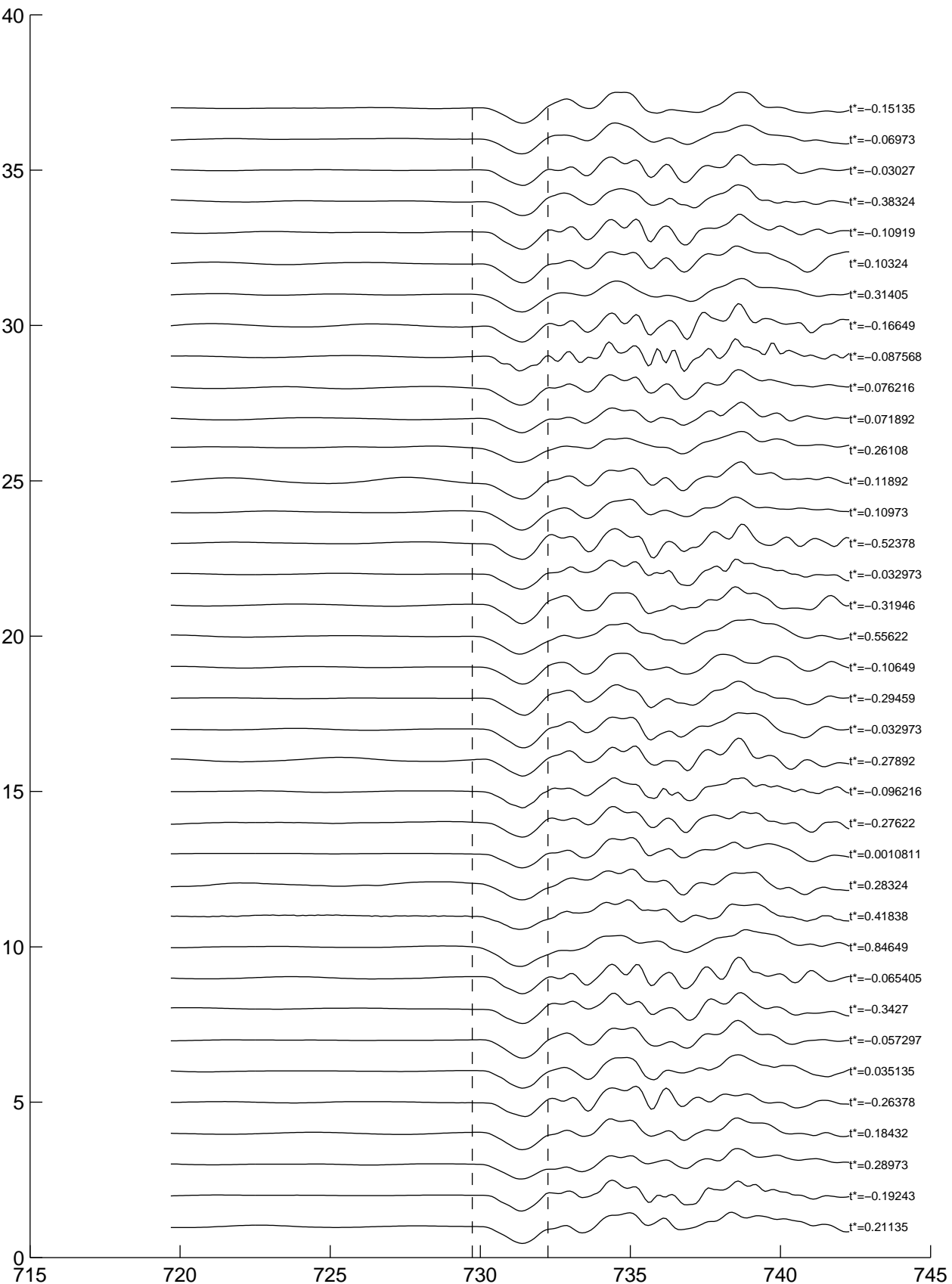


$t^*$  values



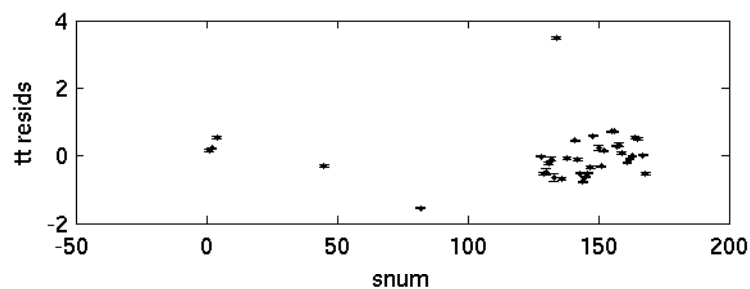
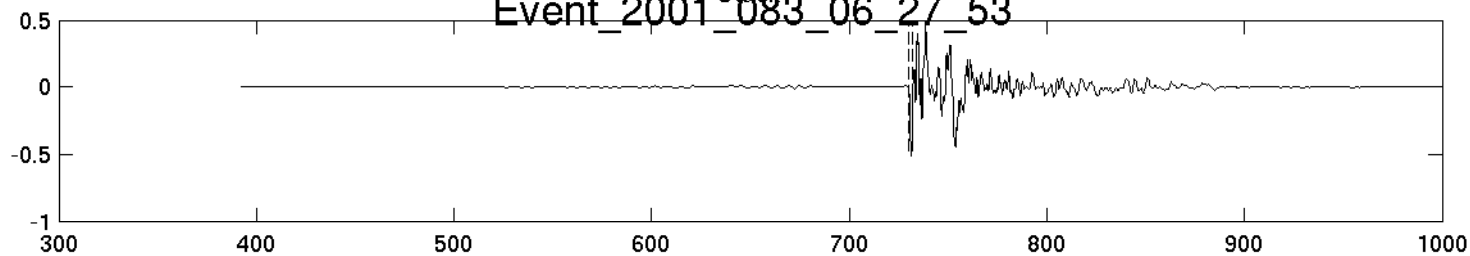


# Event\_2001\_083\_06\_27\_53

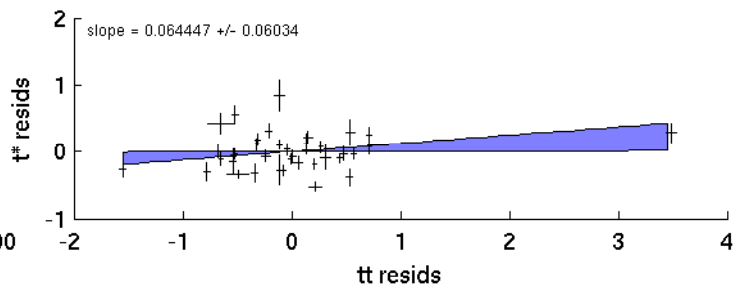
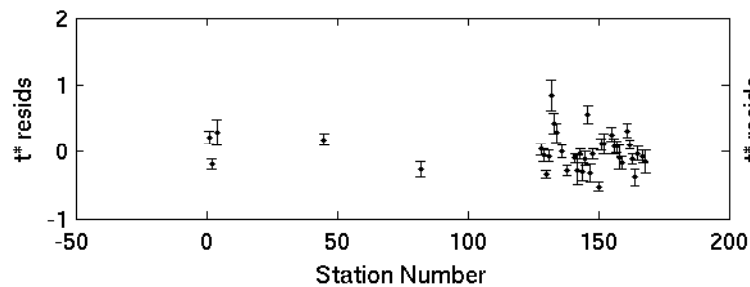


# Event\_2001\_083\_06\_27\_53

Stack

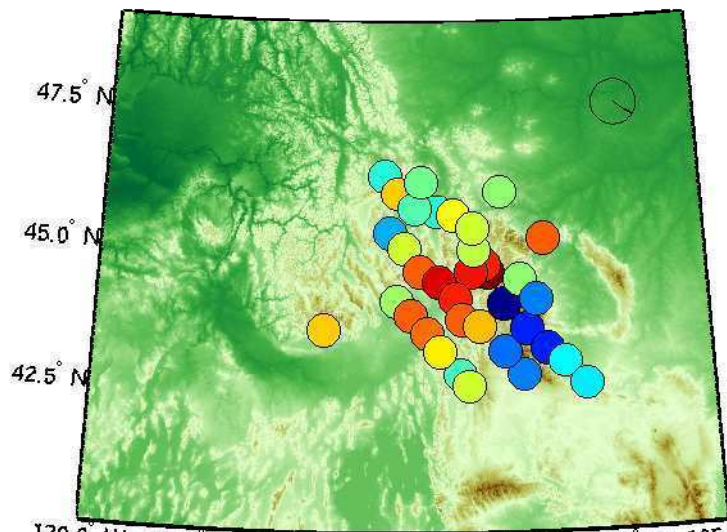


Baz = 306.5493  
Mean xcor value = 0.76324  
Range of  $t^*$  values is 1.3703  
Median  $t^*$  err is 0.099476

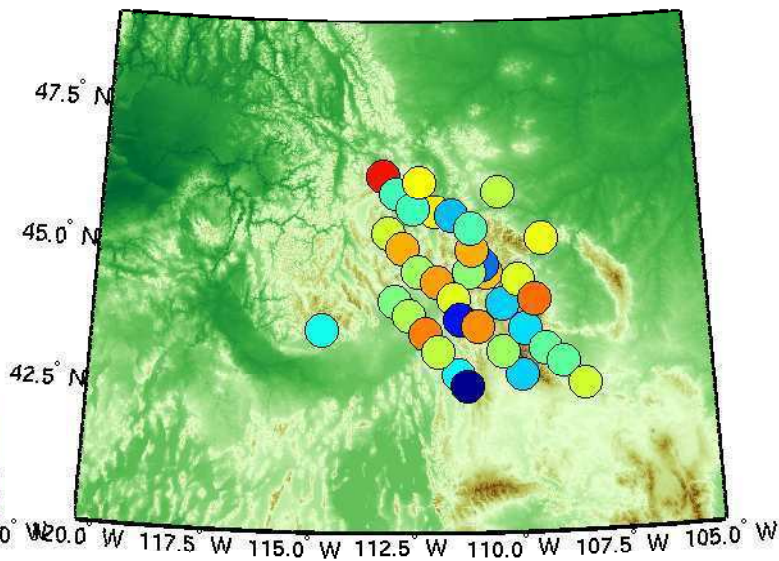


slope = 0.064447 +/- 0.06034

travel time residuals

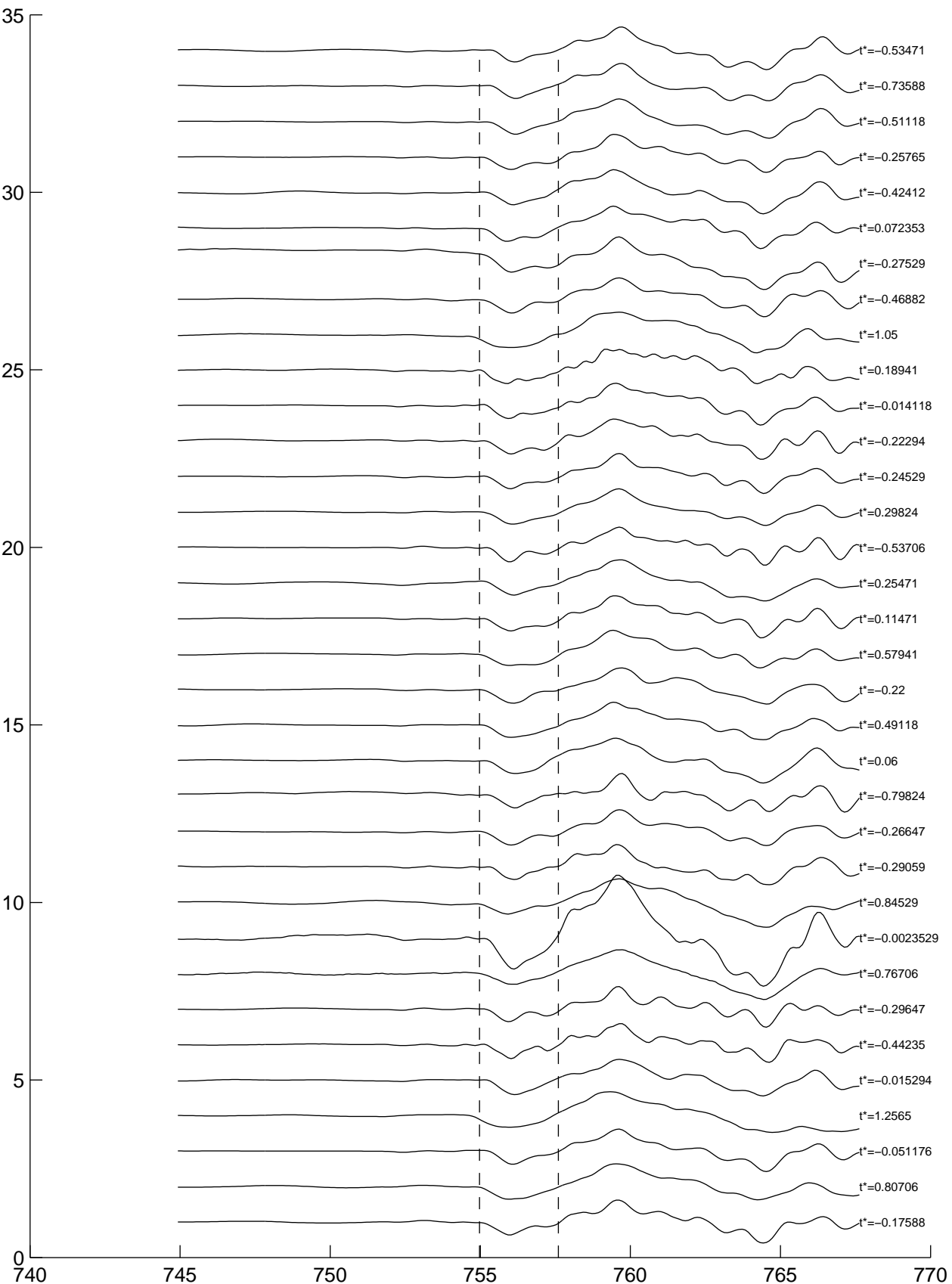


$t^*$  values



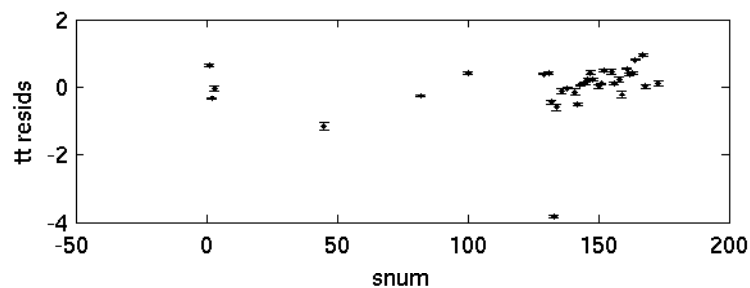
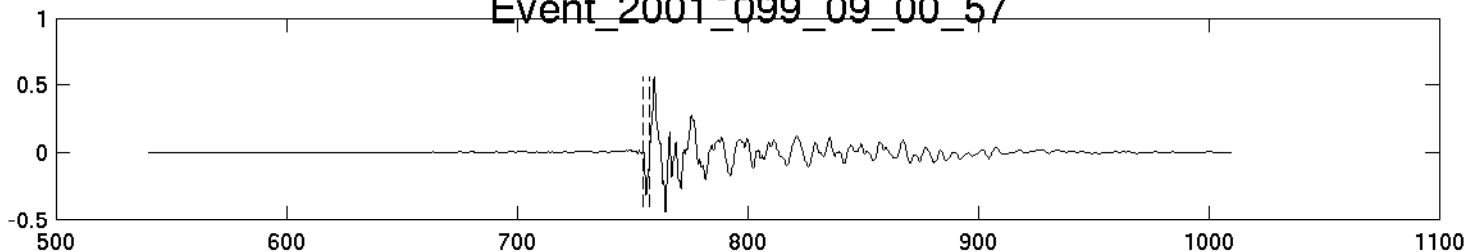


# Event\_2001\_099\_09\_00\_57

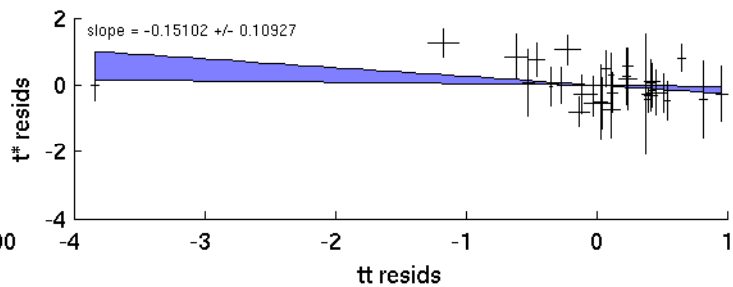
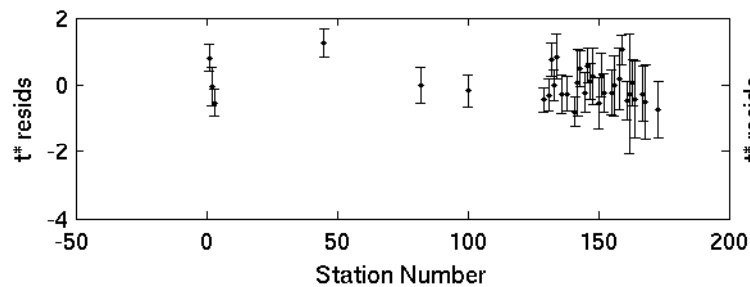


# Event\_2001\_099\_09\_00\_57

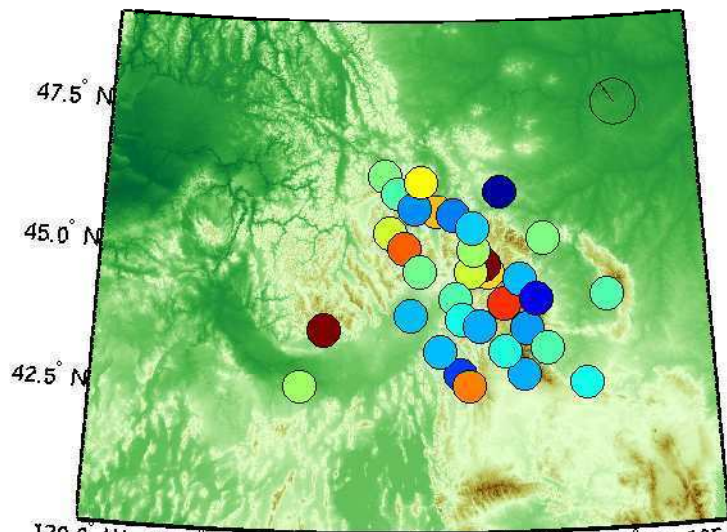
Stack



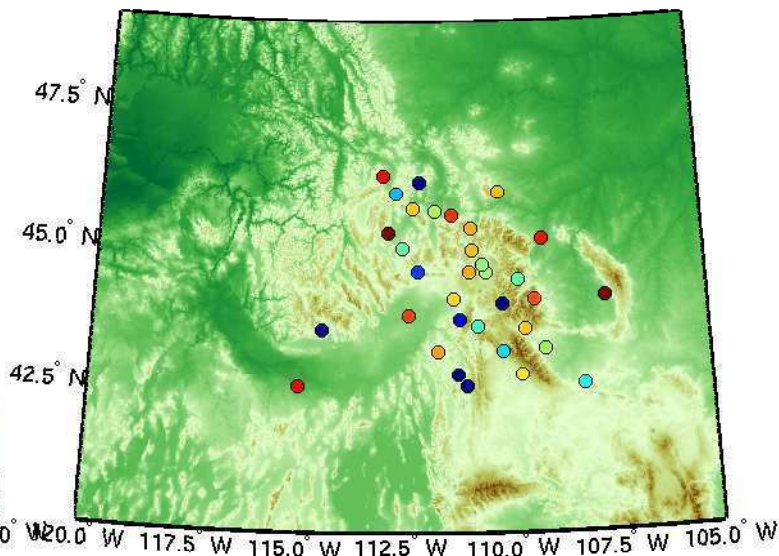
Baz = 148.6209  
Mean xcor value = 0.82735  
Range of  $t^*$  values is 2.0547  
Median  $t^*$  err is 0.57537



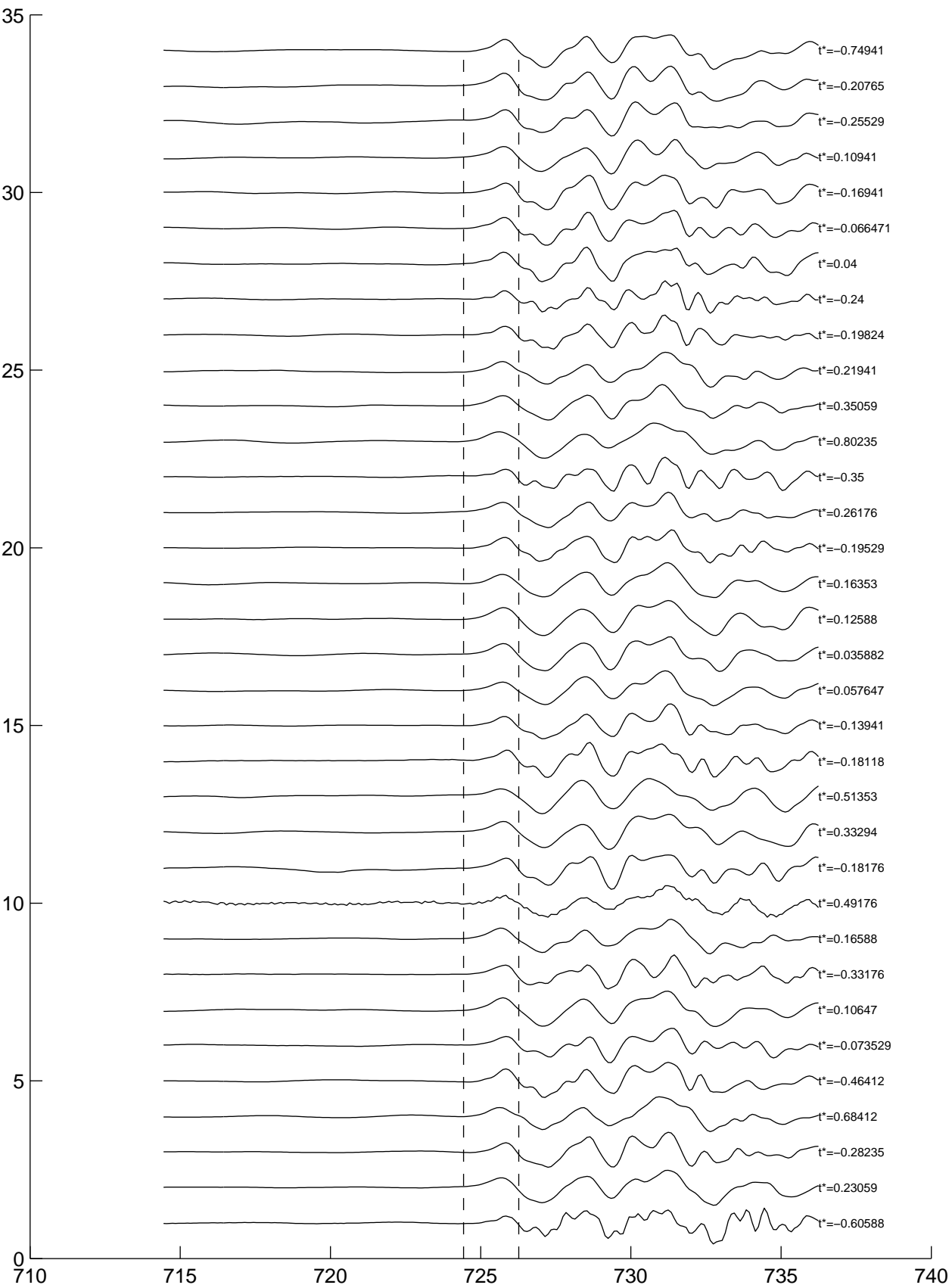
travel time residuals



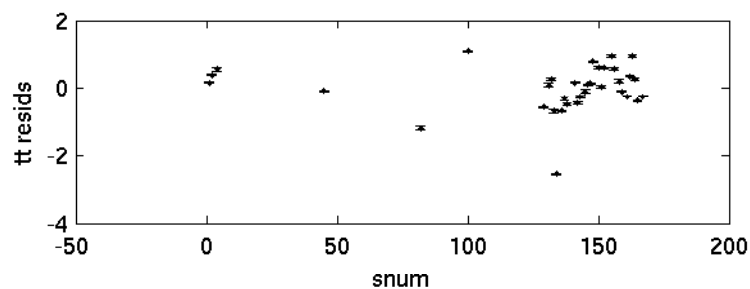
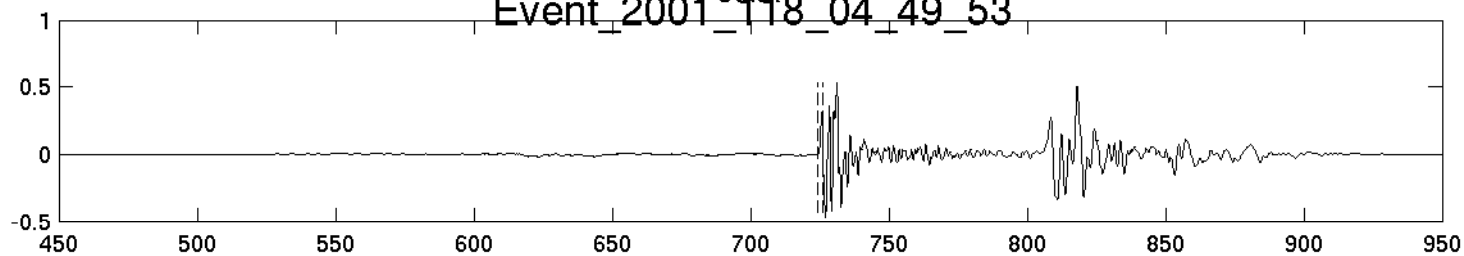
$t^*$  values



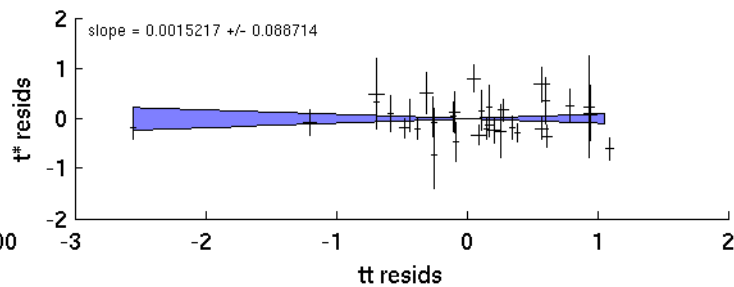
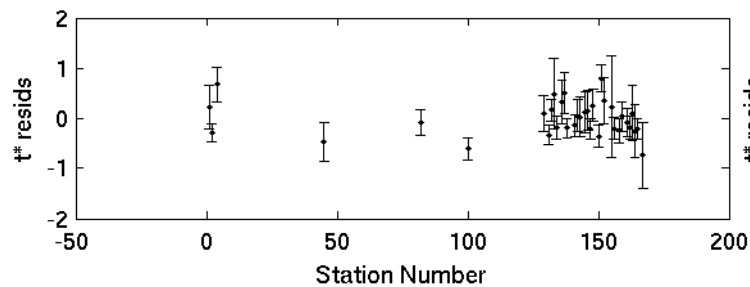
# Event\_2001\_118\_04\_49\_53



# Event\_2001\_118\_04\_49\_53<sup>Stack</sup>

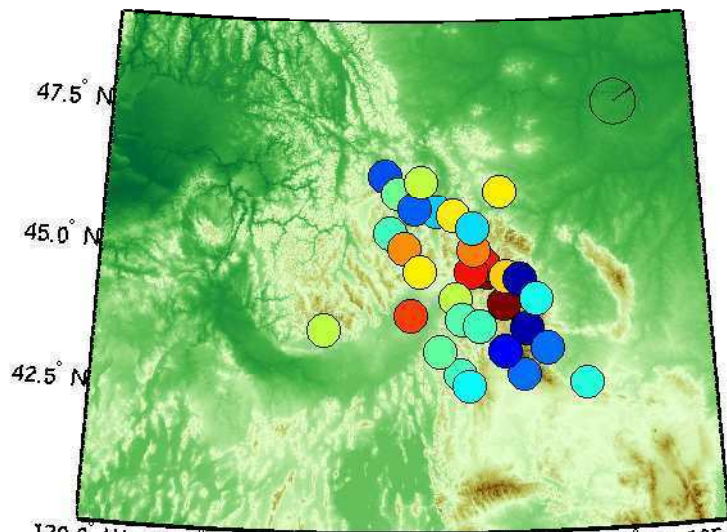


Baz = 237.1532  
Mean xcor value = 0.72029  
Range of  $t^*$  values is 1.5518  
Median  $t^*$  err is 0.30194

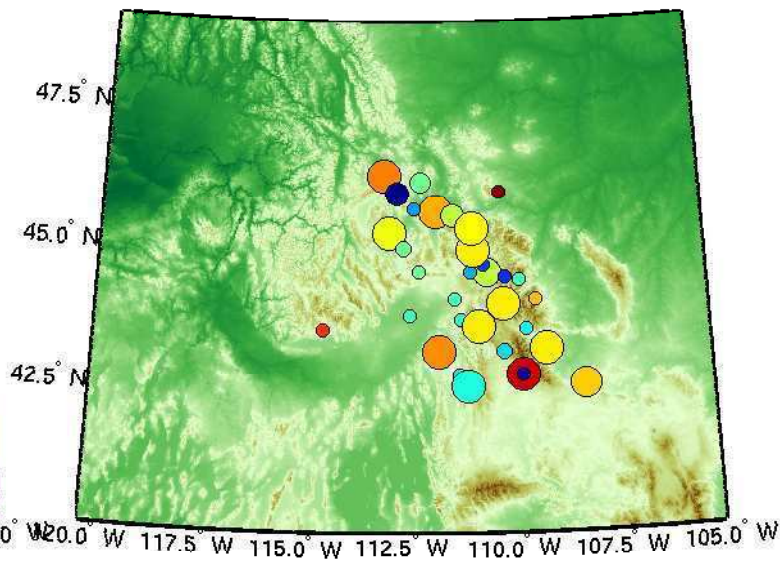


slope = 0.0015217 +/- 0.088714

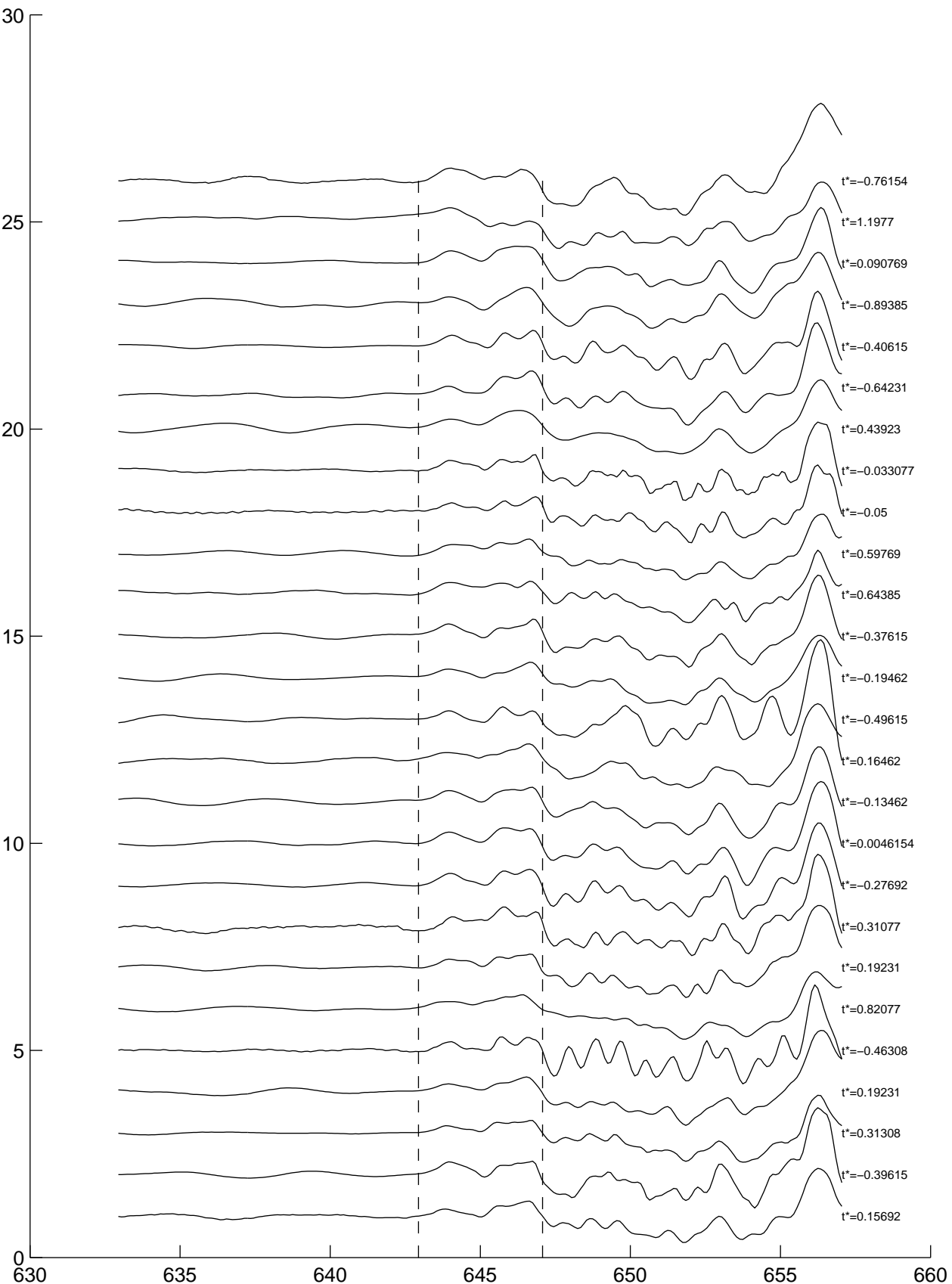
travel time residuals



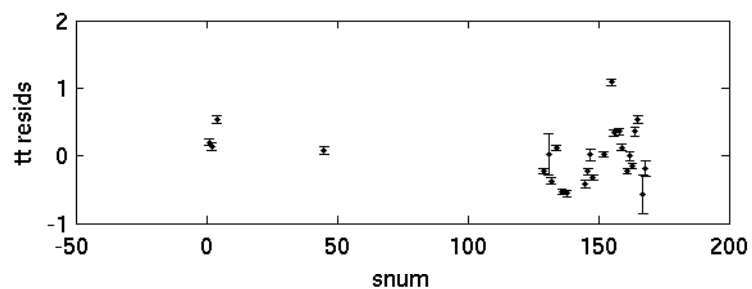
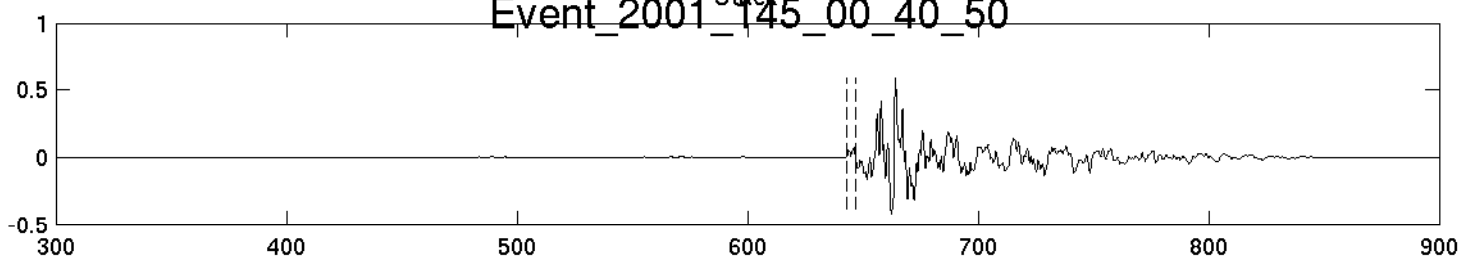
$t^*$  values



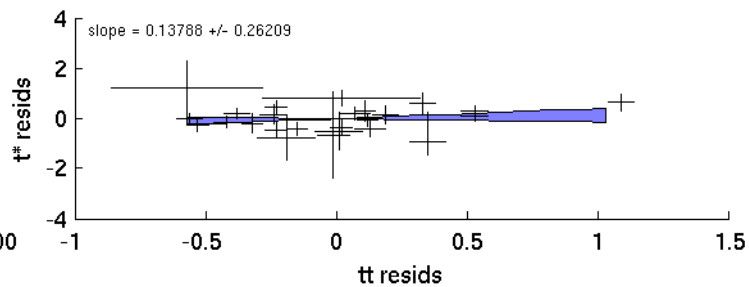
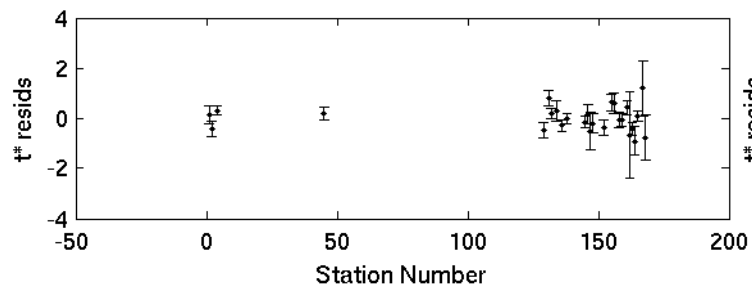
# Event\_2001\_145\_00\_40\_50



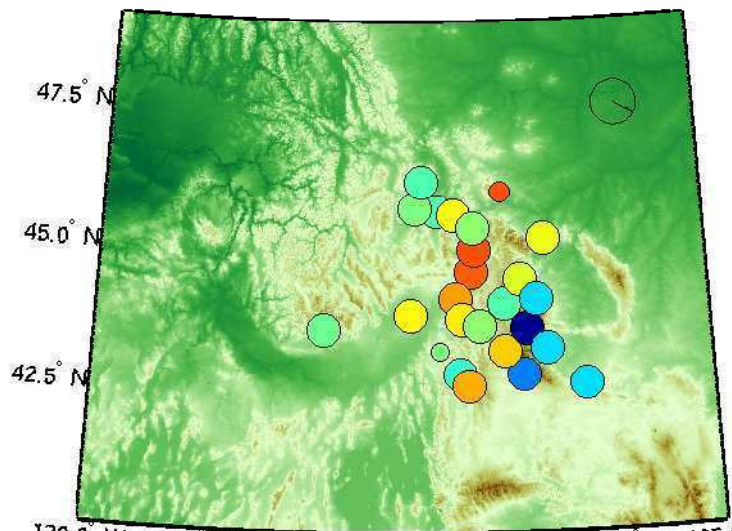
# Event\_2001\_Stack\_145\_00\_40\_50



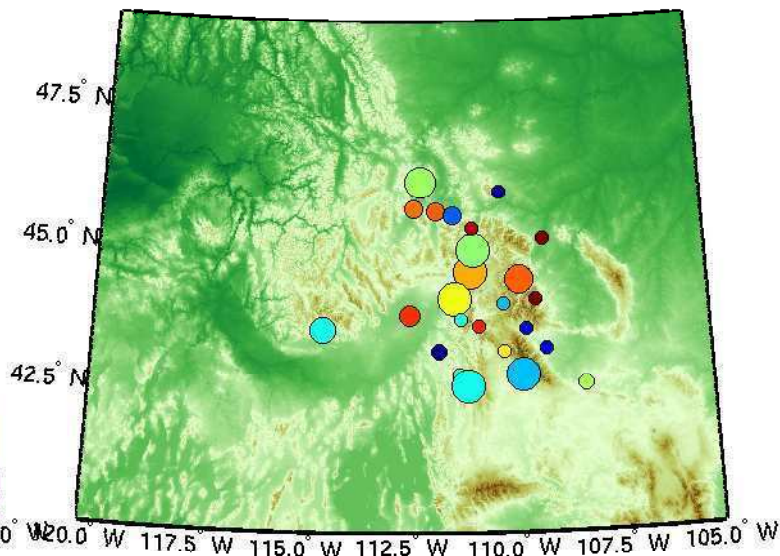
Baz = 302.348  
Mean xcor value = 0.77269  
Range of  $t^*$  values is 2.0915  
Median  $t^*$  err is 0.30972



travel time residuals

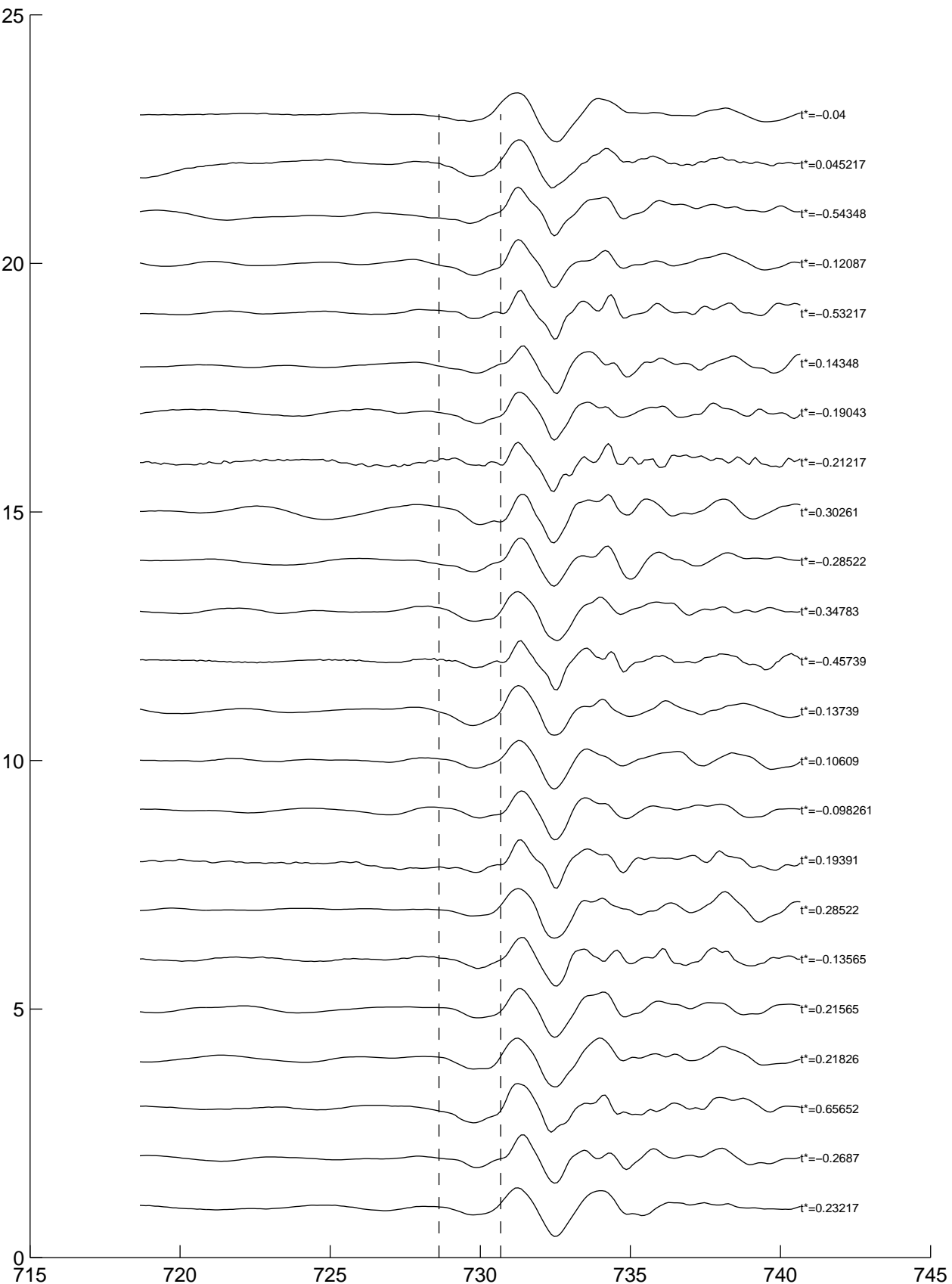


$t^*$  values

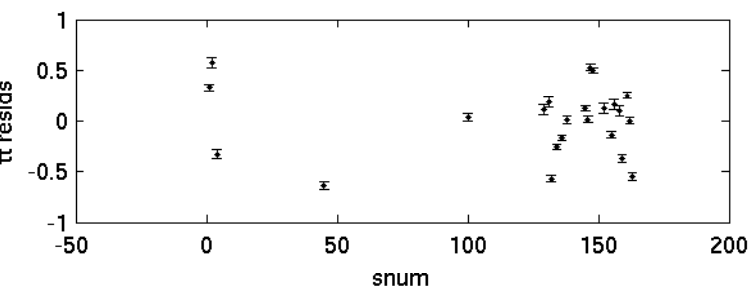
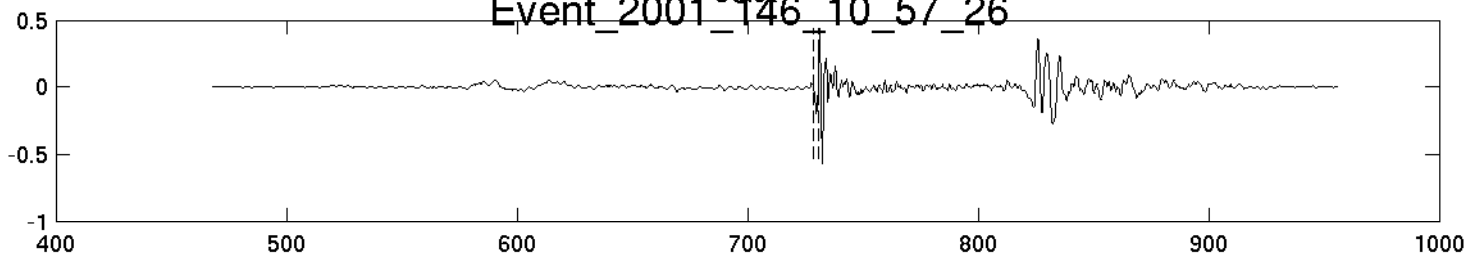




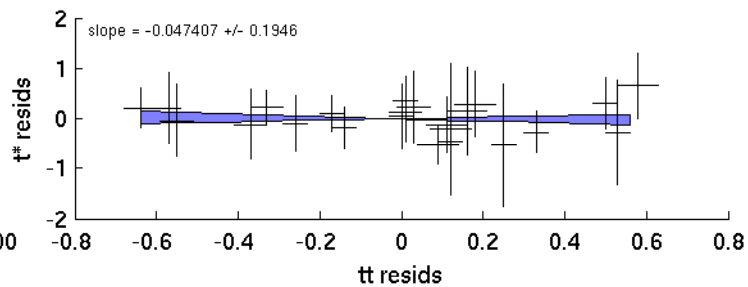
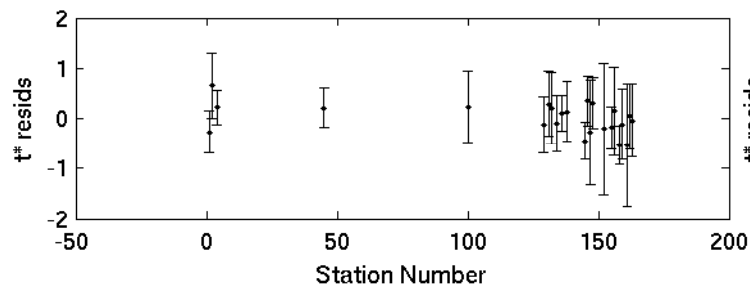
# Event\_2001\_146\_10\_57\_26



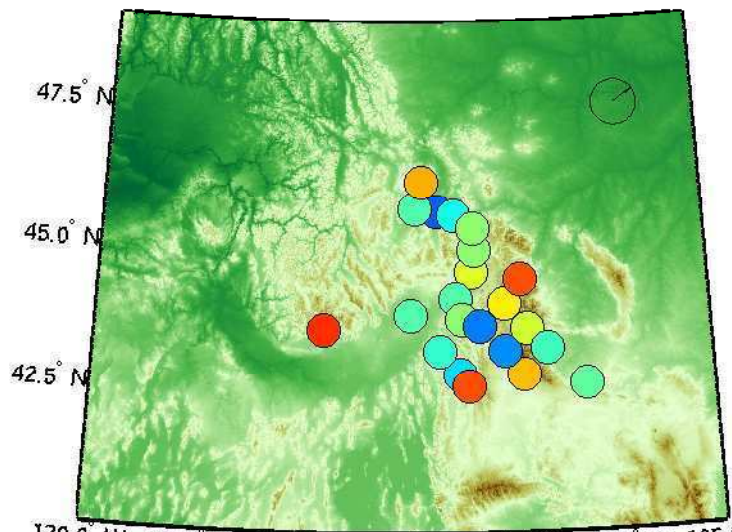
# Event\_2001\_146\_10\_57\_26



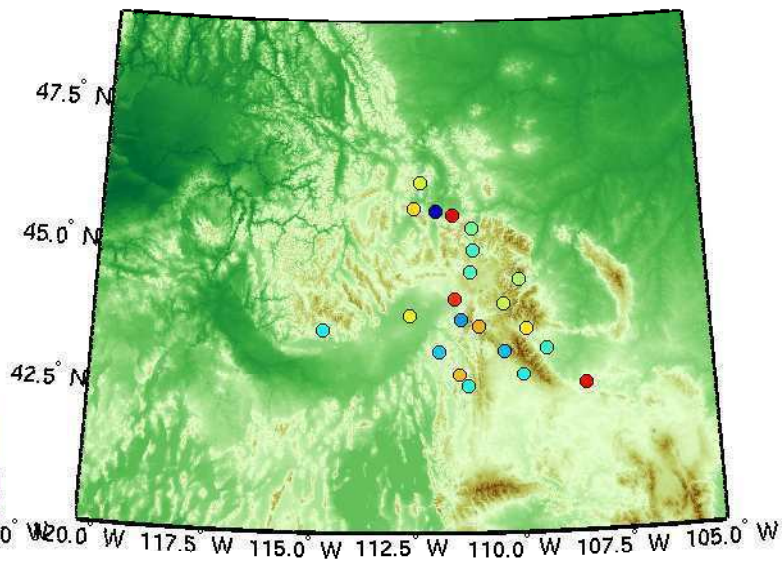
Baz = 235.7213  
Mean xcor value = 0.67652  
Range of  $t^*$  values is 1.2  
Median  $t^*$  err is 0.60797



travel time residuals

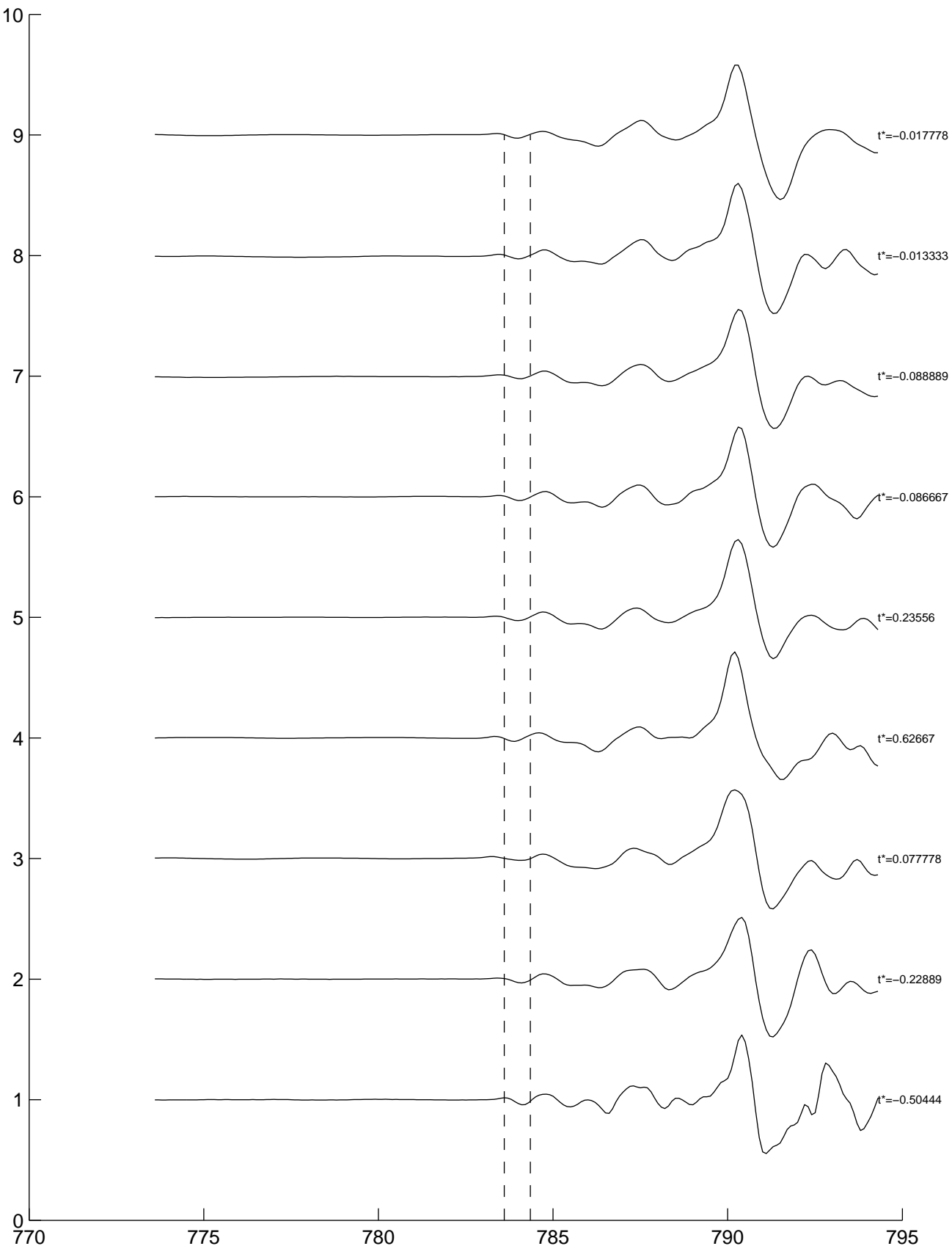


$t^*$  values

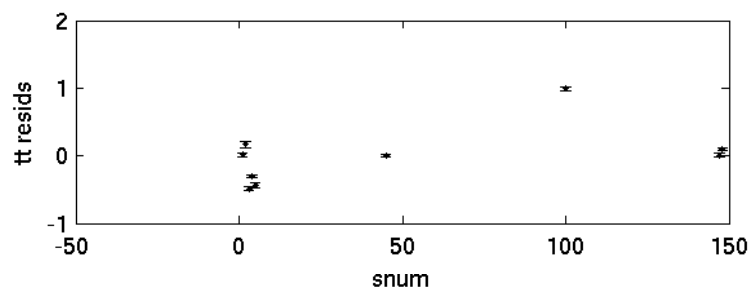
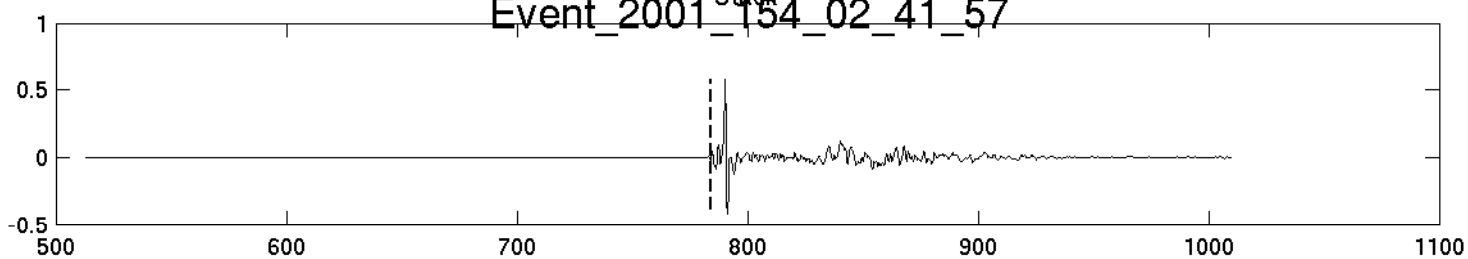




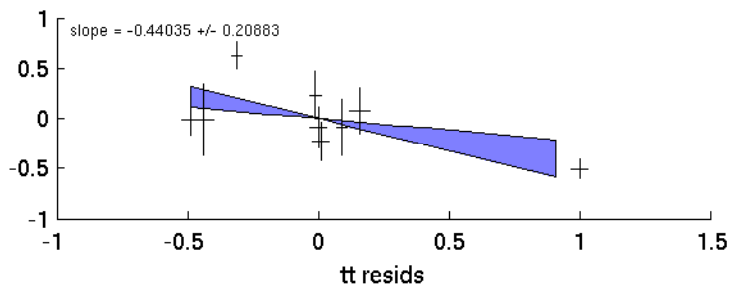
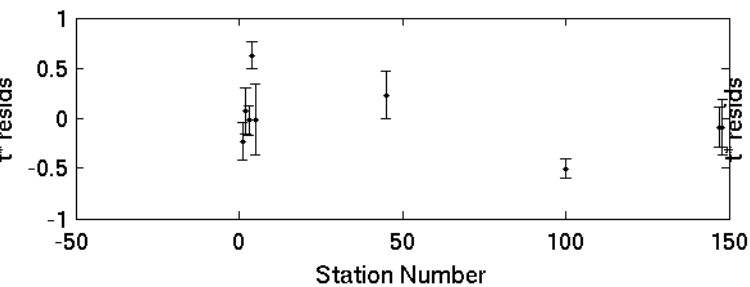
# Event\_2001\_154\_02\_41\_57



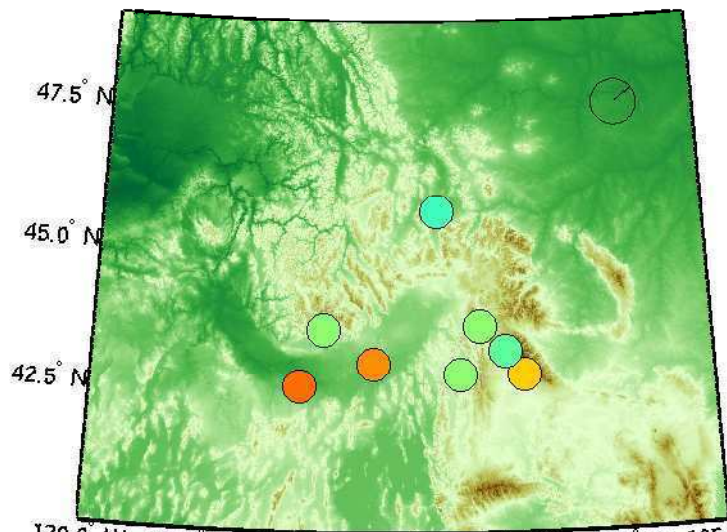
# Event\_2001\_154\_02\_41\_57



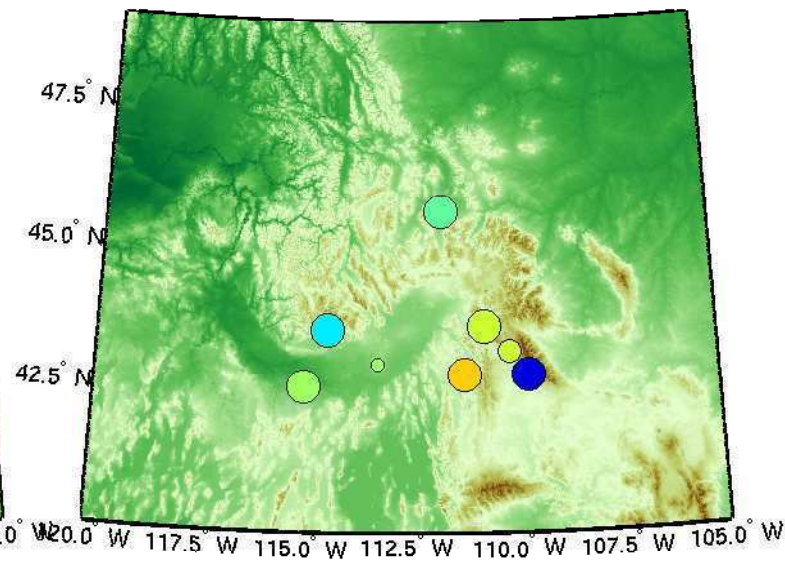
Baz = 233.2653  
 Mean xcor value = 0.76222  
 Range of  $t^*$  values is 1.1311  
 Median  $t^*$  err is 0.20566



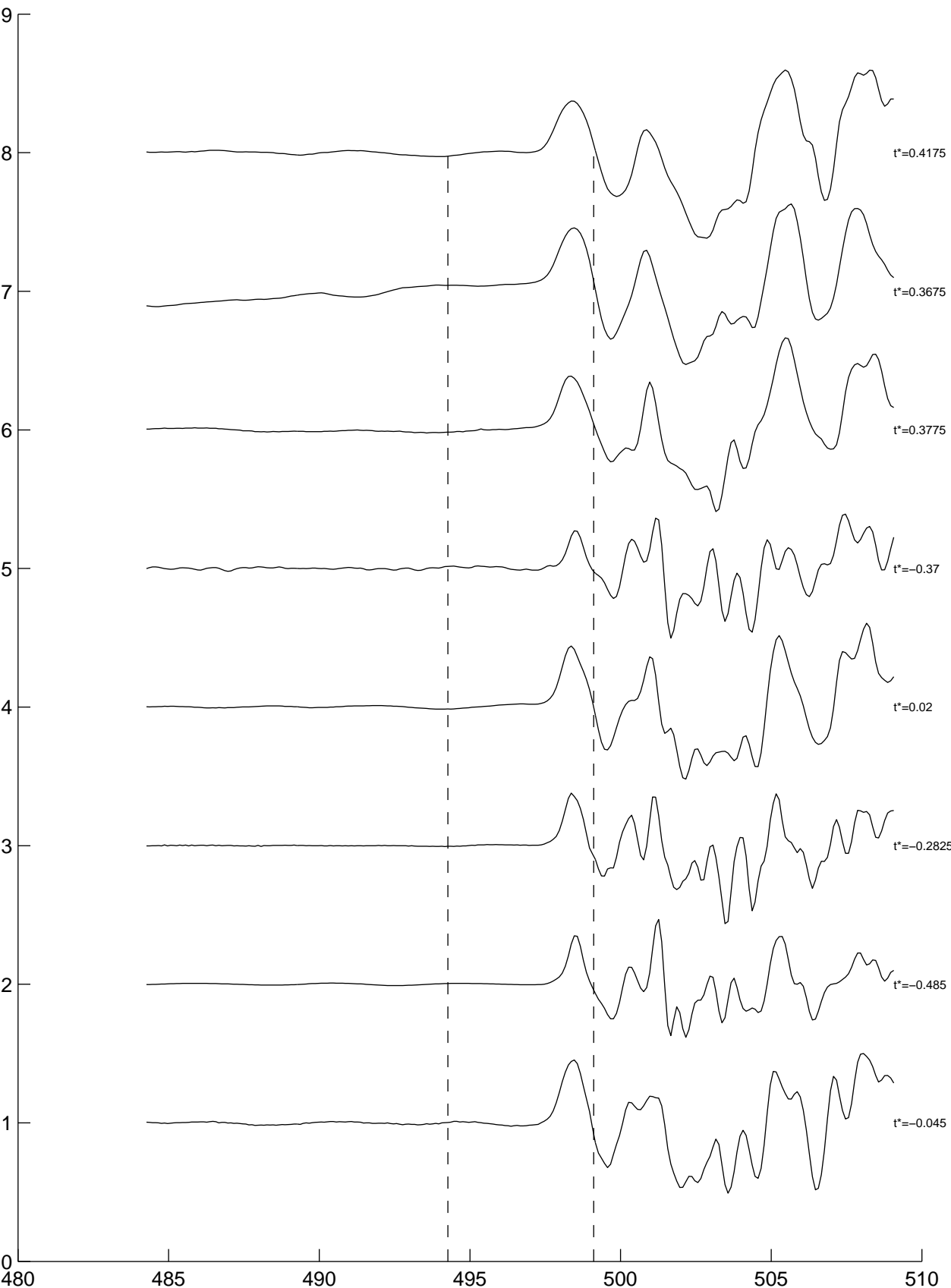
travel time residuals



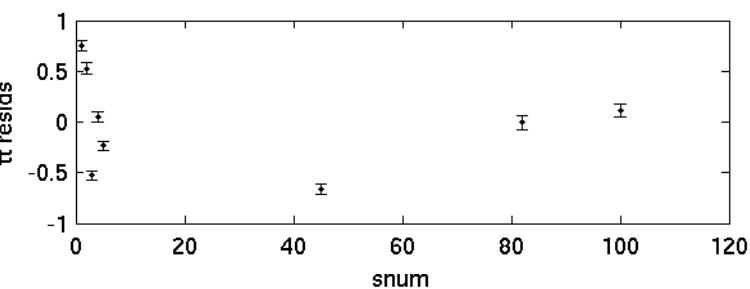
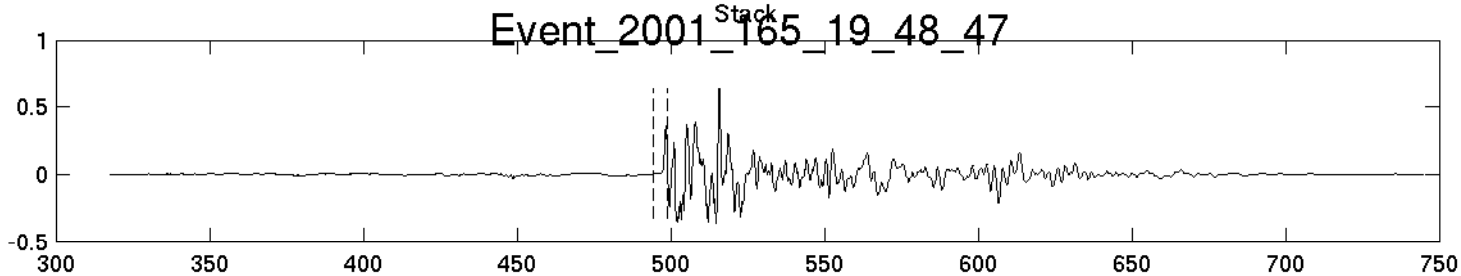
$t^*$  values



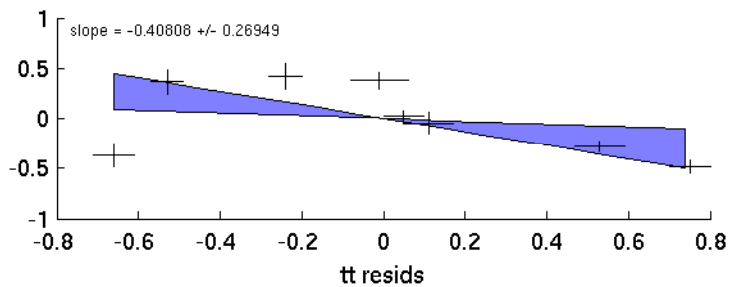
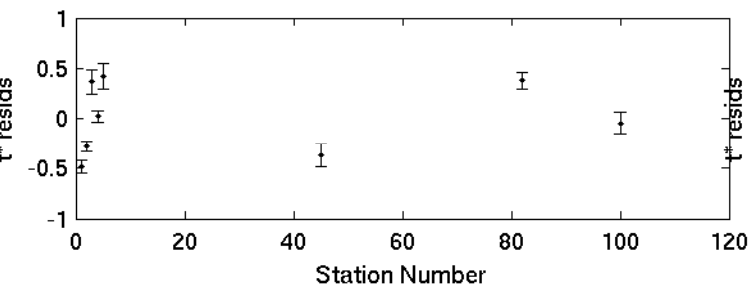
# Event\_2001\_165\_19\_48\_47



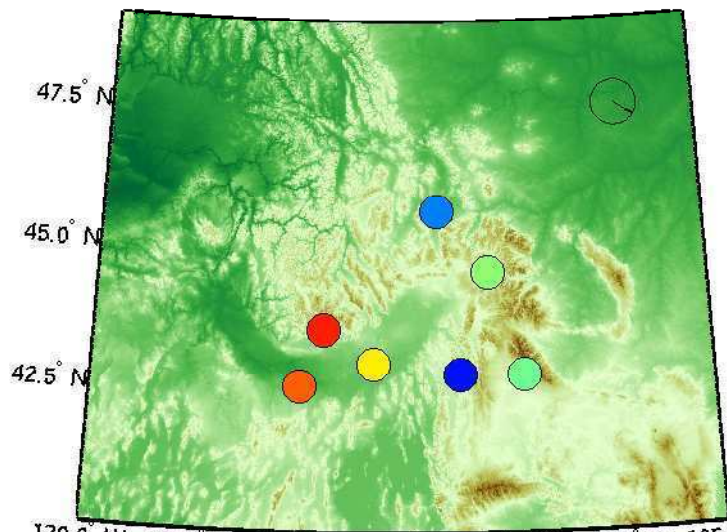
# Event\_2001\_165\_19\_48\_47



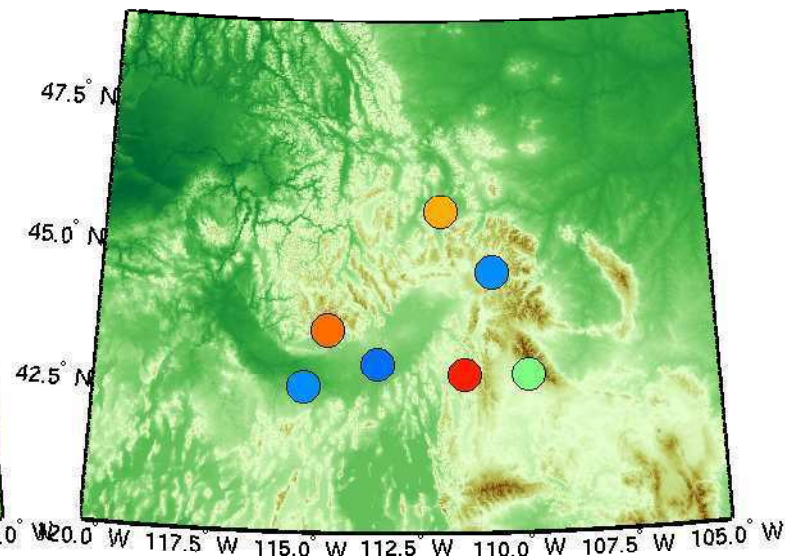
Baz = 304.7697  
 Mean xcor value = 0.67375  
 Range of  $t^*$  values is 0.9025  
 Median  $t^*$  err is 0.091246



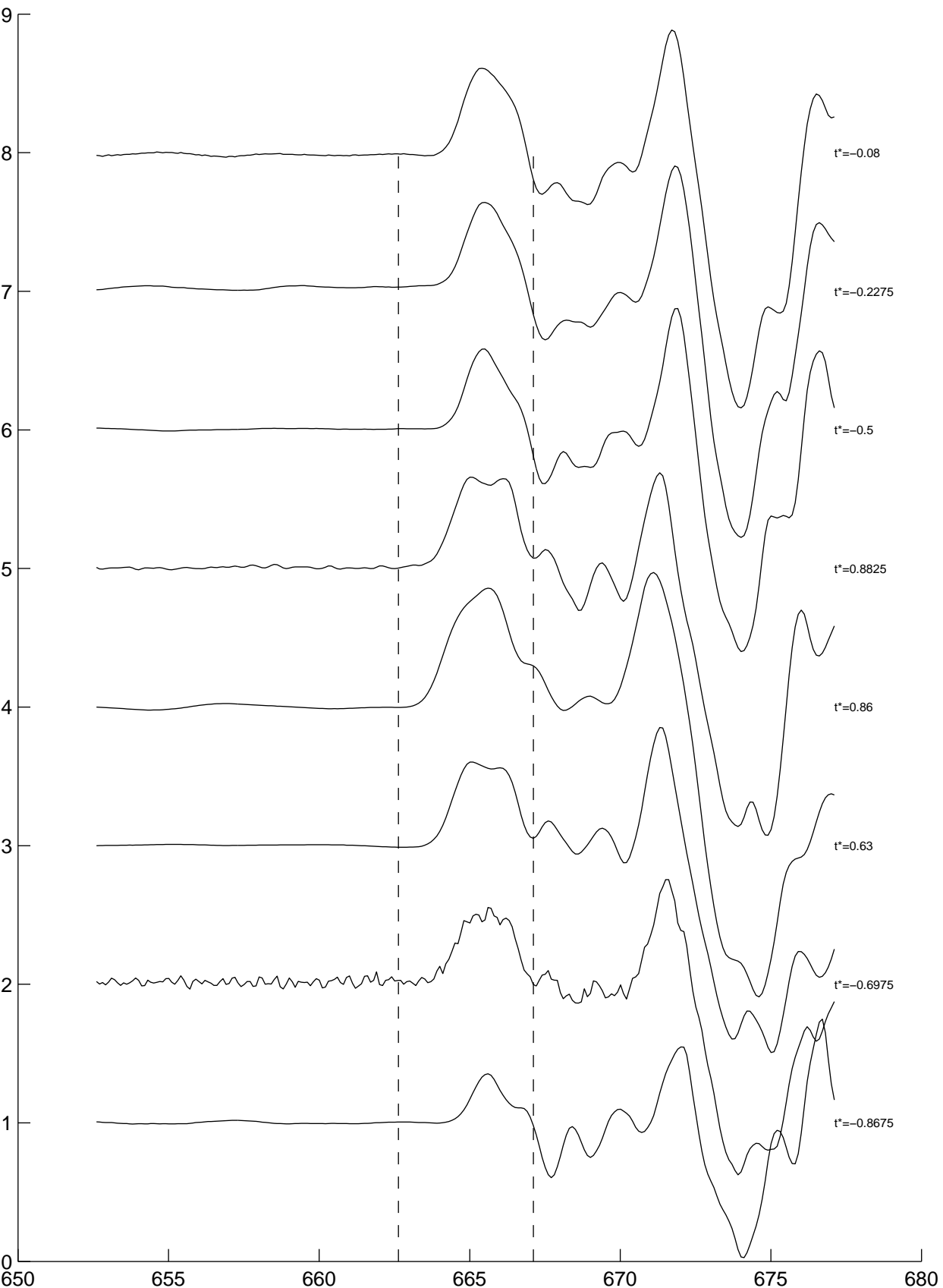
travel time residuals



$t^*$  values

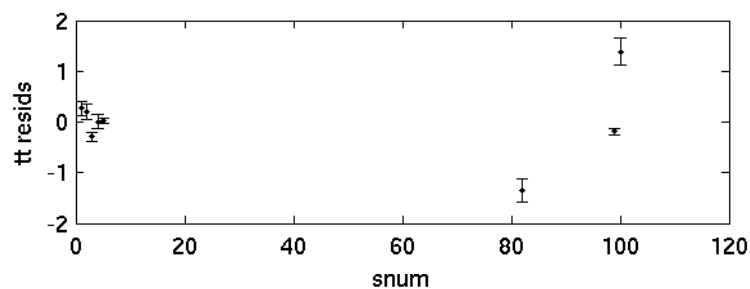
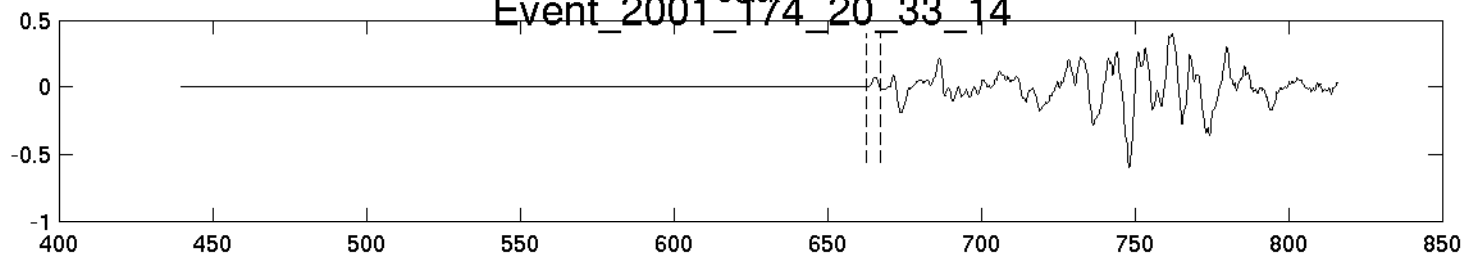


# Event\_2001\_174\_20\_33\_14

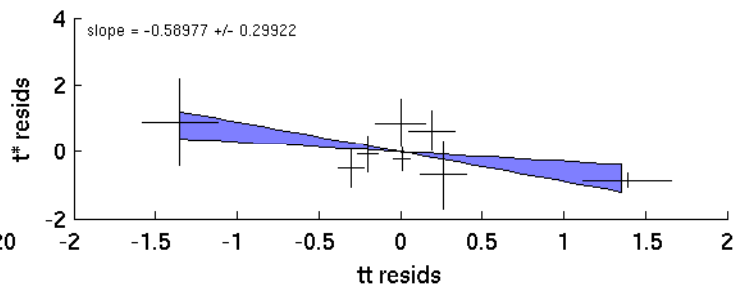
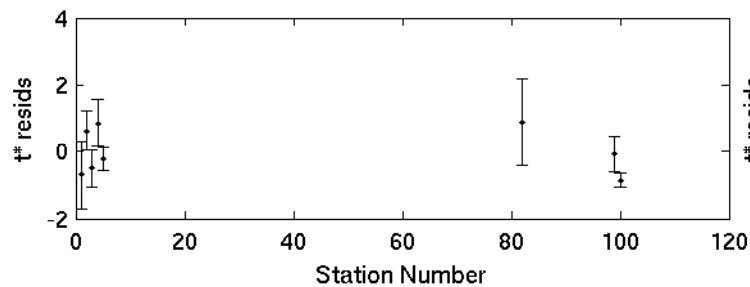


# Event\_2001\_174\_20\_33\_14

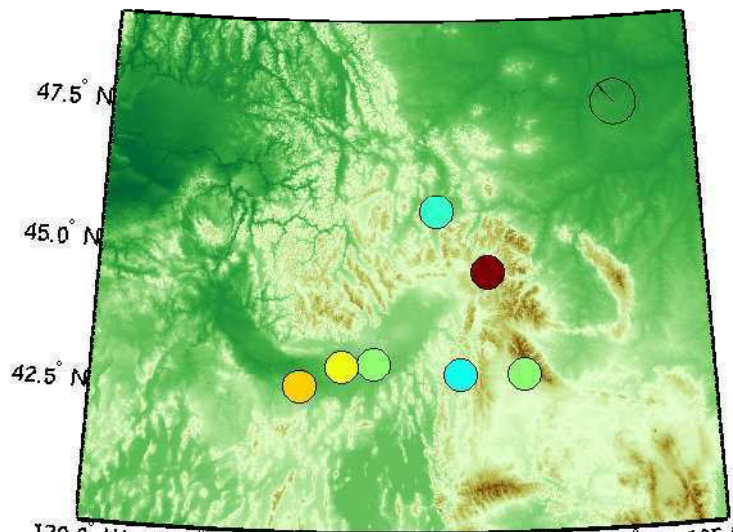
Stack



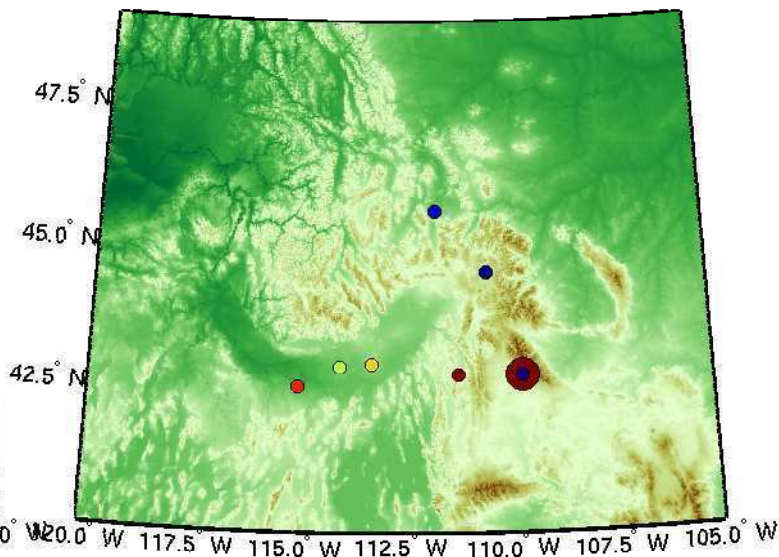
Baz = 140.6029  
Mean xcor value = 0.82375  
Range of  $t^*$  values is 1.75  
Median  $t^*$  err is 0.56564



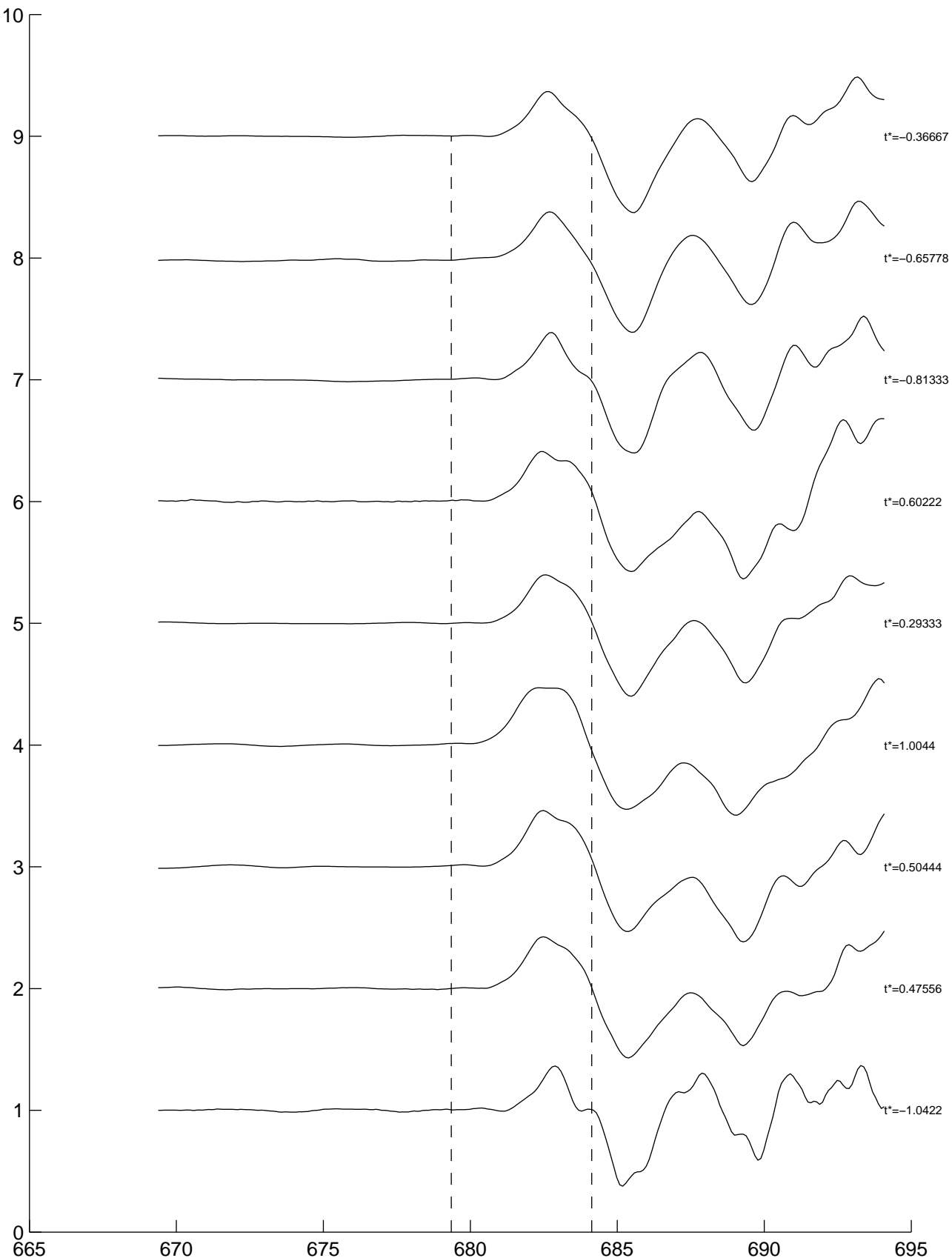
travel time residuals



$t^*$  values

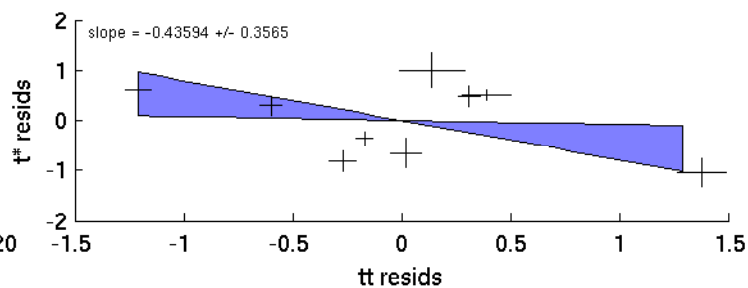
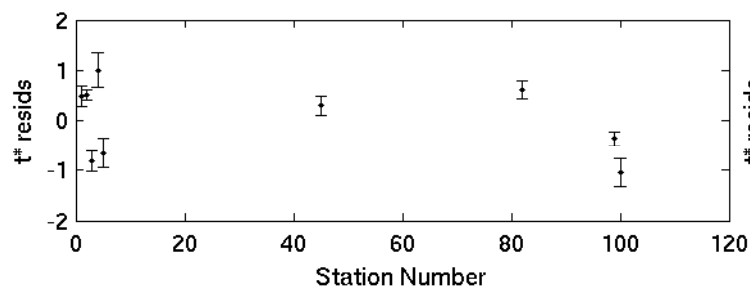
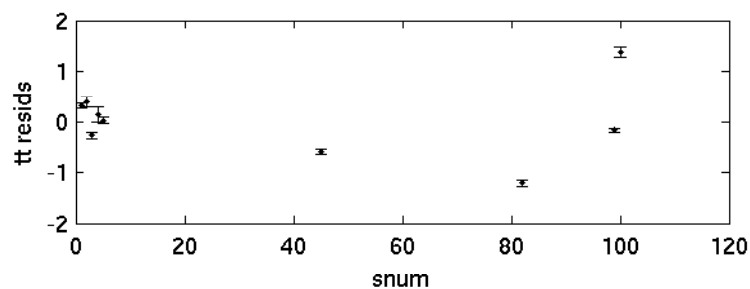
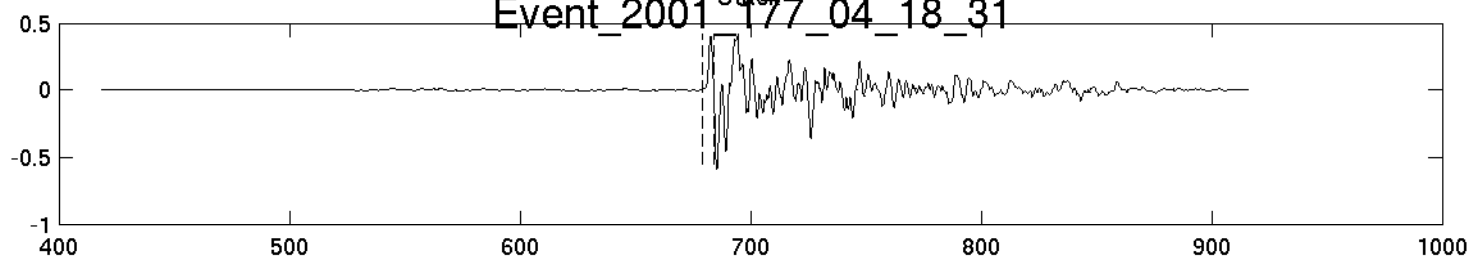


# Event\_2001\_177\_04\_18\_31

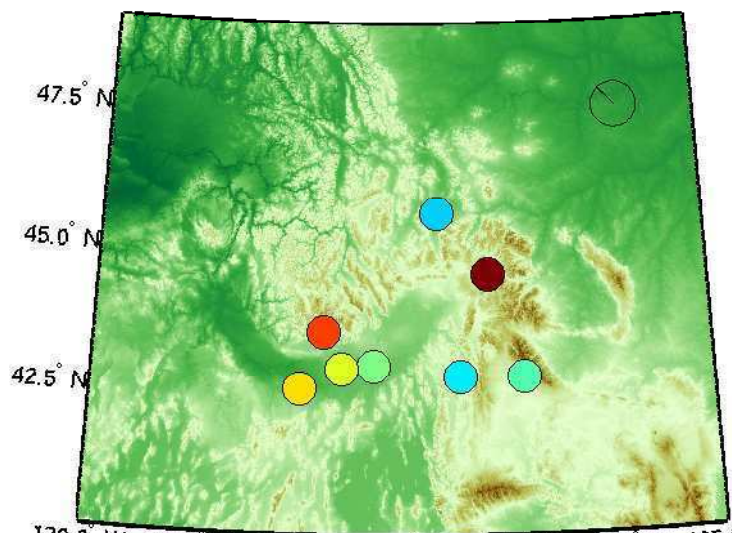




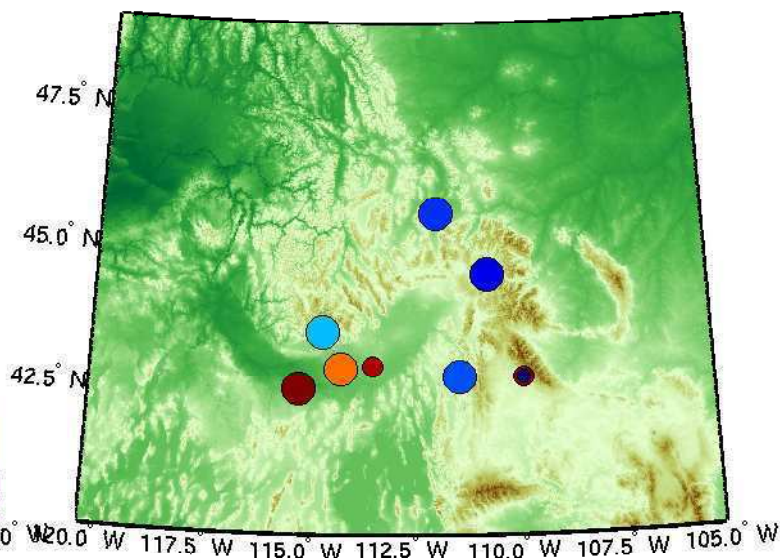
# Event\_2001\_177\_04\_18\_31



travel time residuals

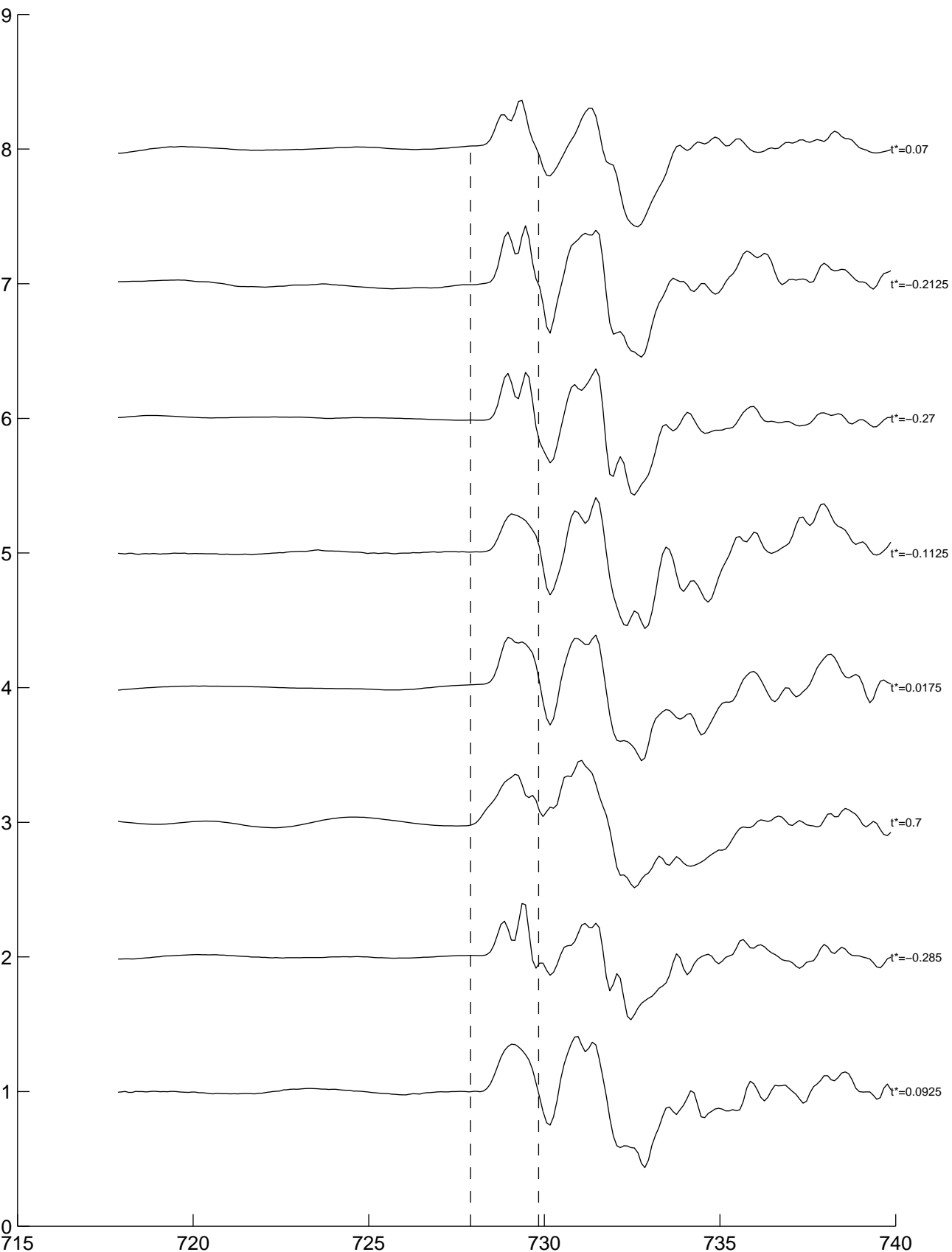


$t^*$  values

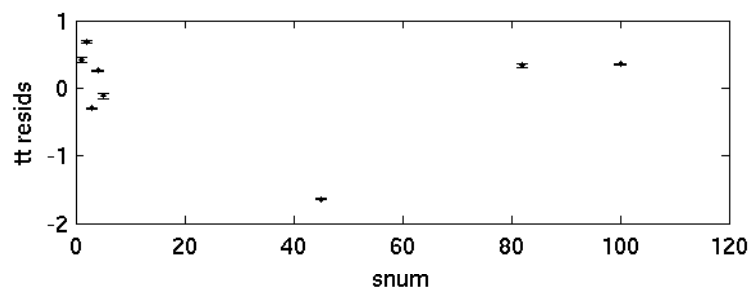
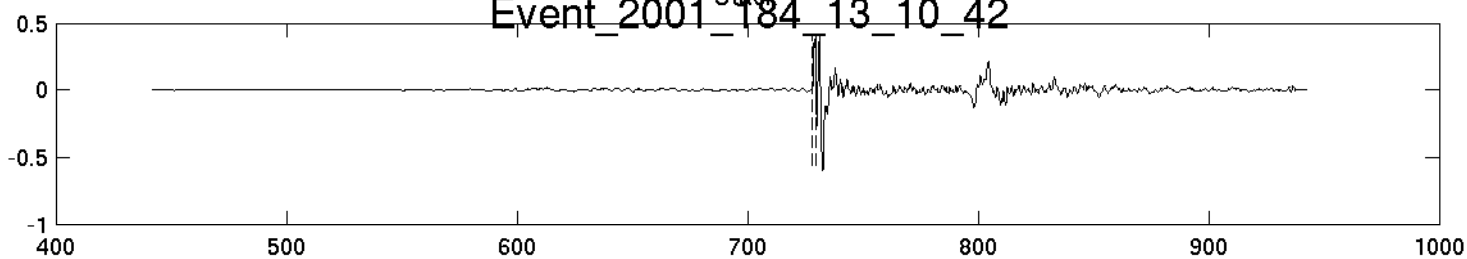




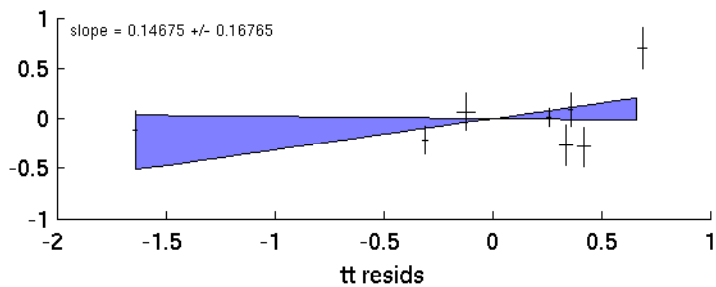
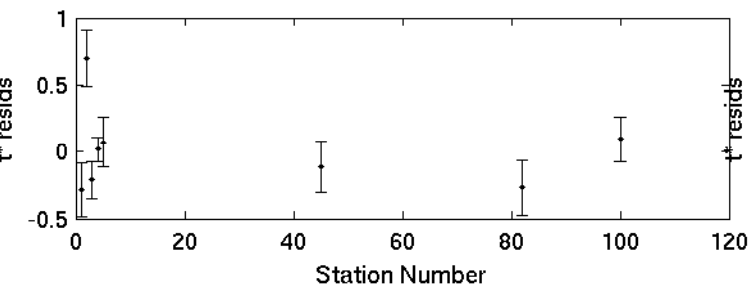
# Event\_2001\_184\_13\_10\_42



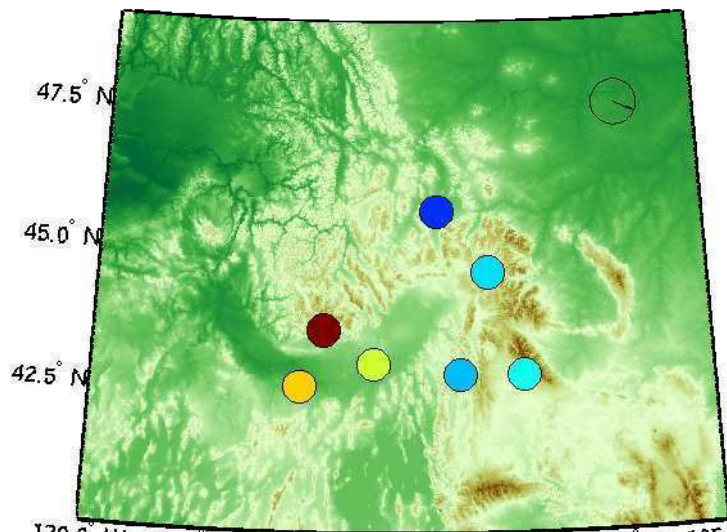
# Event\_2001\_184\_13\_10\_42



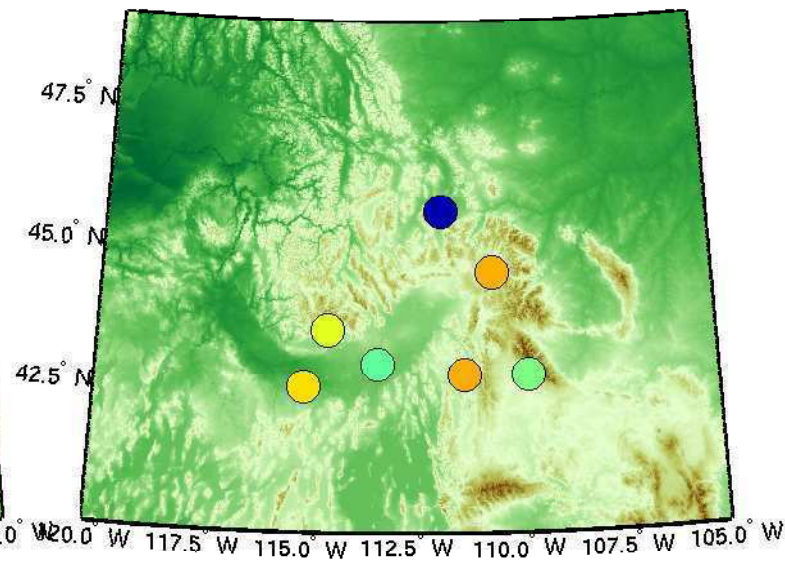
Baz = 295.7169  
 Mean xcor value = 0.75875  
 Range of  $t^*$  values is 0.985  
 Median  $t^*$  err is 0.18757



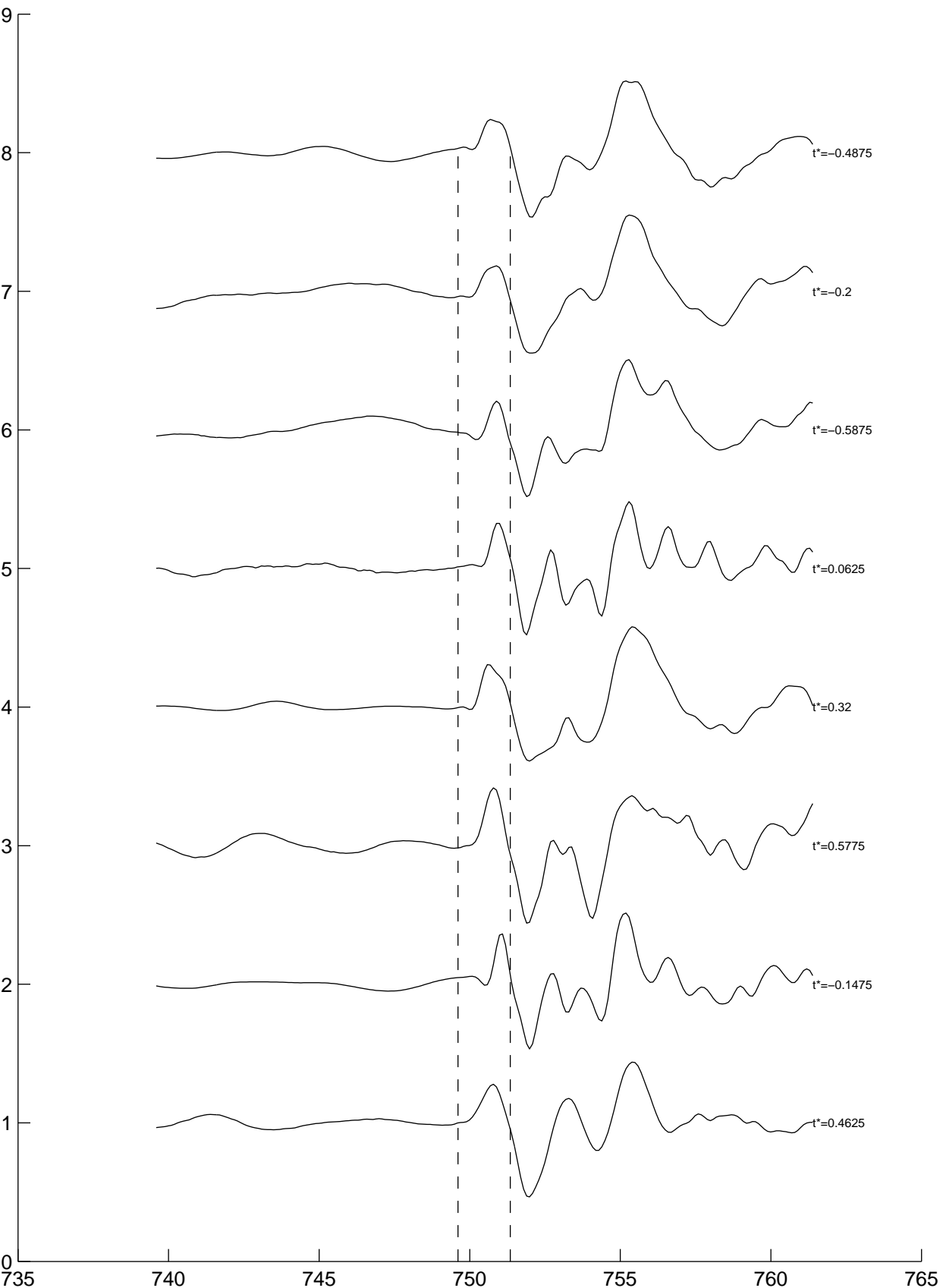
travel time residuals



$t^*$  values

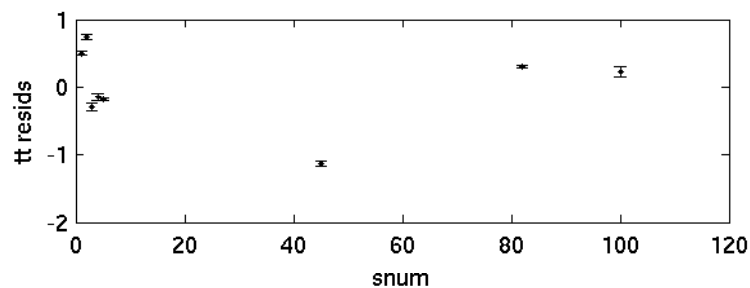
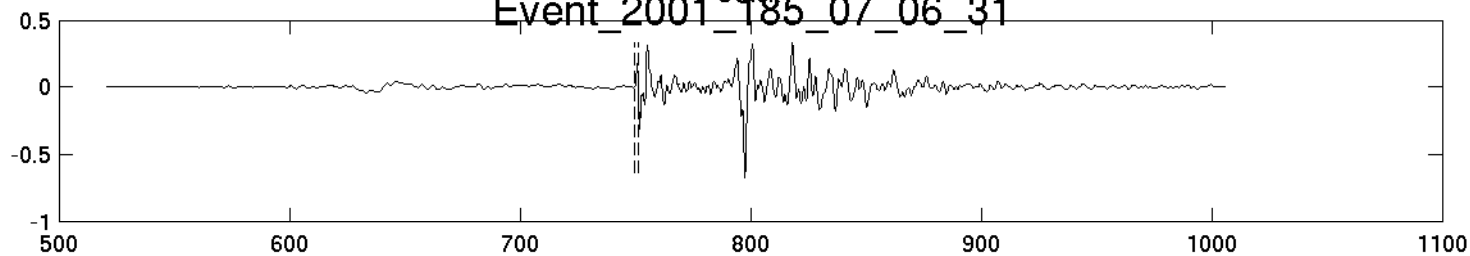


# Event\_2001\_185\_07\_06\_31

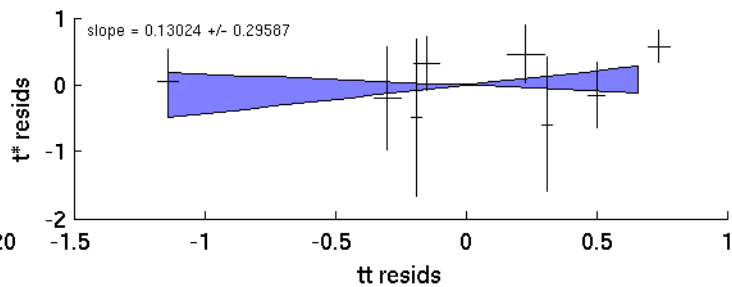
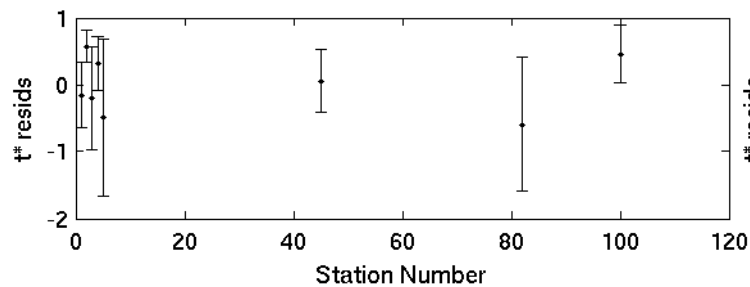


# Event\_2001\_185\_07\_06\_31

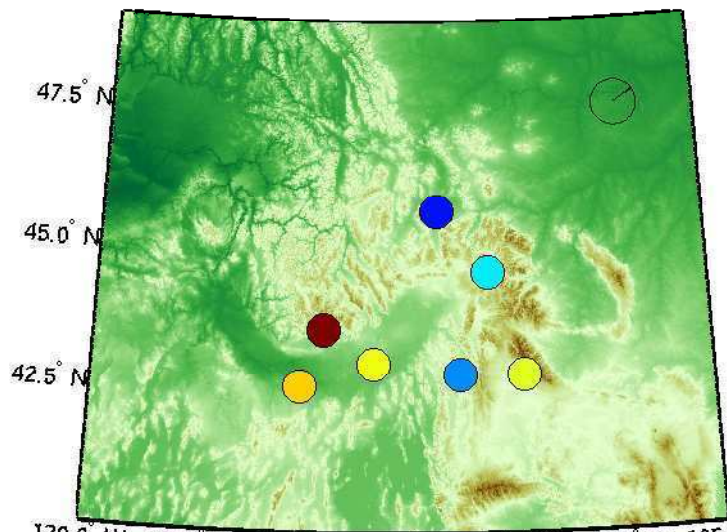
Stack



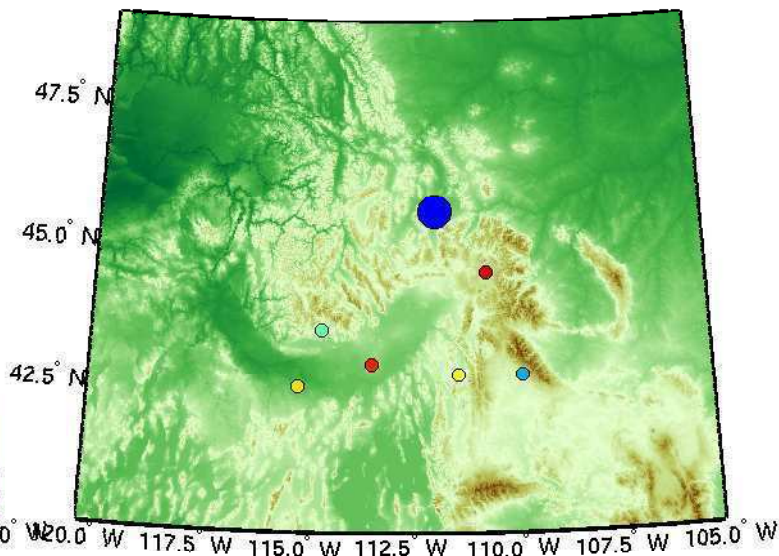
Baz = 237.1157  
Mean xcor value = 0.715  
Range of  $t^*$  values is 1.165  
Median  $t^*$  err is 0.47564



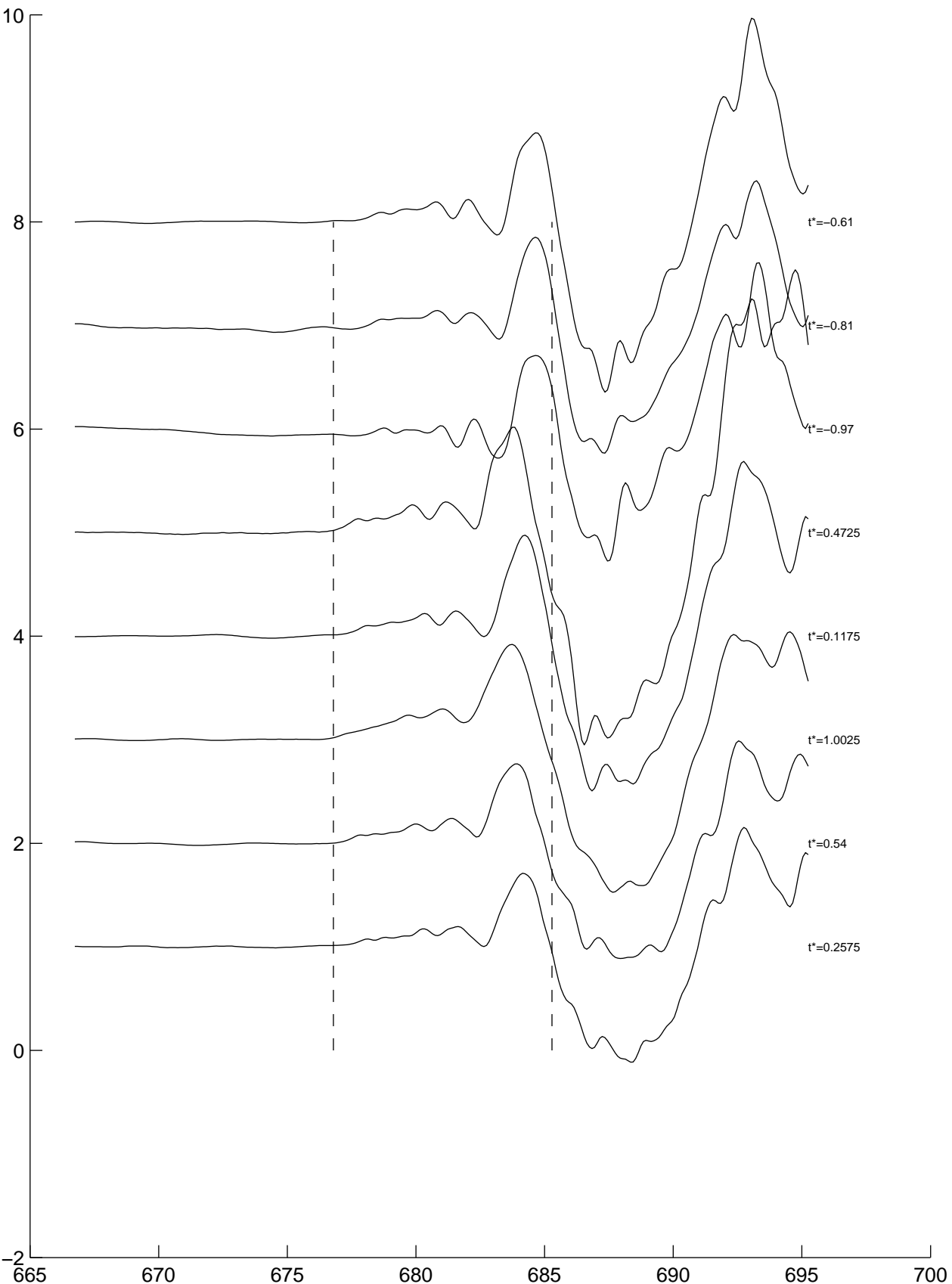
travel time residuals



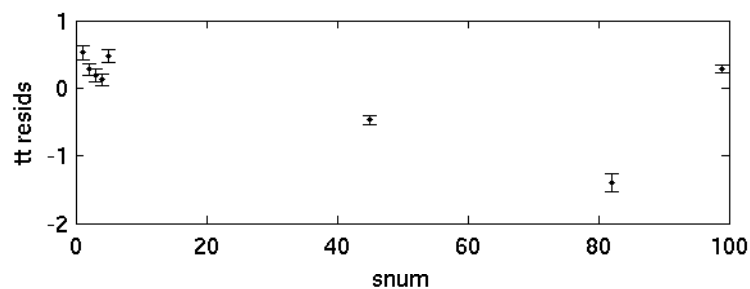
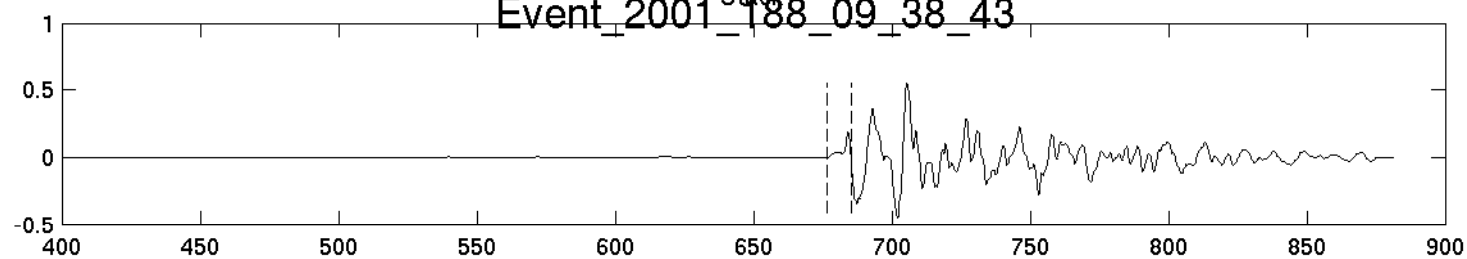
$t^*$  values



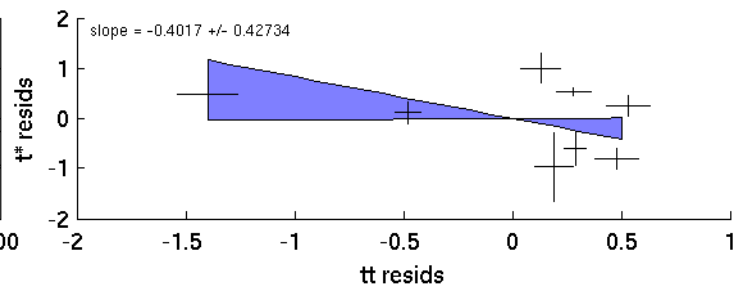
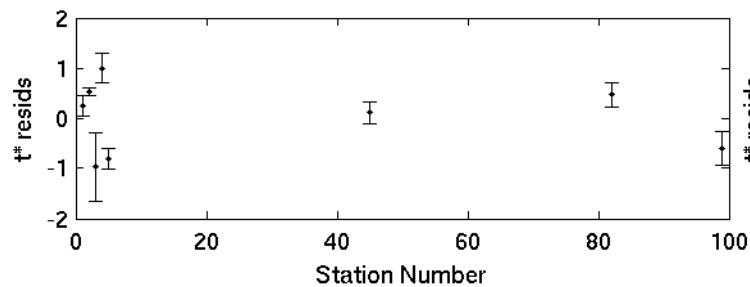
# Event\_2001\_188\_09\_38\_43



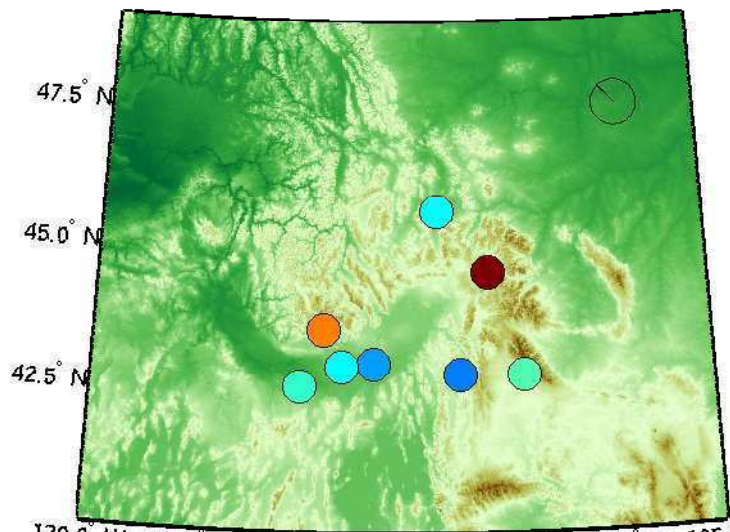
# Event\_2001\_188\_09\_38\_43



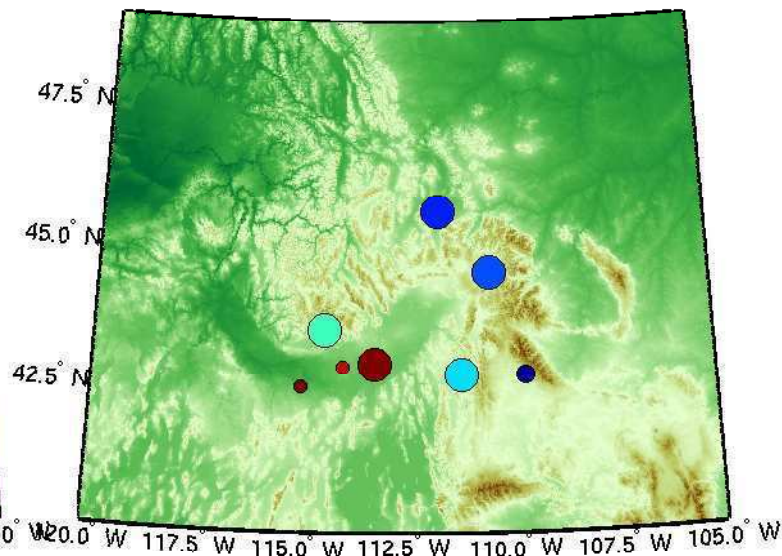
Baz = 139.3624  
 Mean xcor value = 0.9125  
 Range of  $t^*$  values is 1.9725  
 Median  $t^*$  err is 0.22939



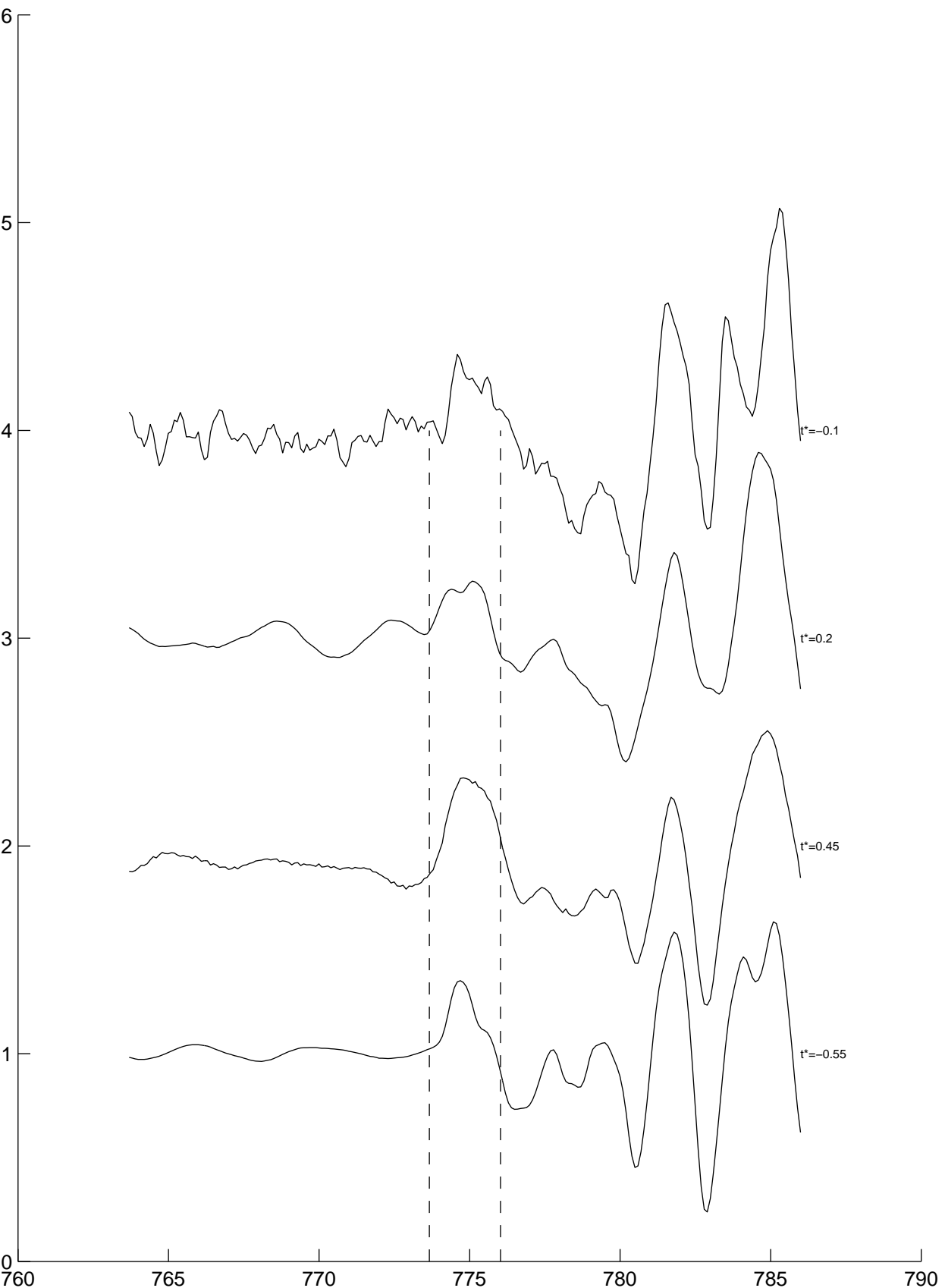
travel time residuals



$t^*$  values



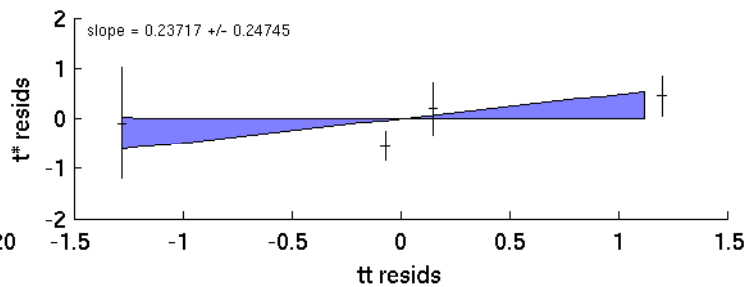
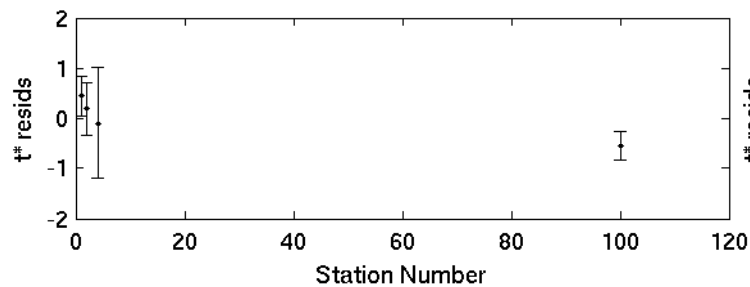
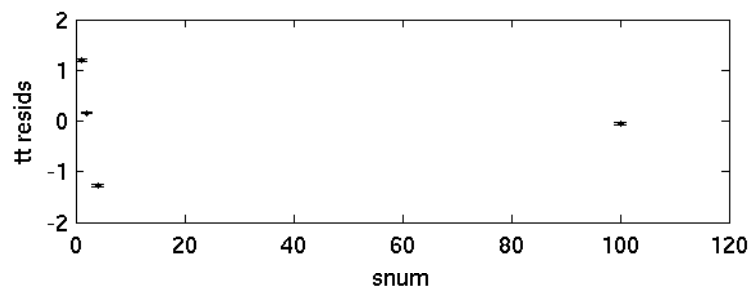
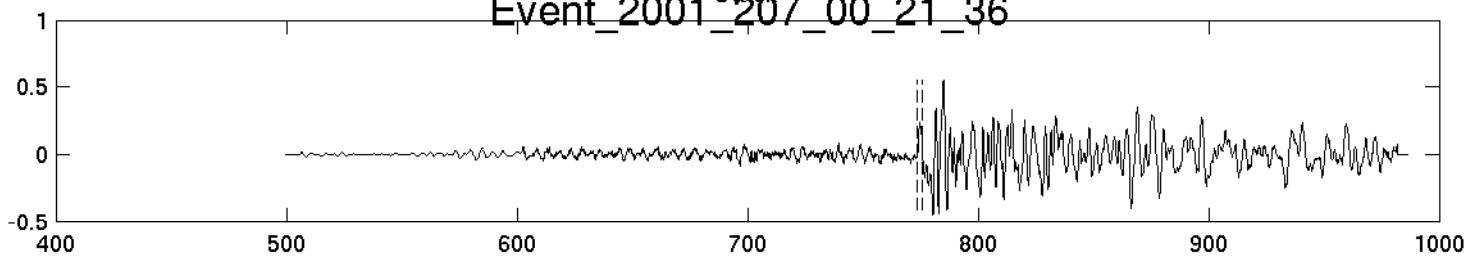
# Event\_2001\_207\_00\_21\_36



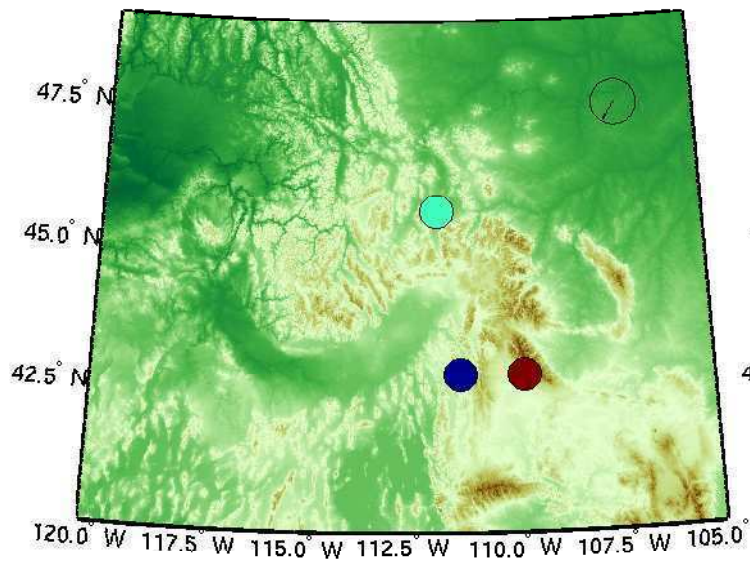


# Event\_2001\_207\_00\_21\_36

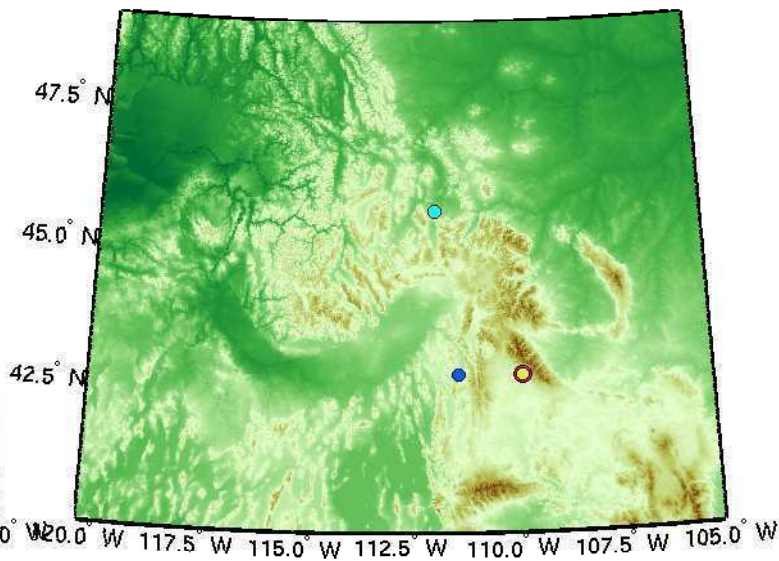
Stack



travel time residuals

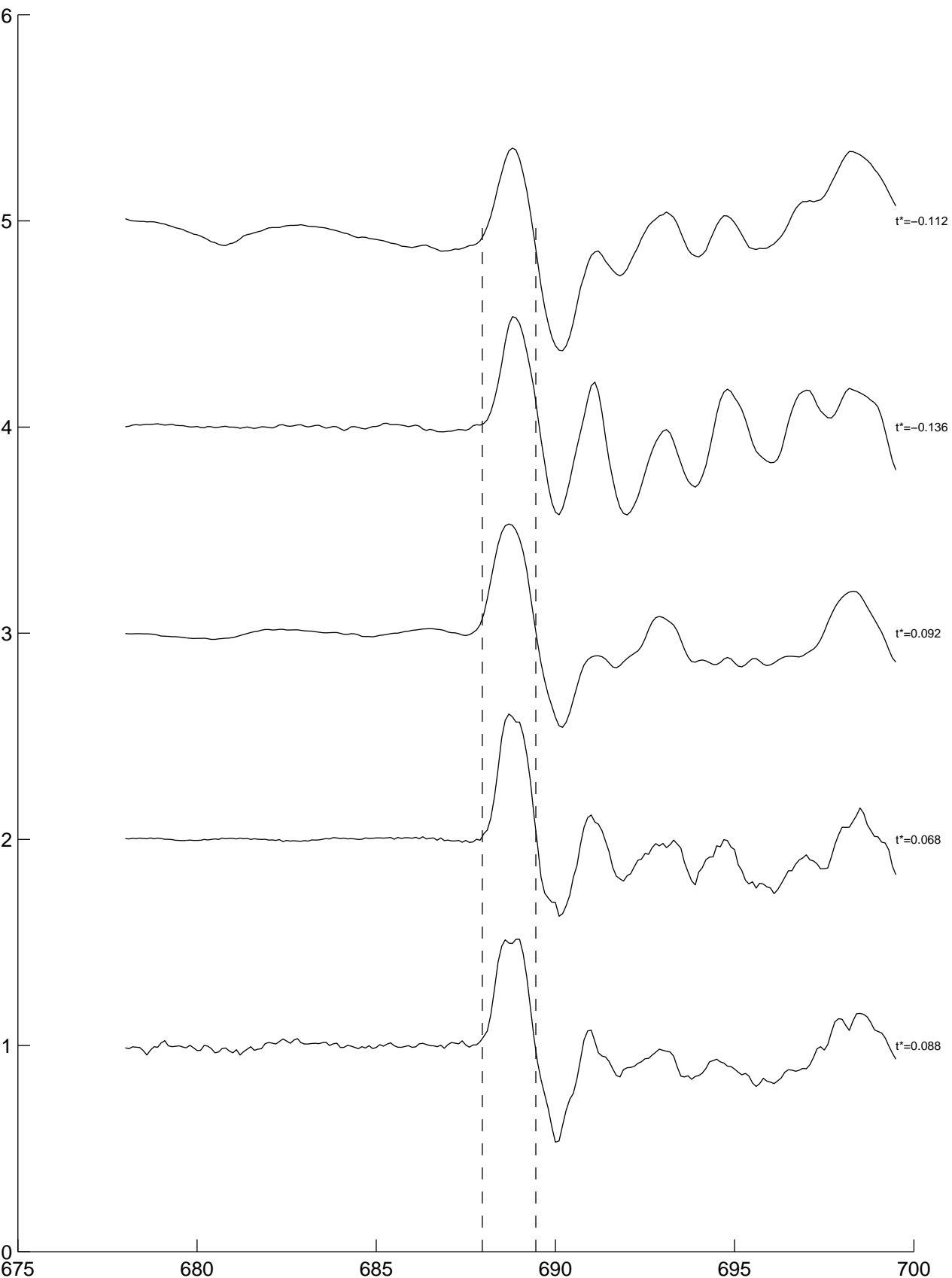


$t^*$  values



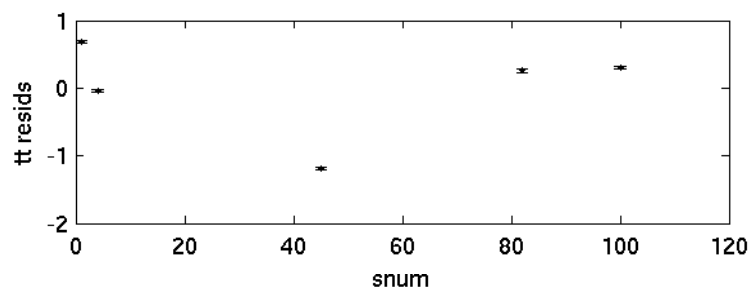
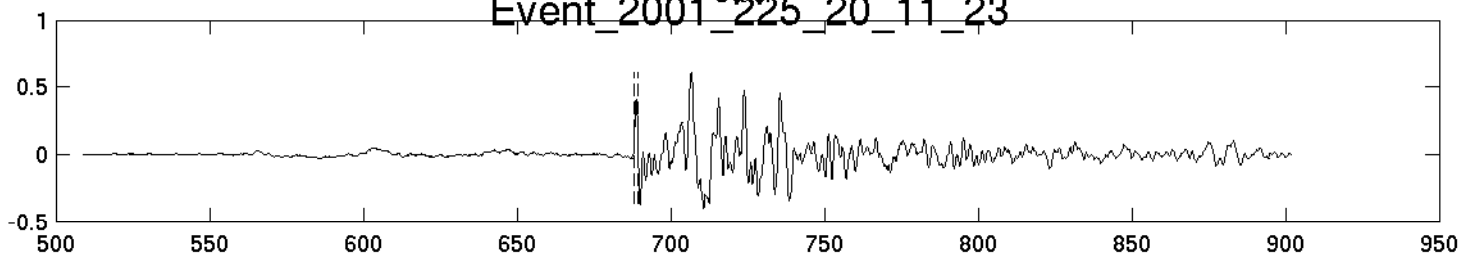


# Event\_2001\_225\_20\_11\_23

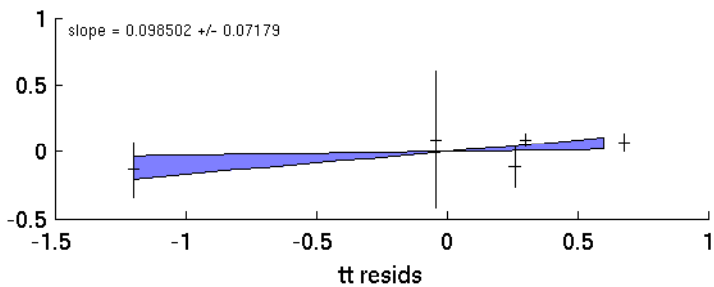
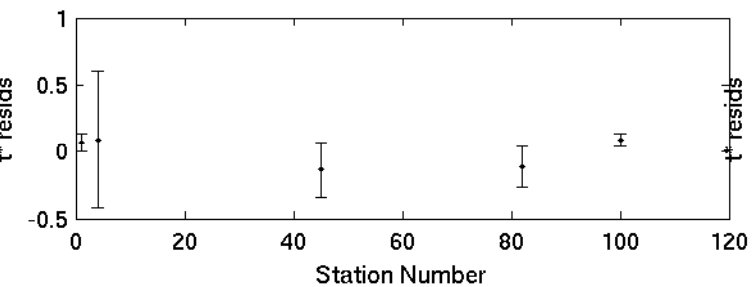


# Event\_2001\_225\_20\_11\_23

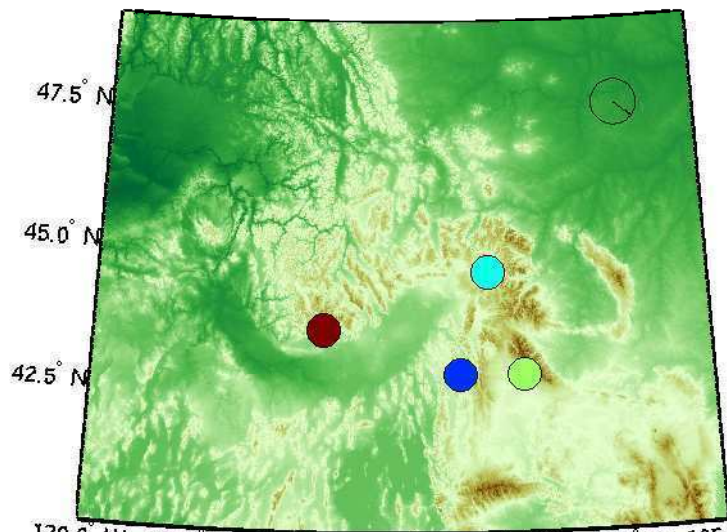
Stack



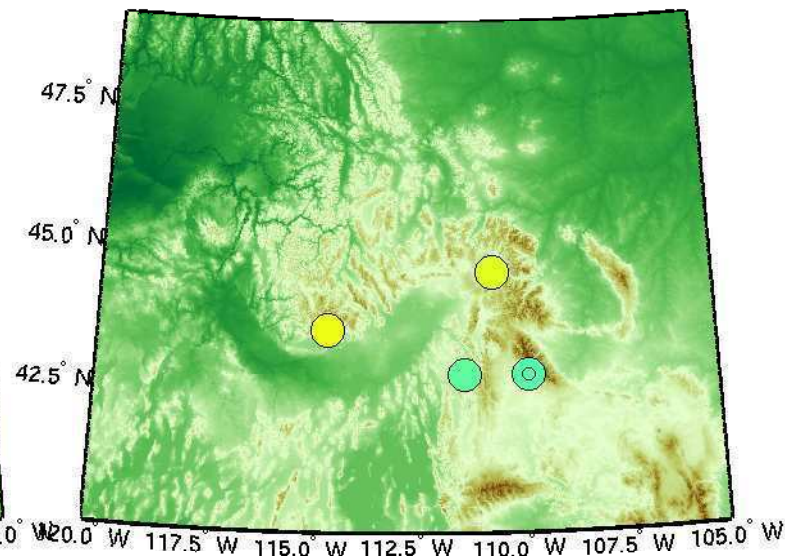
Baz = 310.6128  
Mean xcor value = 0.682  
Range of  $t^*$  values is 0.2226  
Median  $t^*$  err is 0.15226



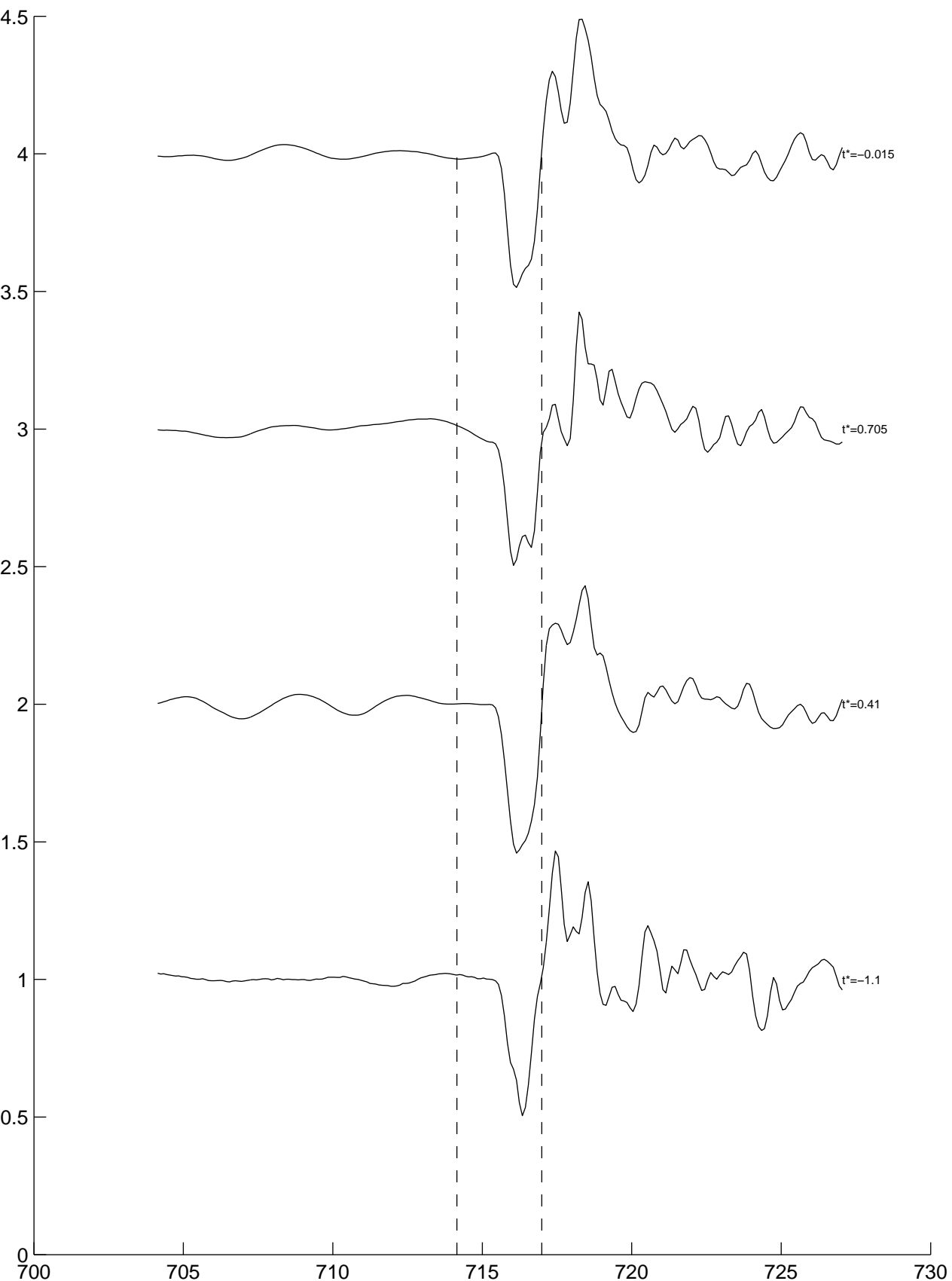
travel time residuals



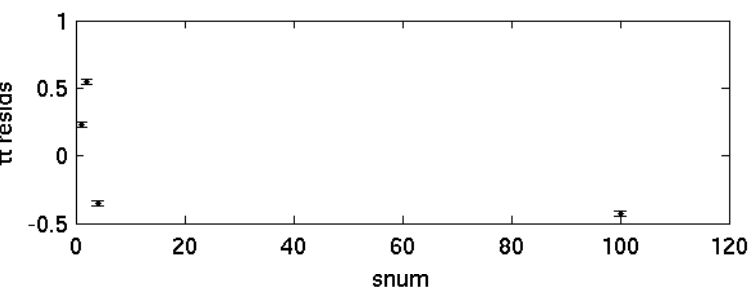
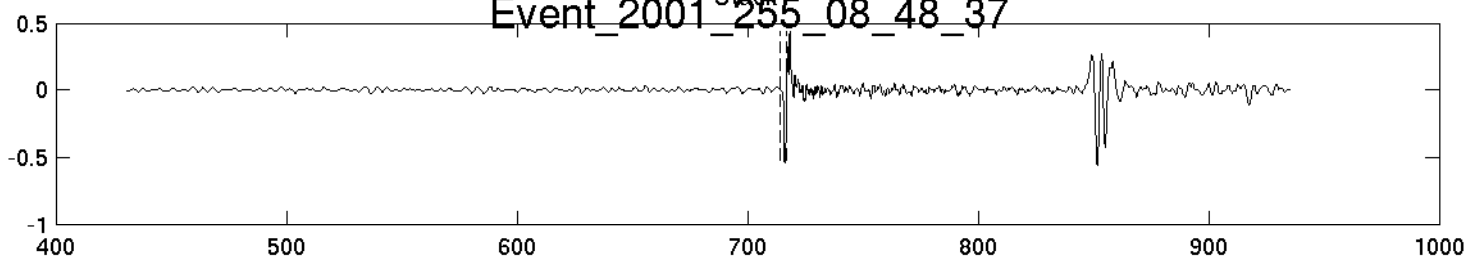
$t^*$  values



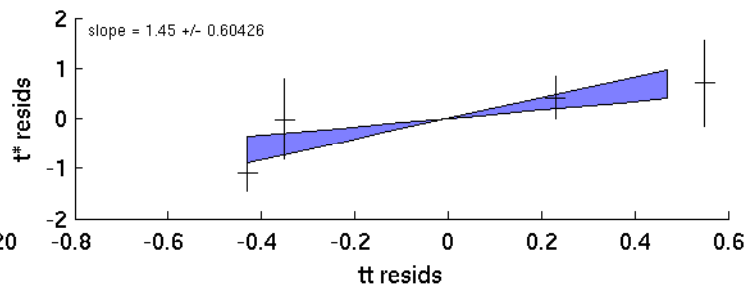
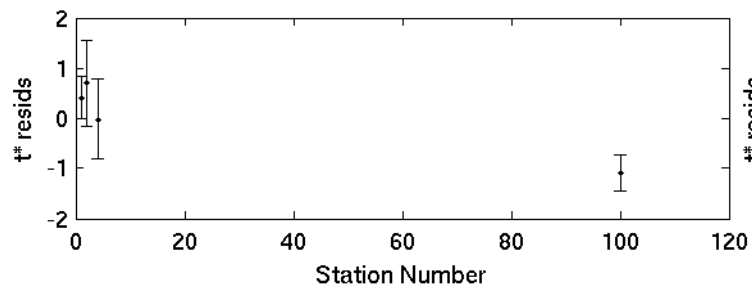
# Event\_2001\_255\_08\_48\_37



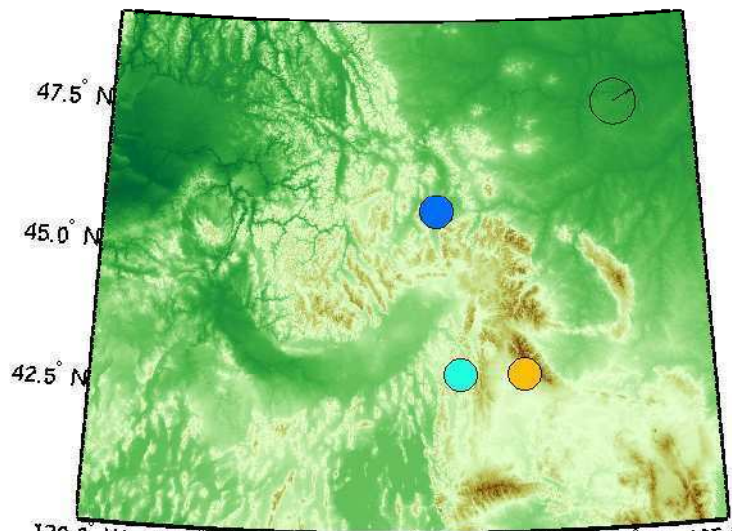
# Event\_2001\_255\_08\_48\_37



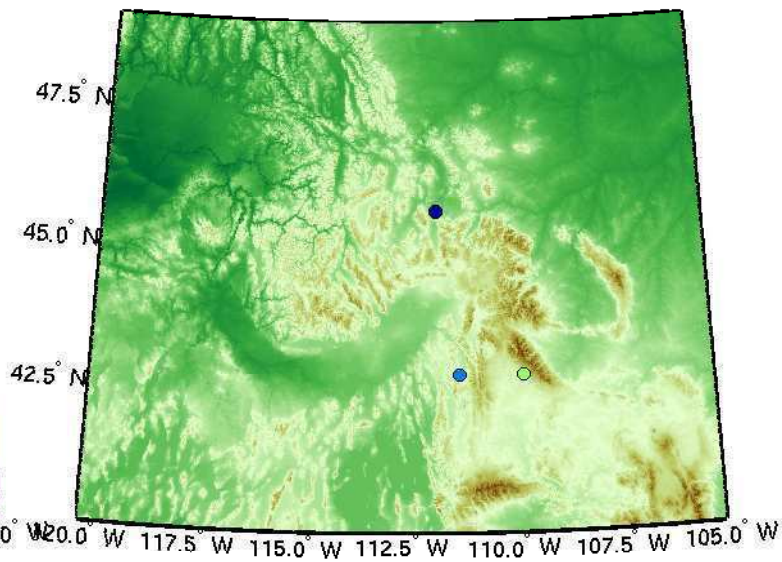
Baz = 239.9512  
Mean xcor value = 0.6875  
Range of  $t^*$  values is 1.805  
Median  $t^*$  err is 0.61525



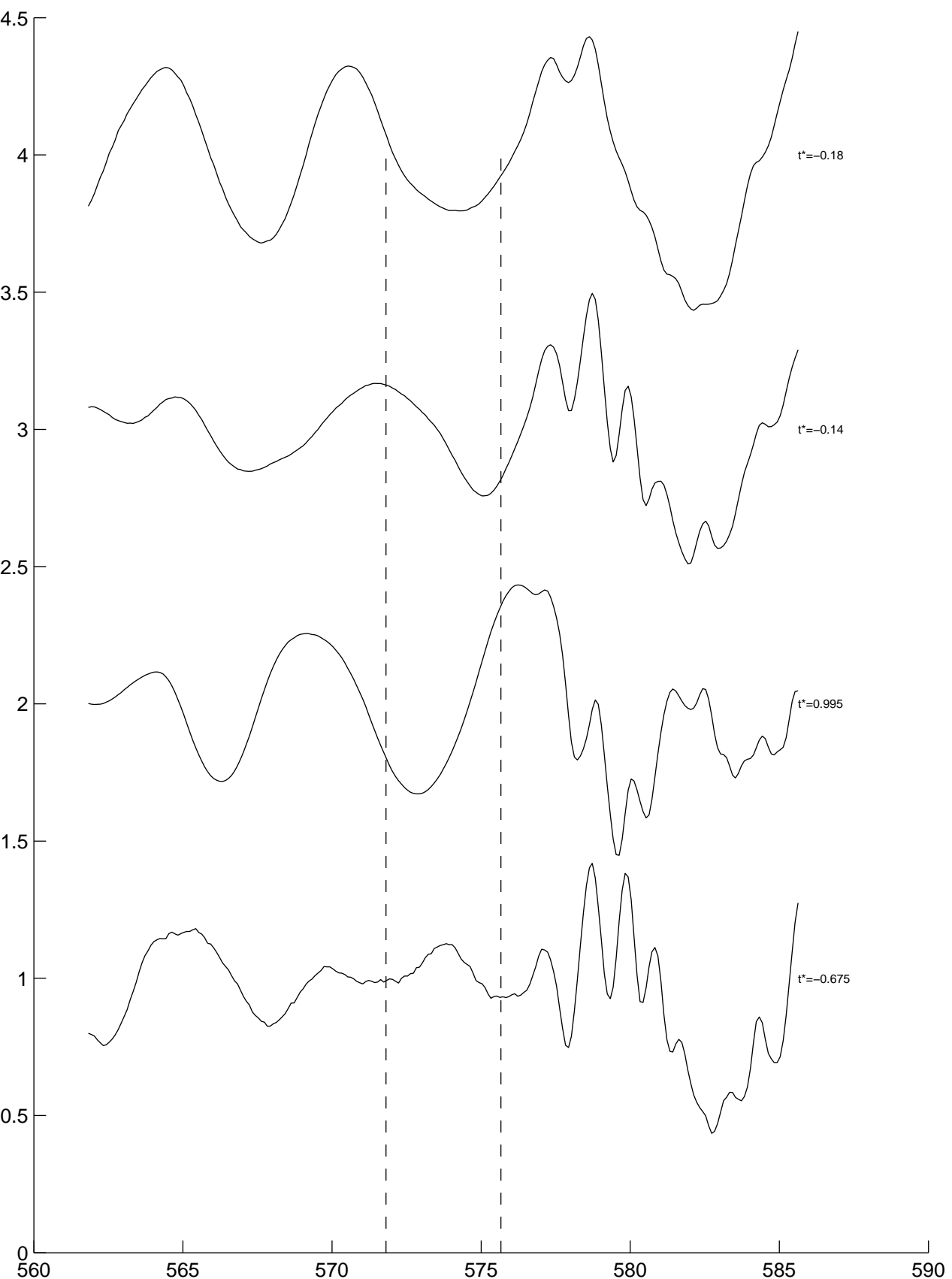
travel time residuals



$t^*$  values

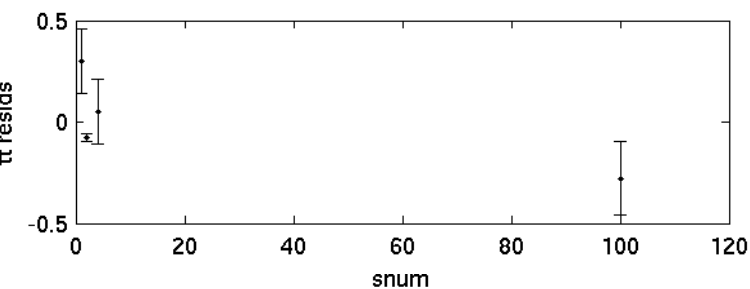
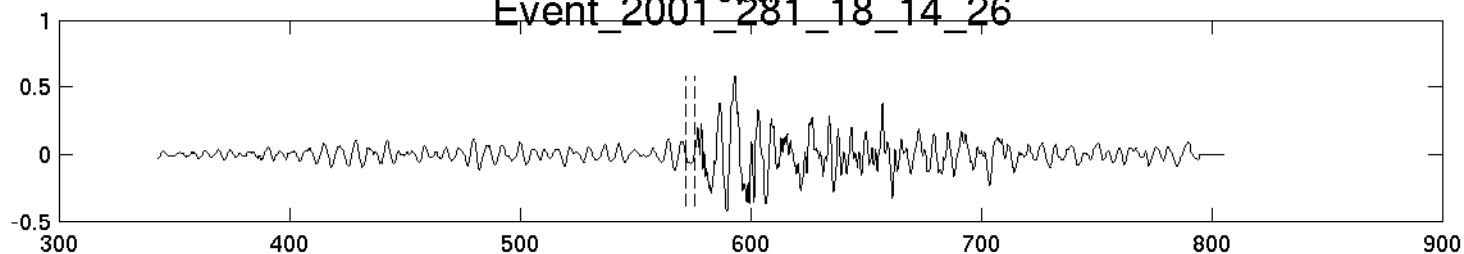


Event\_2001\_281\_18\_14\_26

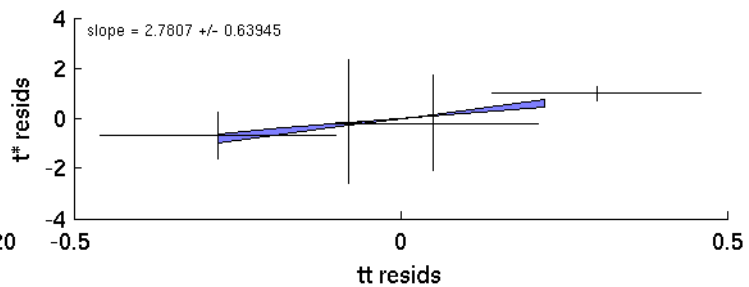
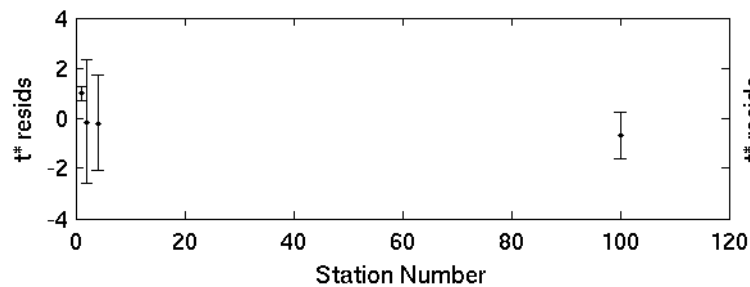


# Event\_2001\_281\_18\_14\_26

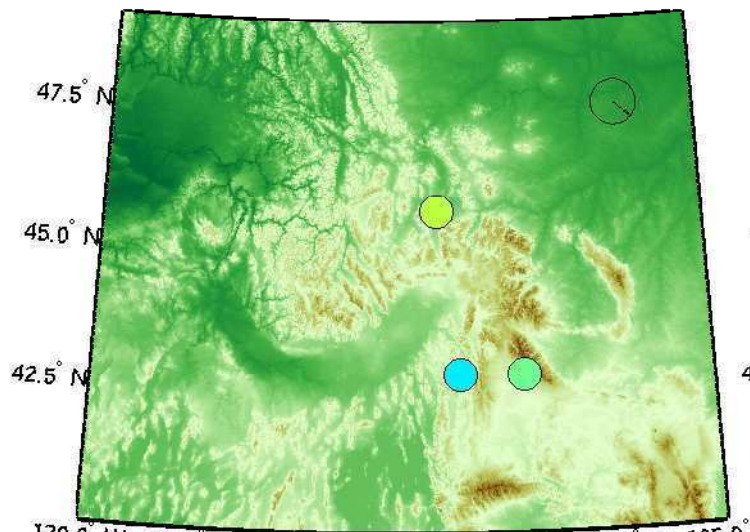
Stack



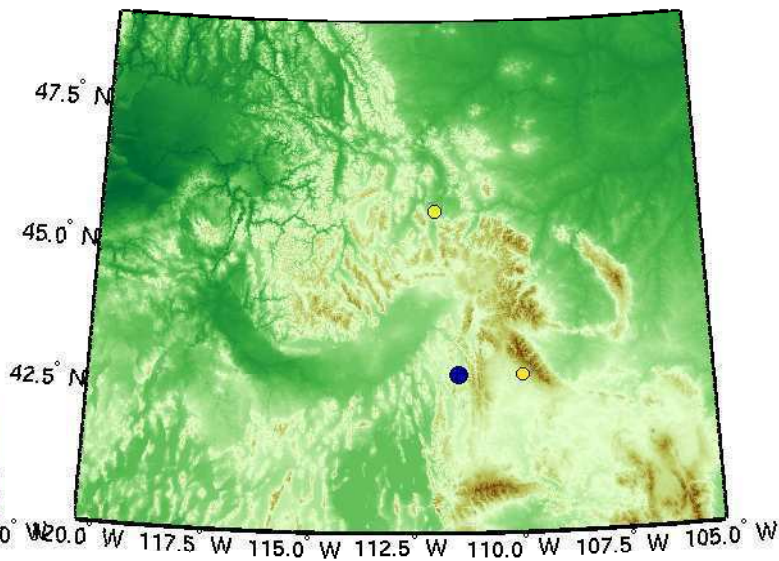
Baz = 312.8709  
Mean xcor value = 0.7075  
Range of  $t^*$  values is 1.67  
Median  $t^*$  err is 1.4211



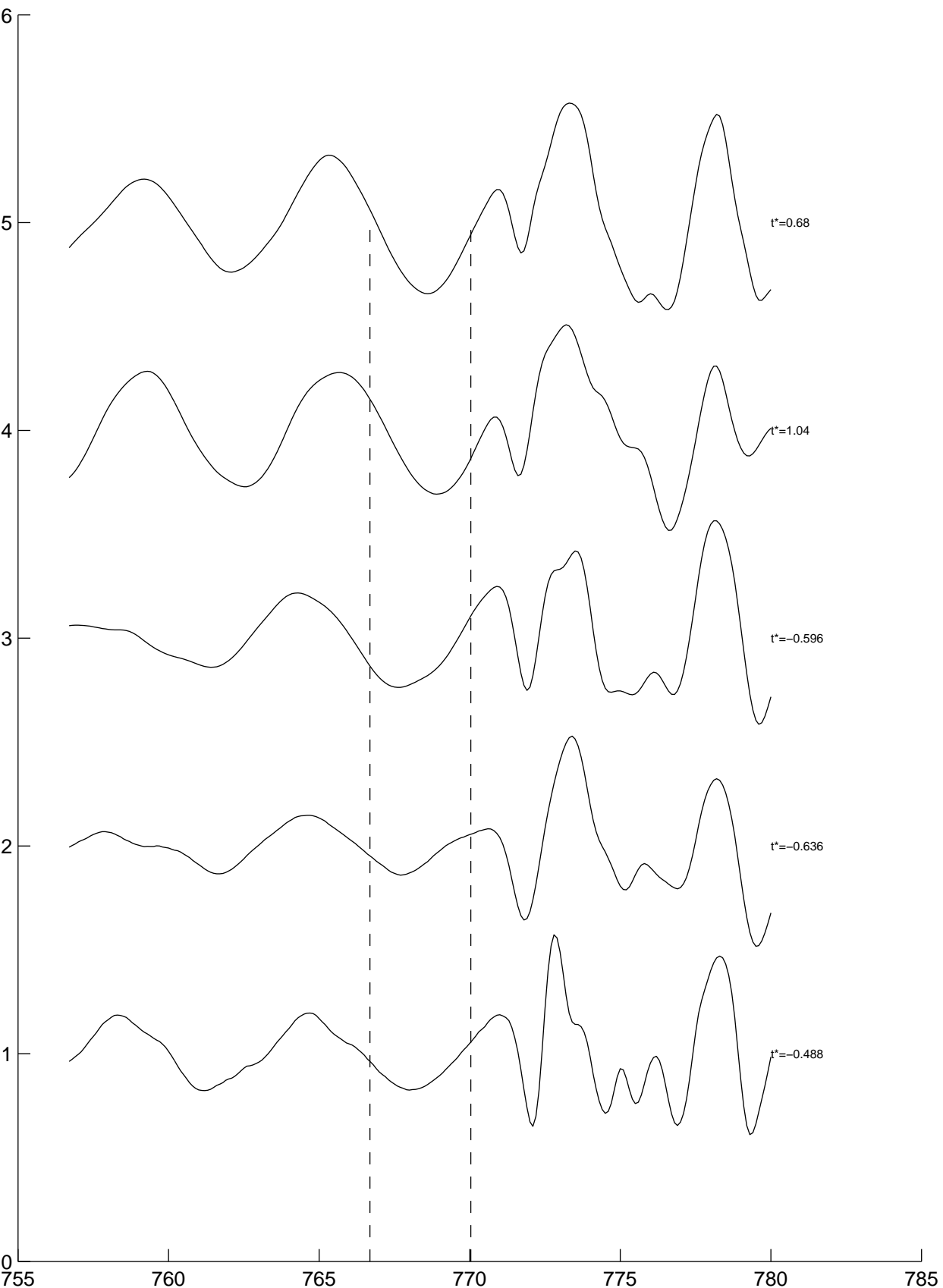
travel time residuals



$t^*$  values



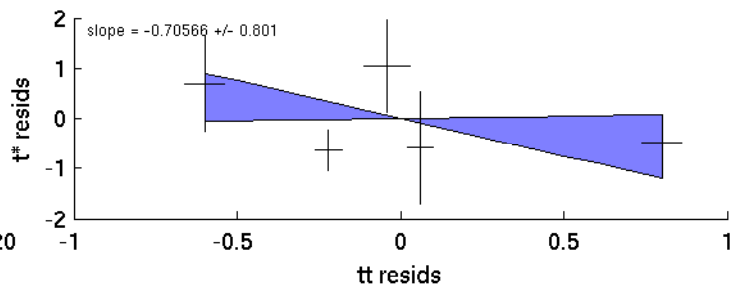
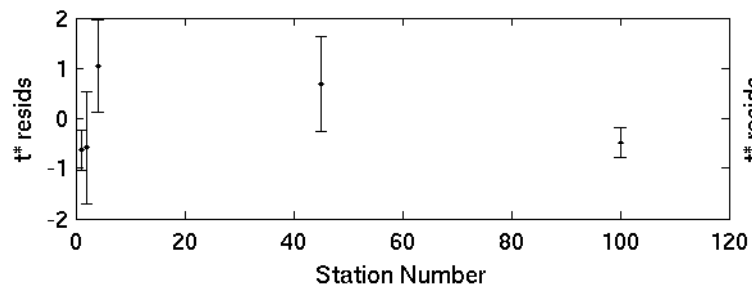
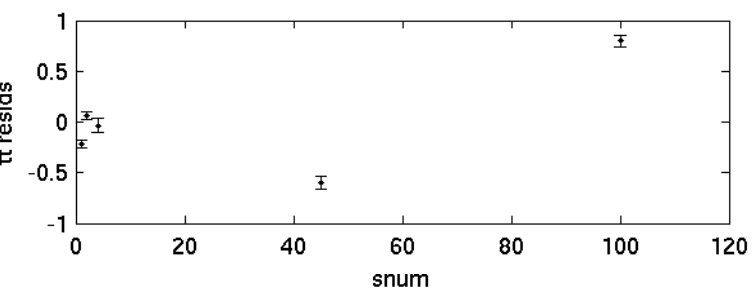
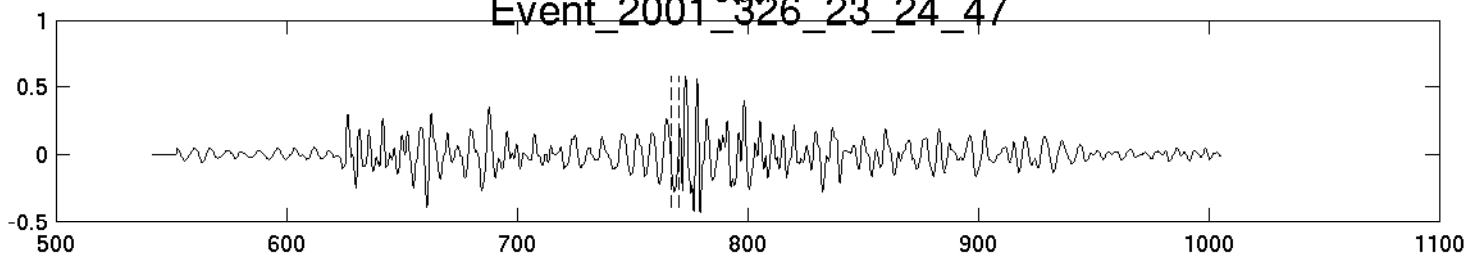
# Event\_2001\_326\_23\_24\_47



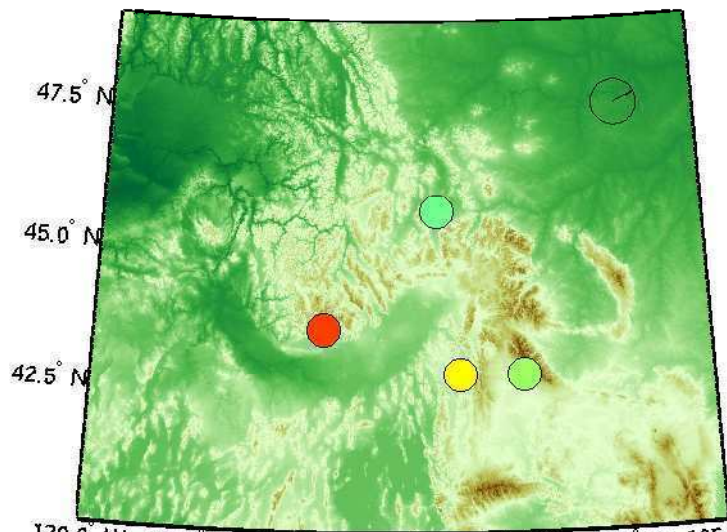


# Event\_2001\_326\_23\_24\_47

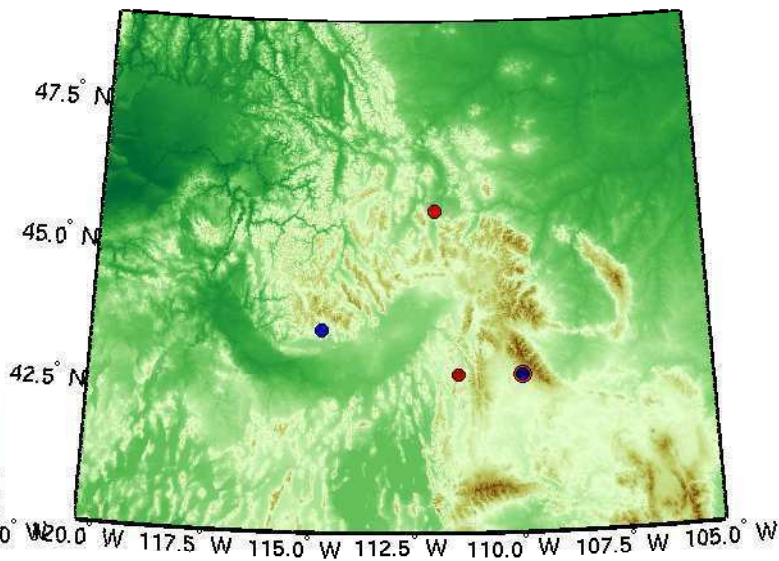
Stack



travel time residuals

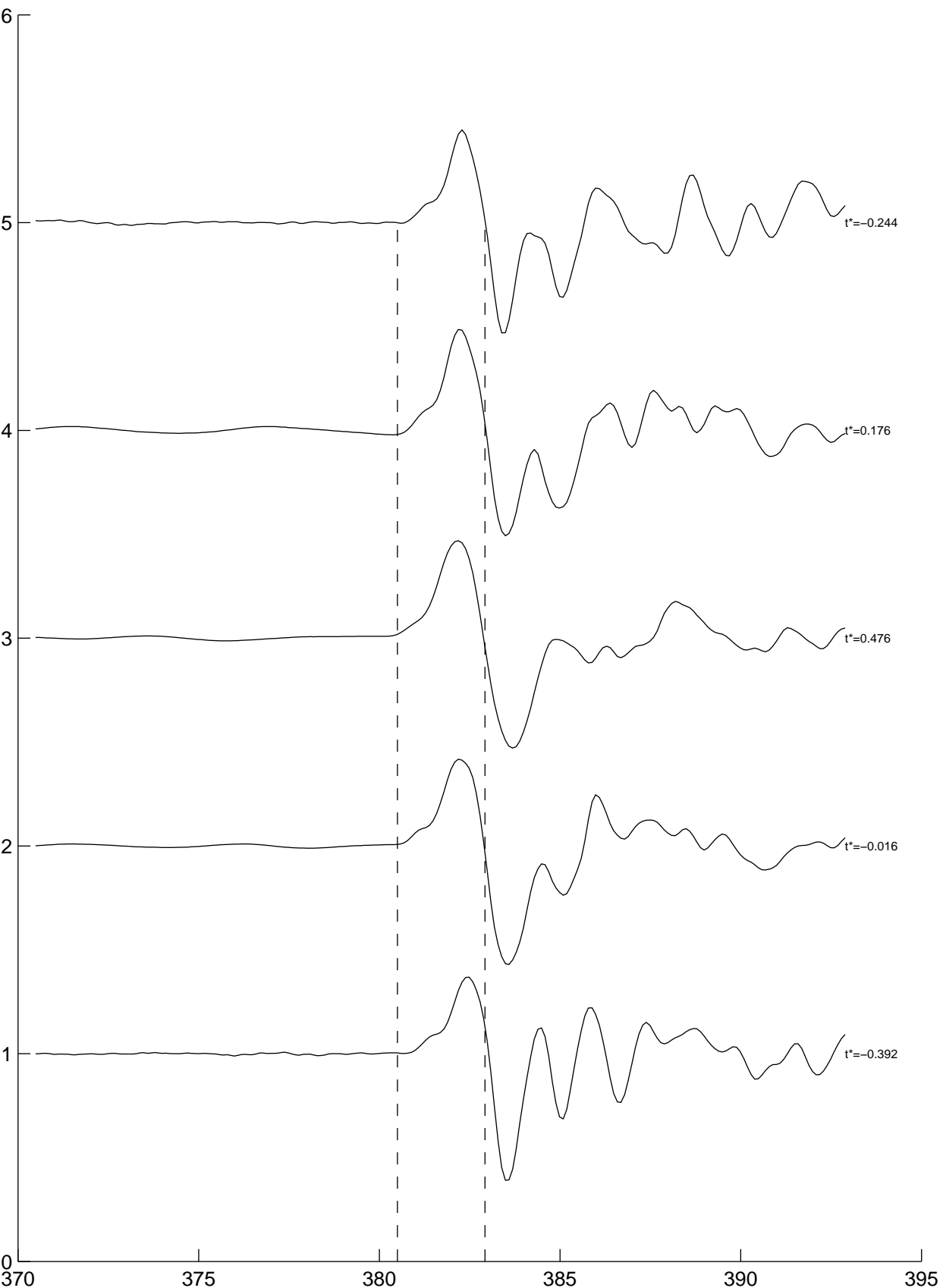


$t^*$  values



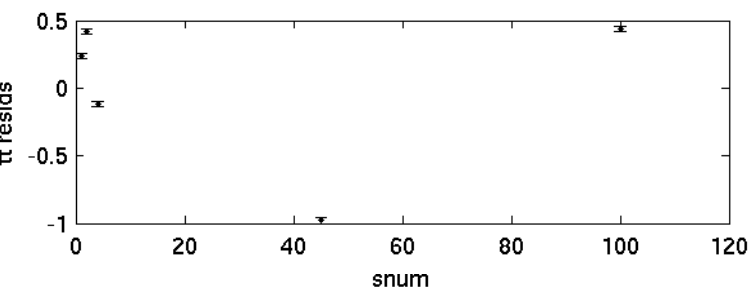
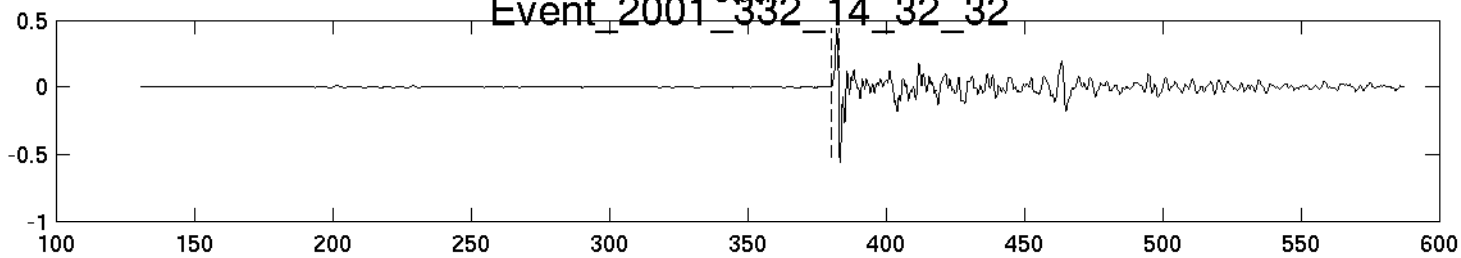


# Event\_2001\_332\_14\_32\_32

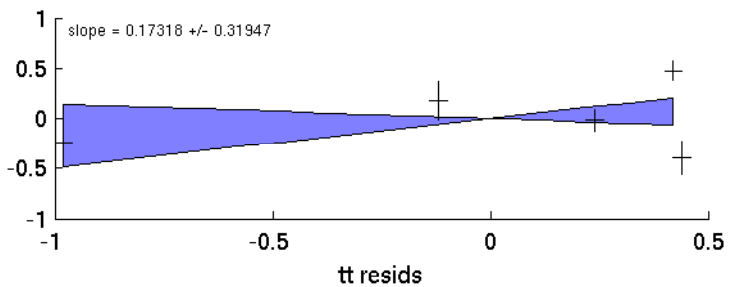
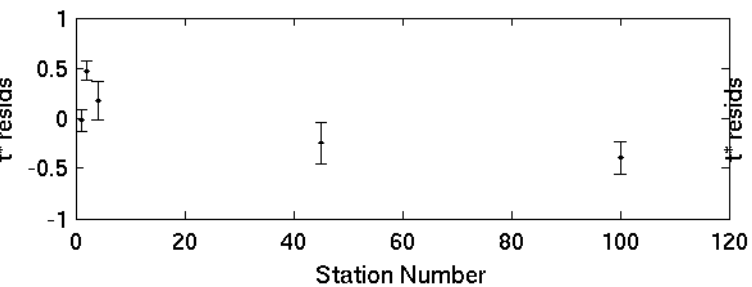


# Event\_2001\_332\_14\_32\_32

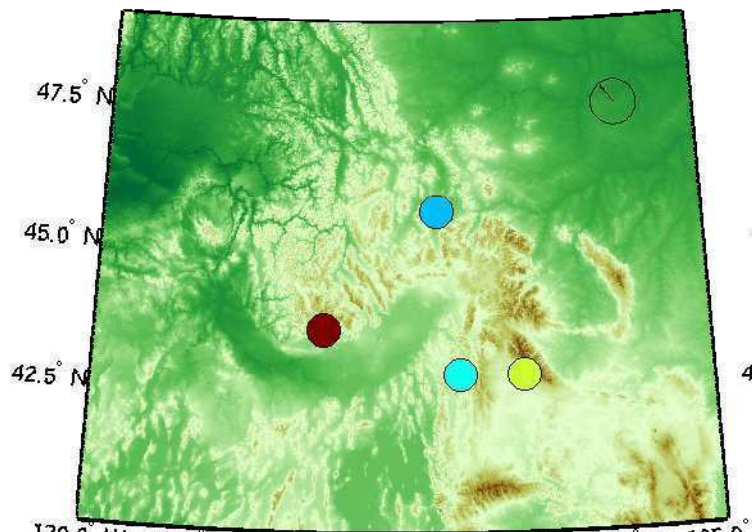
Stack



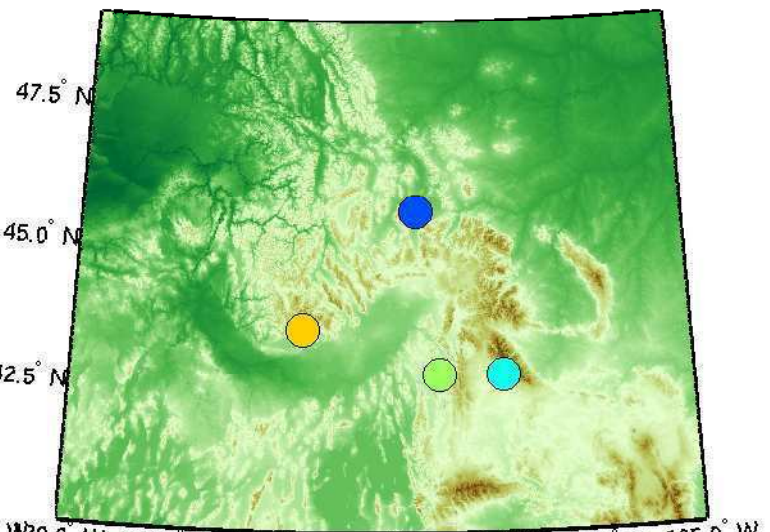
Baz = 145.8571  
Mean xcor value = 0.726  
Range of  $t^*$  values is 0.868  
Median  $t^*$  err is 0.16424



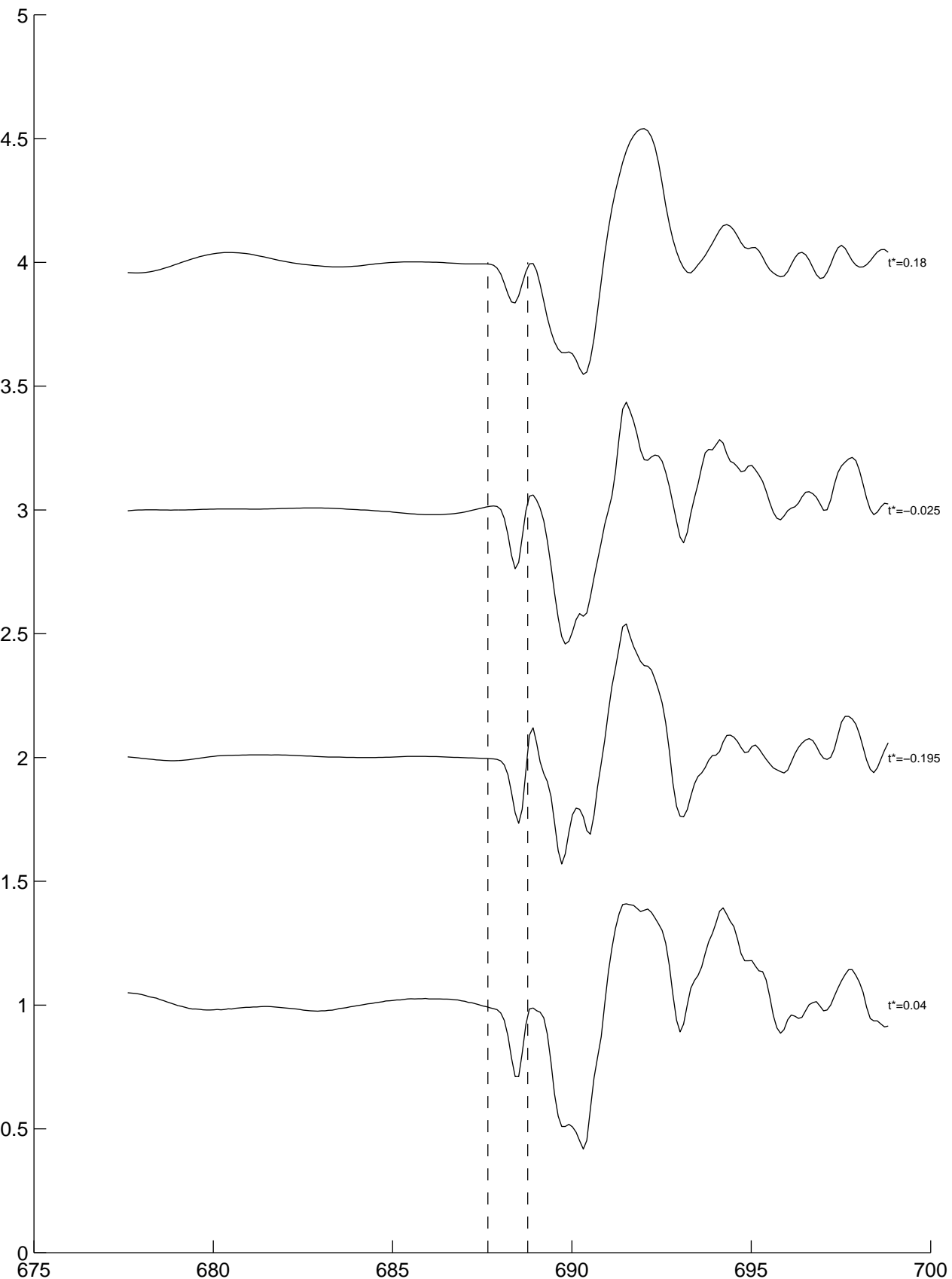
travel time residuals



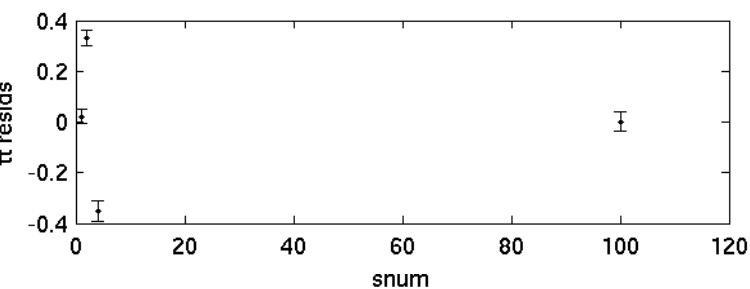
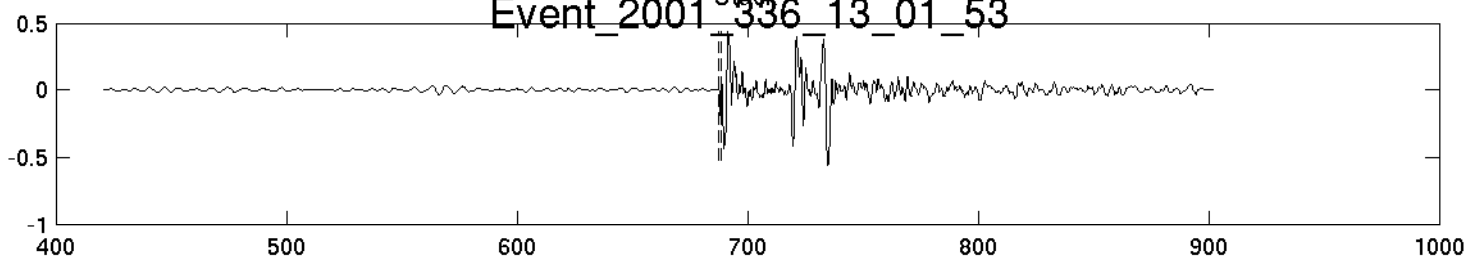
$t^*$  values



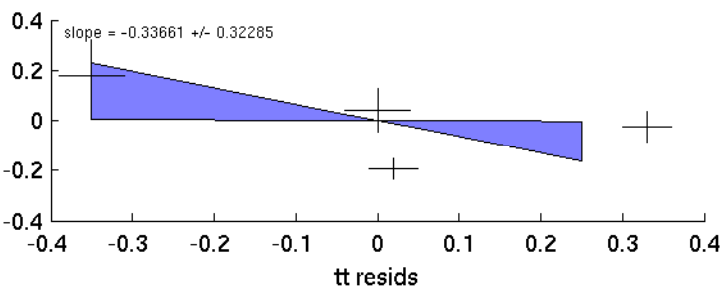
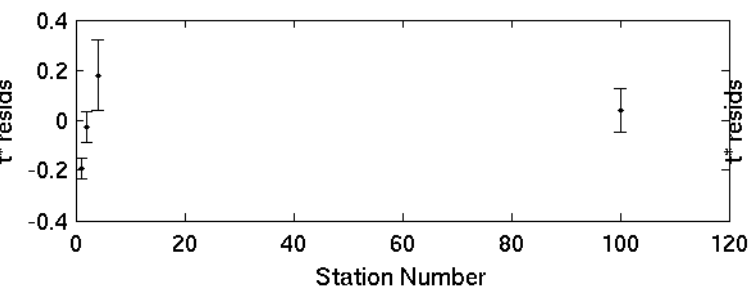
# Event\_2001\_336\_13\_01\_53



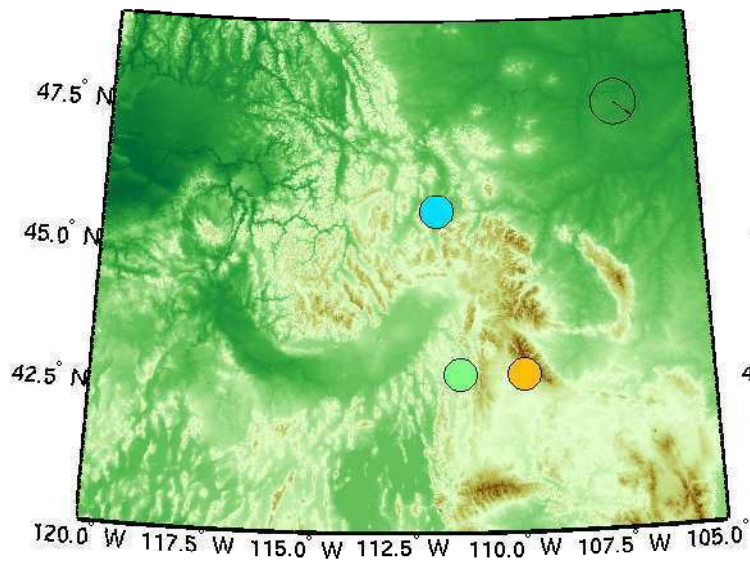
# Event\_2001\_336\_13\_01\_53



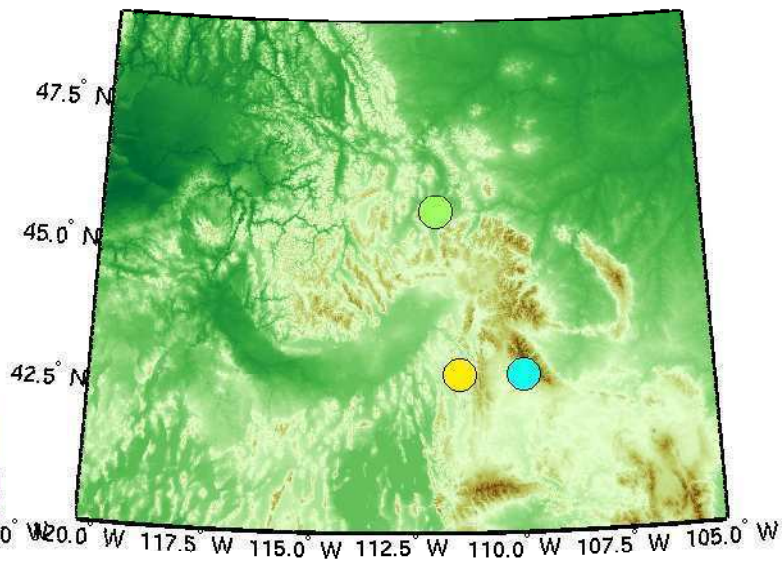
Baz = 310.216  
 Mean xcor value = 0.7225  
 Range of  $t^*$  values is 0.375  
 Median  $t^*$  err is 0.074257



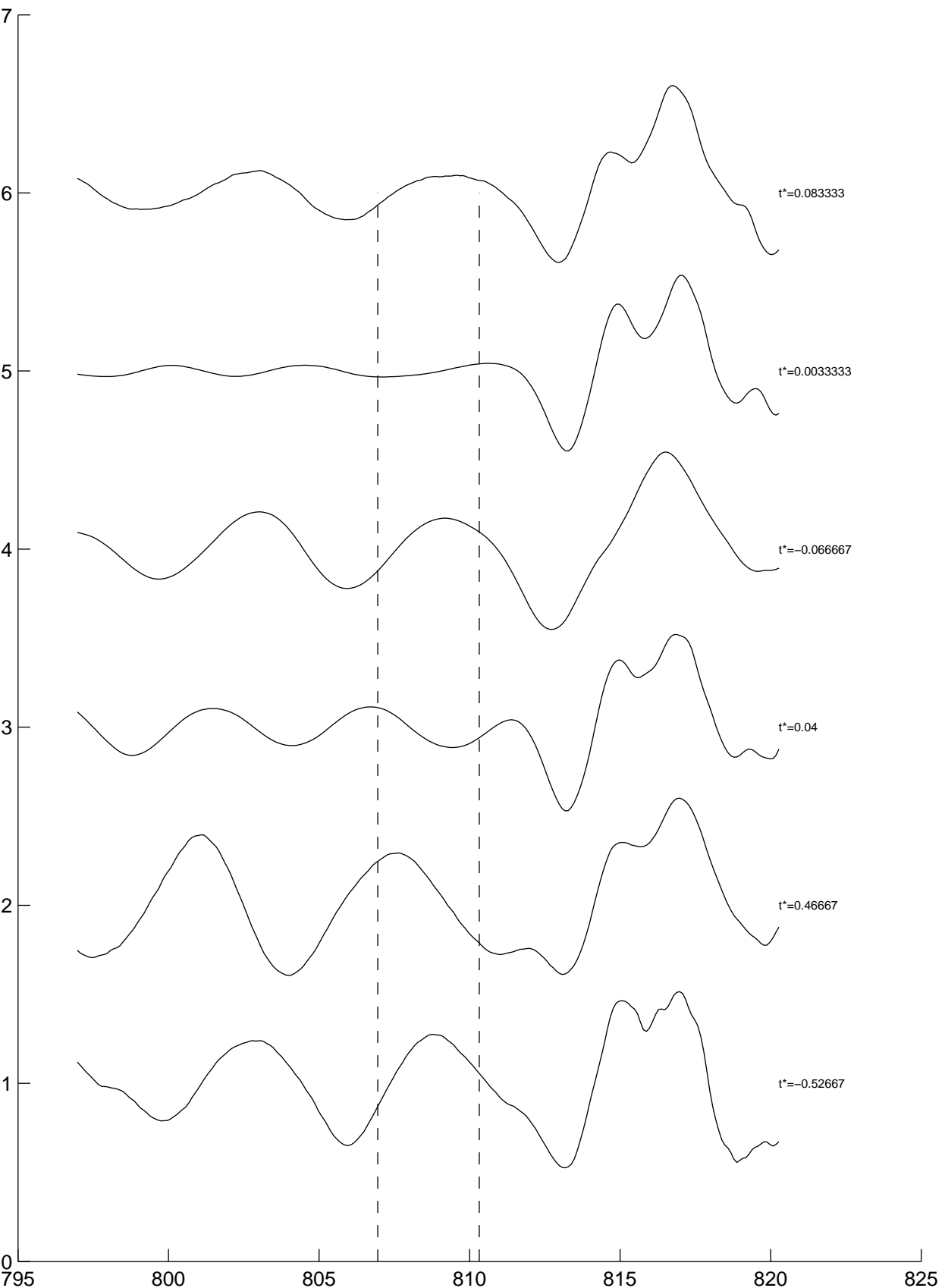
travel time residuals



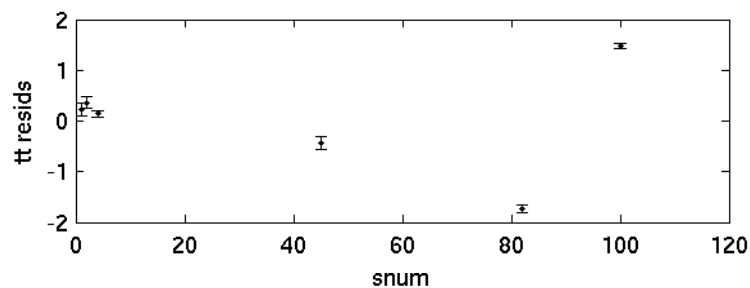
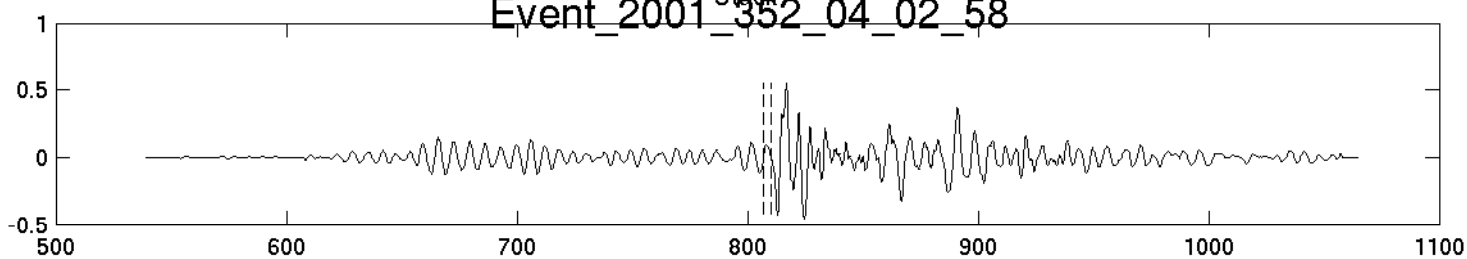
$t^*$  values



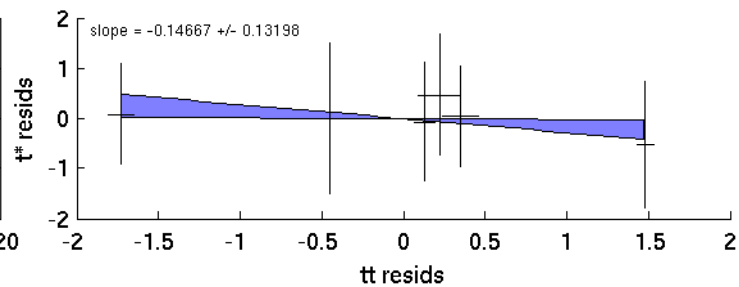
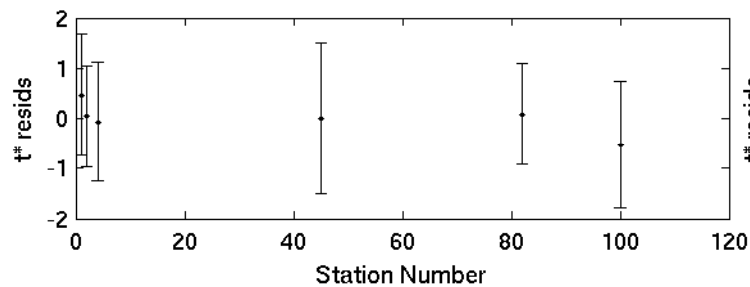
# Event\_2001\_352\_04\_02\_58



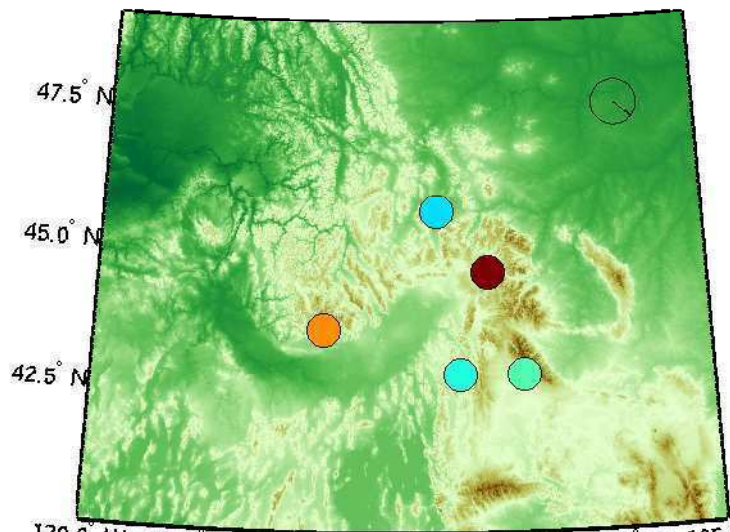
# Event\_2001\_352\_04\_02\_58



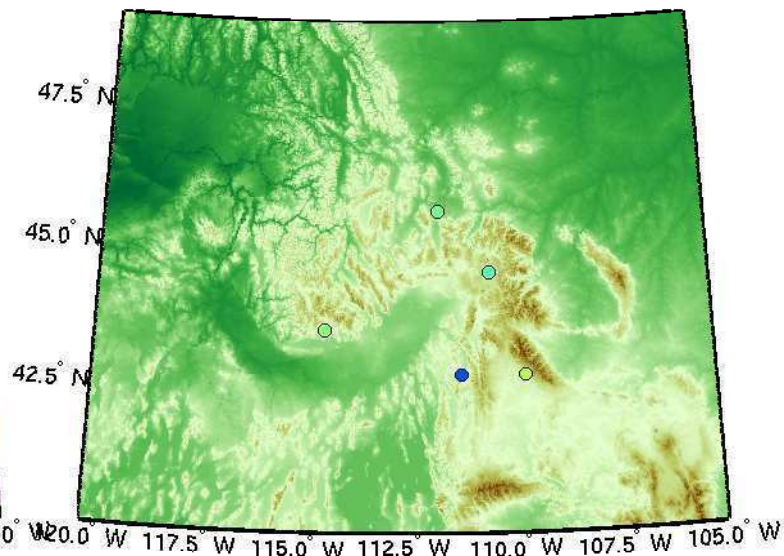
Baz = 312.068  
Mean xcor value = 0.77167  
Range of  $t^*$  values is 0.99333  
Median  $t^*$  err is 1.1935



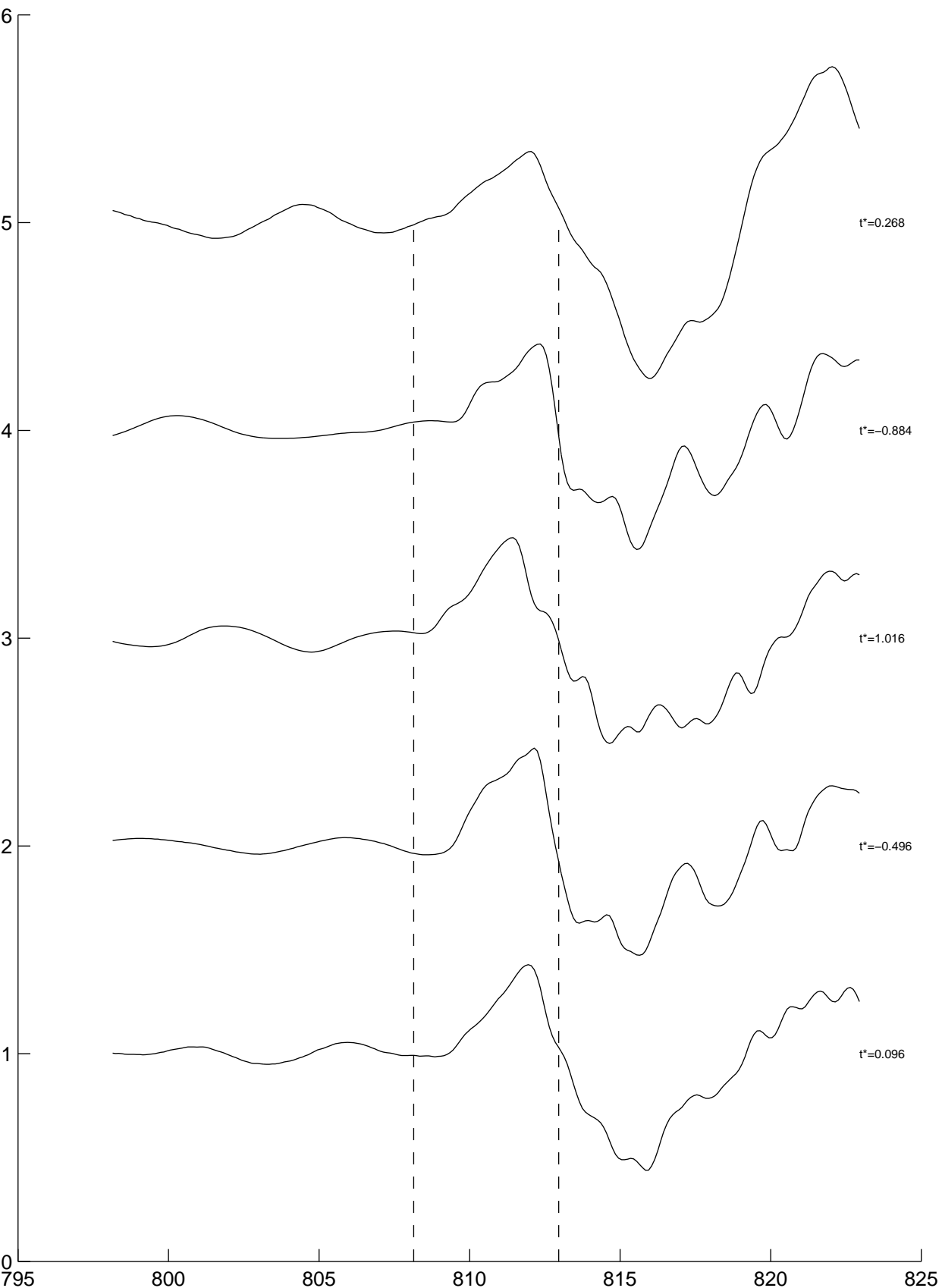
travel time residuals



$t^*$  values



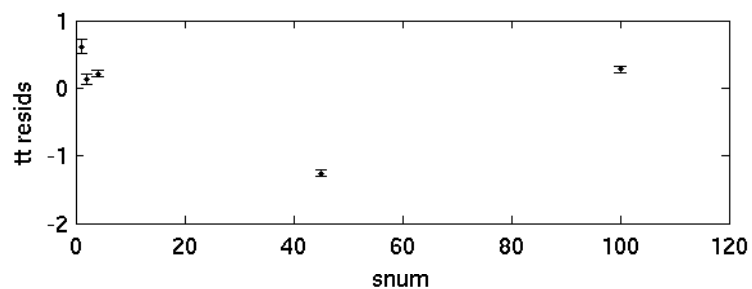
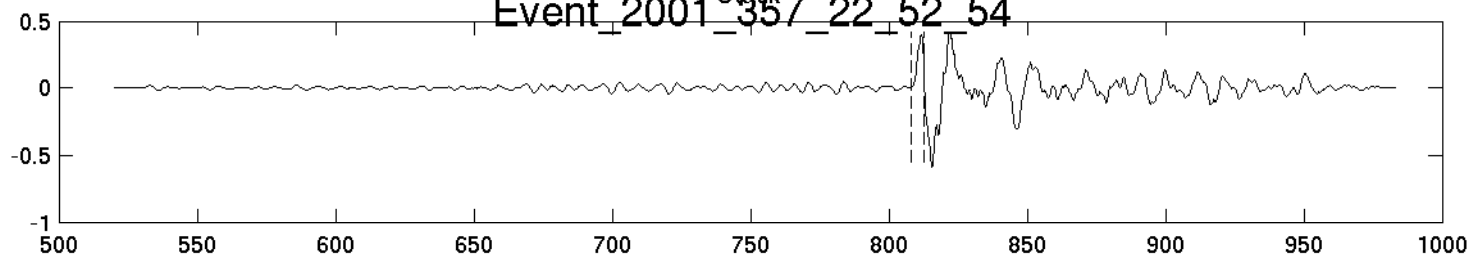
# Event\_2001\_357\_22\_52\_54



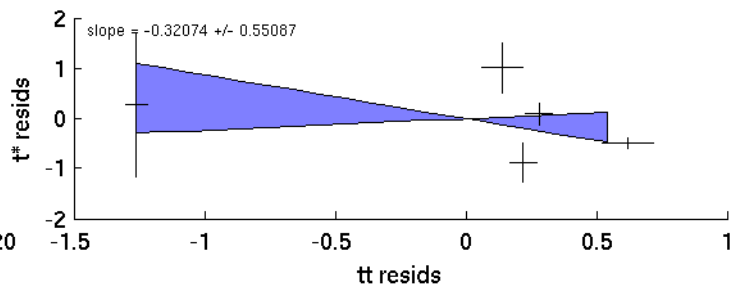
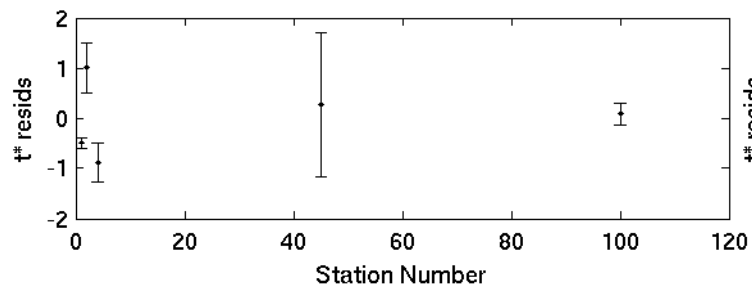


# Event 2001\_357\_22\_52\_54

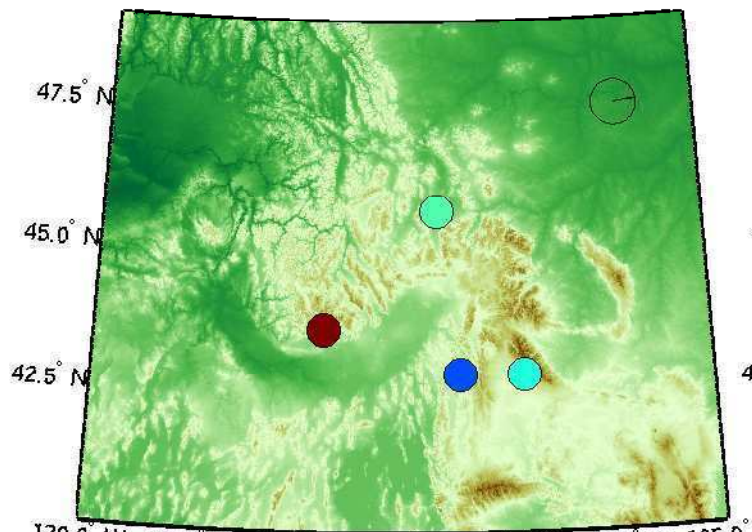
Stack



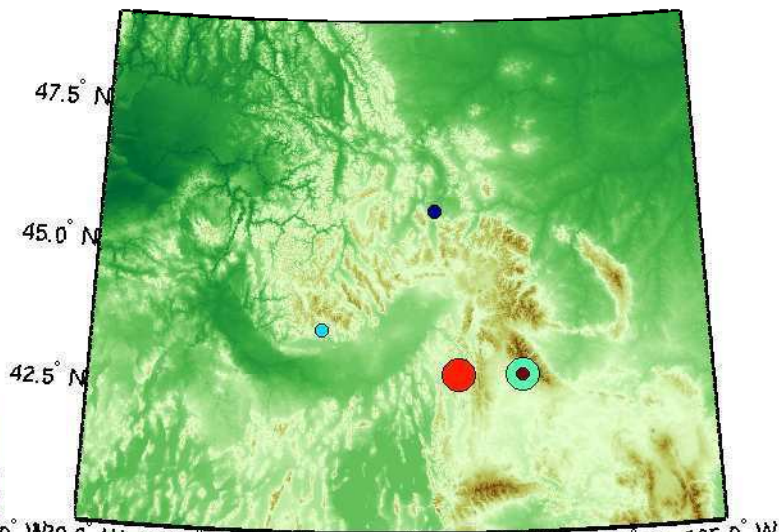
Baz = 262.5757  
Mean xcor value = 0.808  
Range of  $t^*$  values is 1.9  
Median  $t^*$  err is 0.39875



travel time residuals

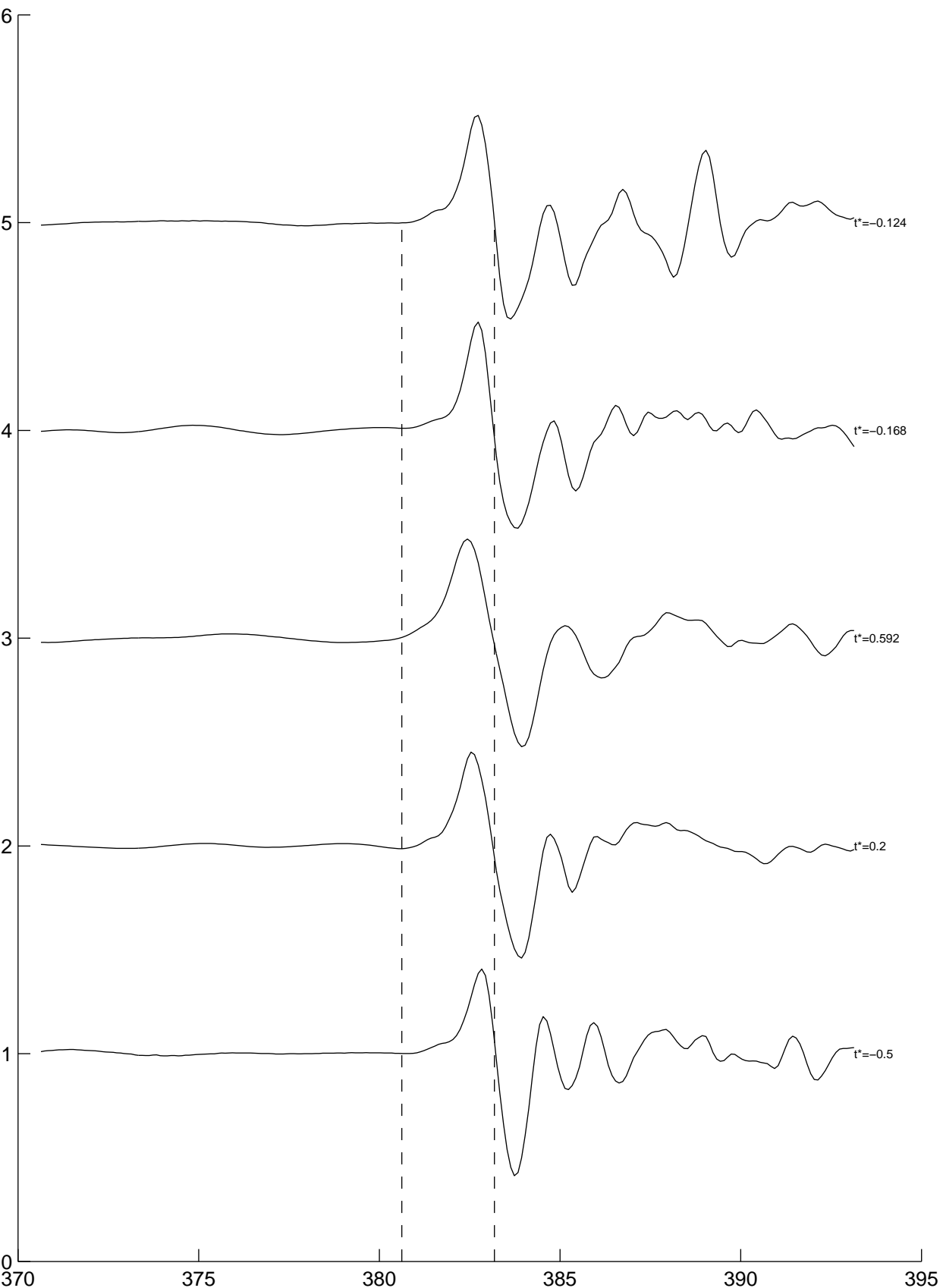


$t^*$  values

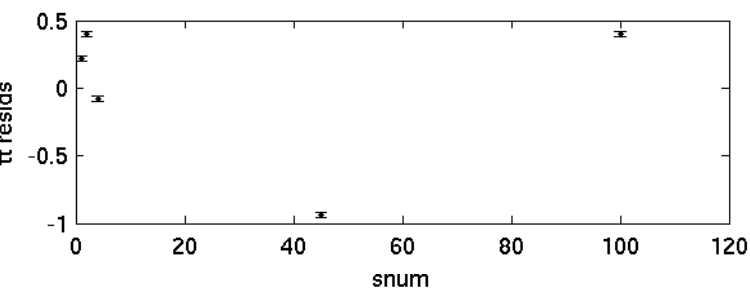
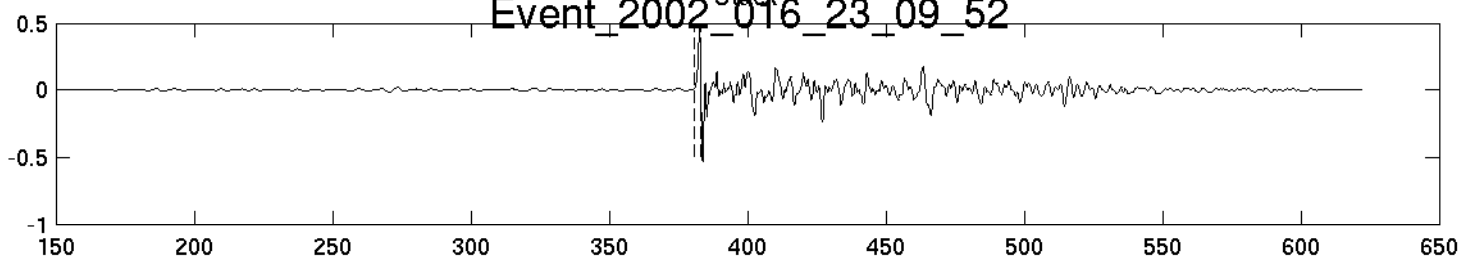




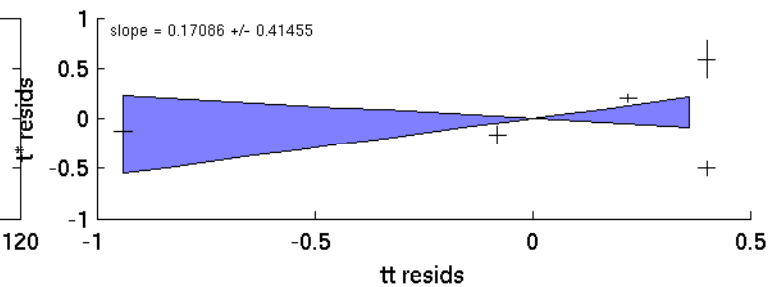
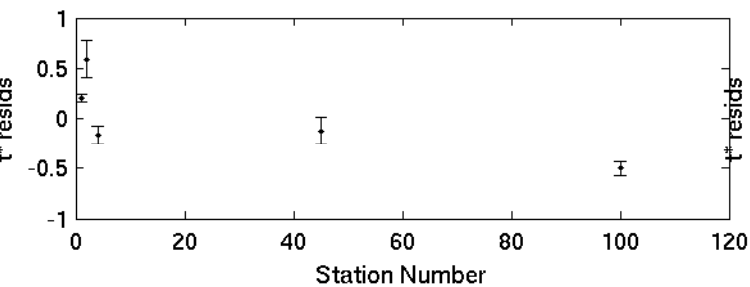
# Event\_2002\_016\_23\_09\_52



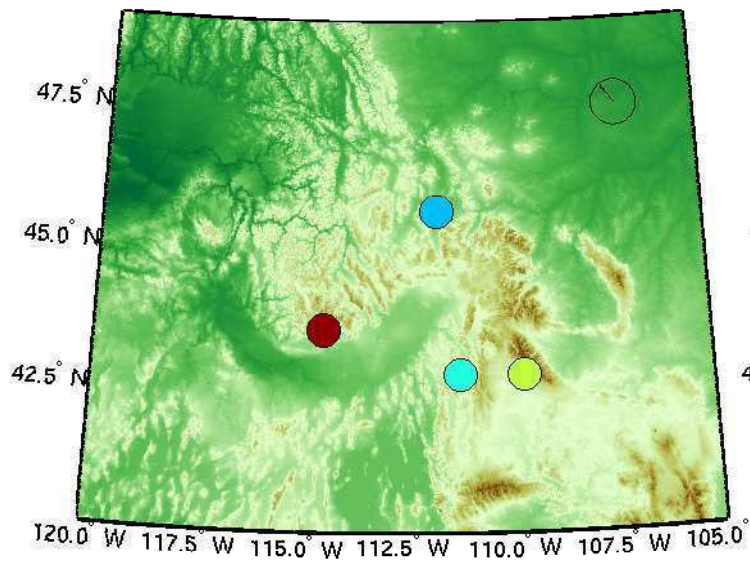
Event\_2002\_016\_23\_09\_52



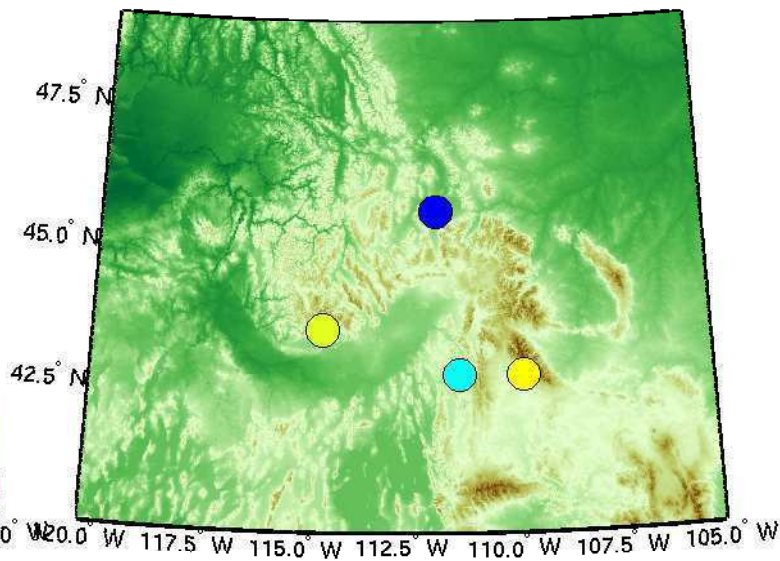
Baz = 145.9563  
Mean xcor value = 0.728  
Range of  $t^*$  values is 1.092  
Median  $t^*$  err is 0.086687



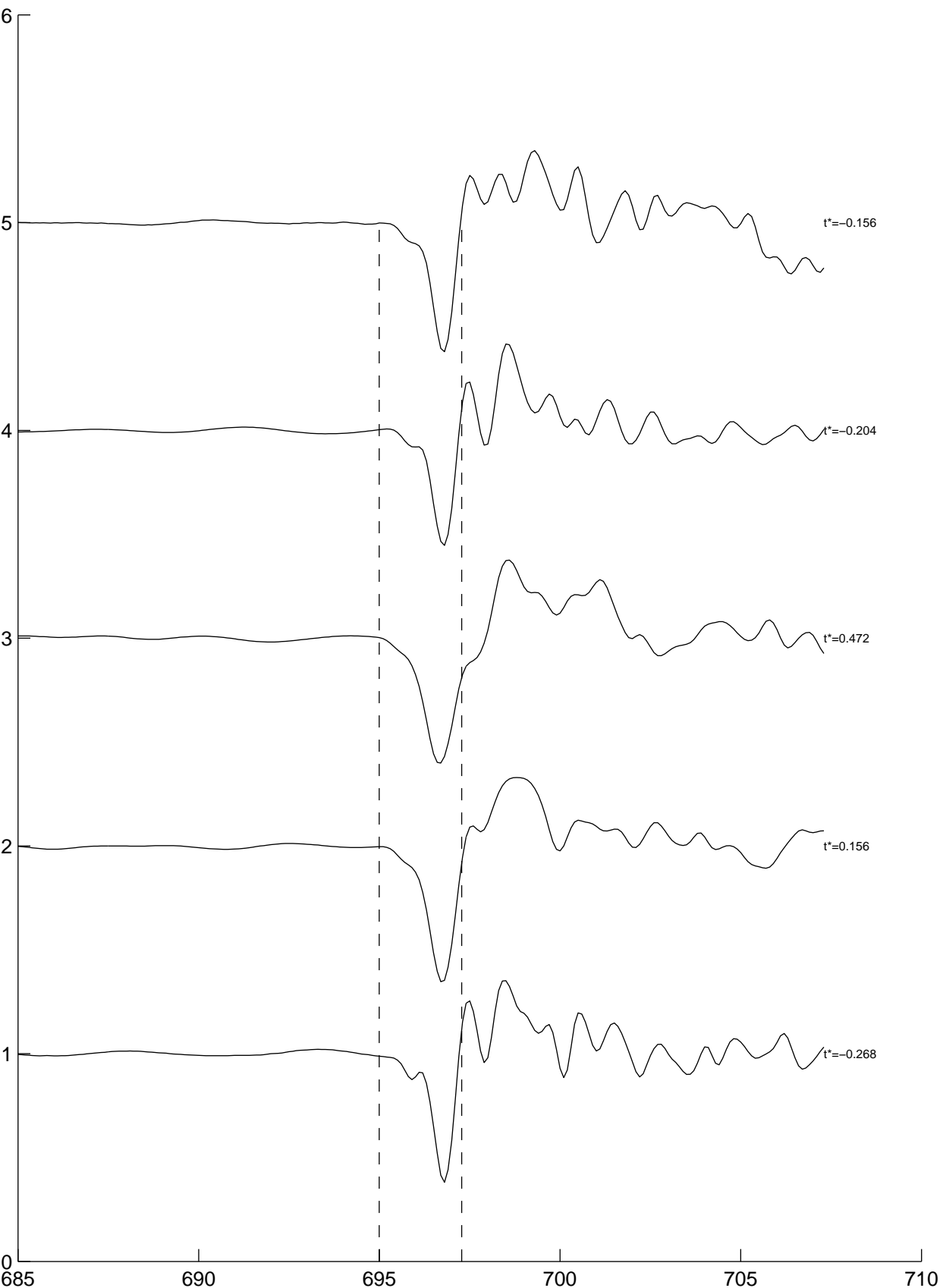
travel time residuals



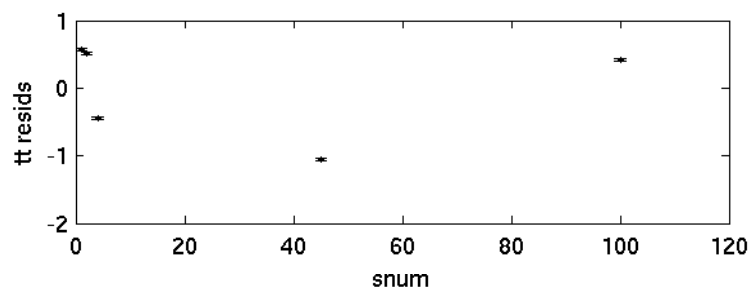
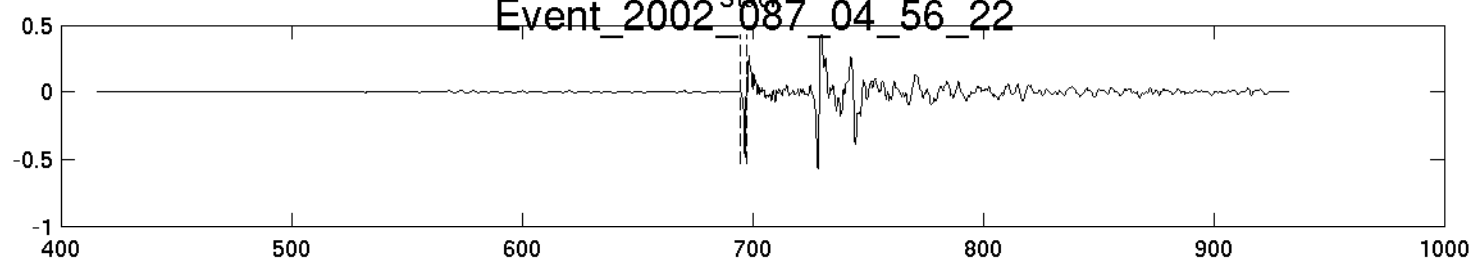
$t^*$  values



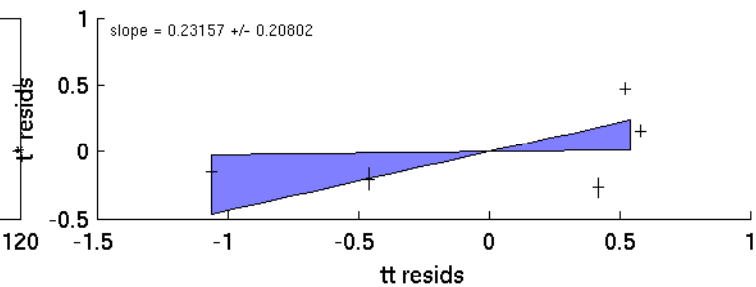
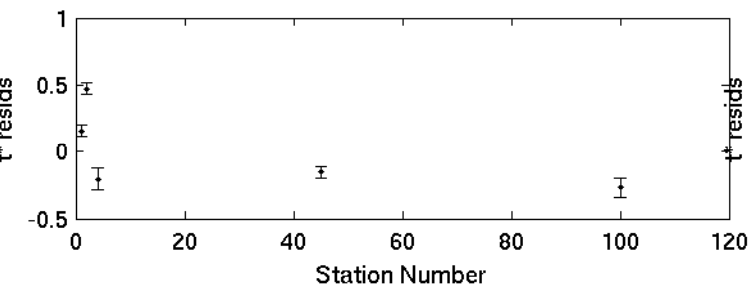
# Event\_2002\_087\_04\_56\_22



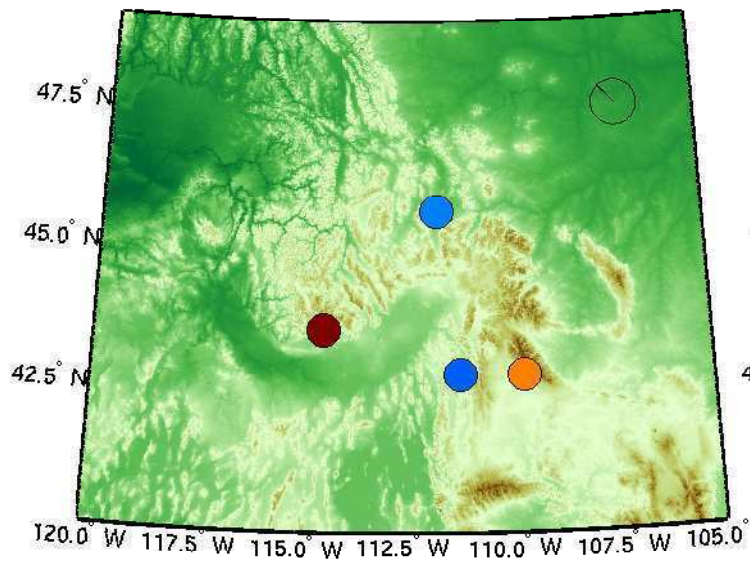
# Event\_2002\_087\_04\_56\_22



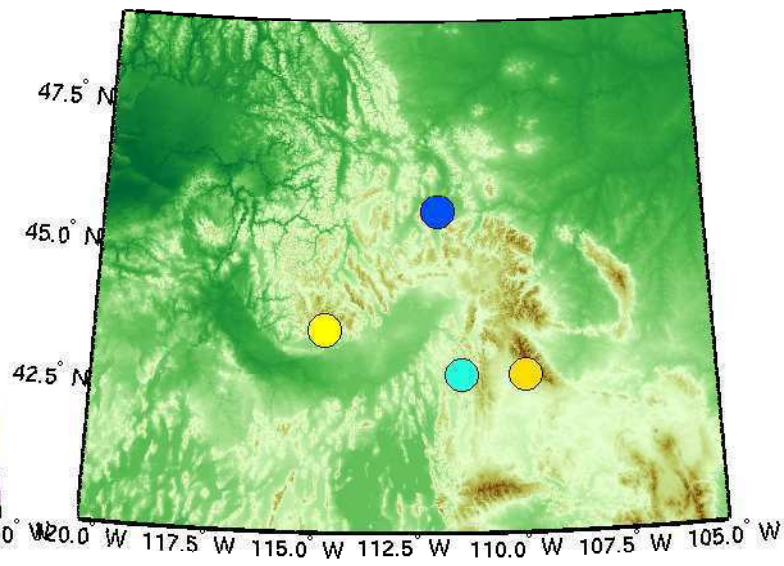
Baz = 139.4628  
 Mean xcor value = 0.734  
 Range of  $t^*$  values is 0.74  
 Median  $t^*$  err is 0.046533



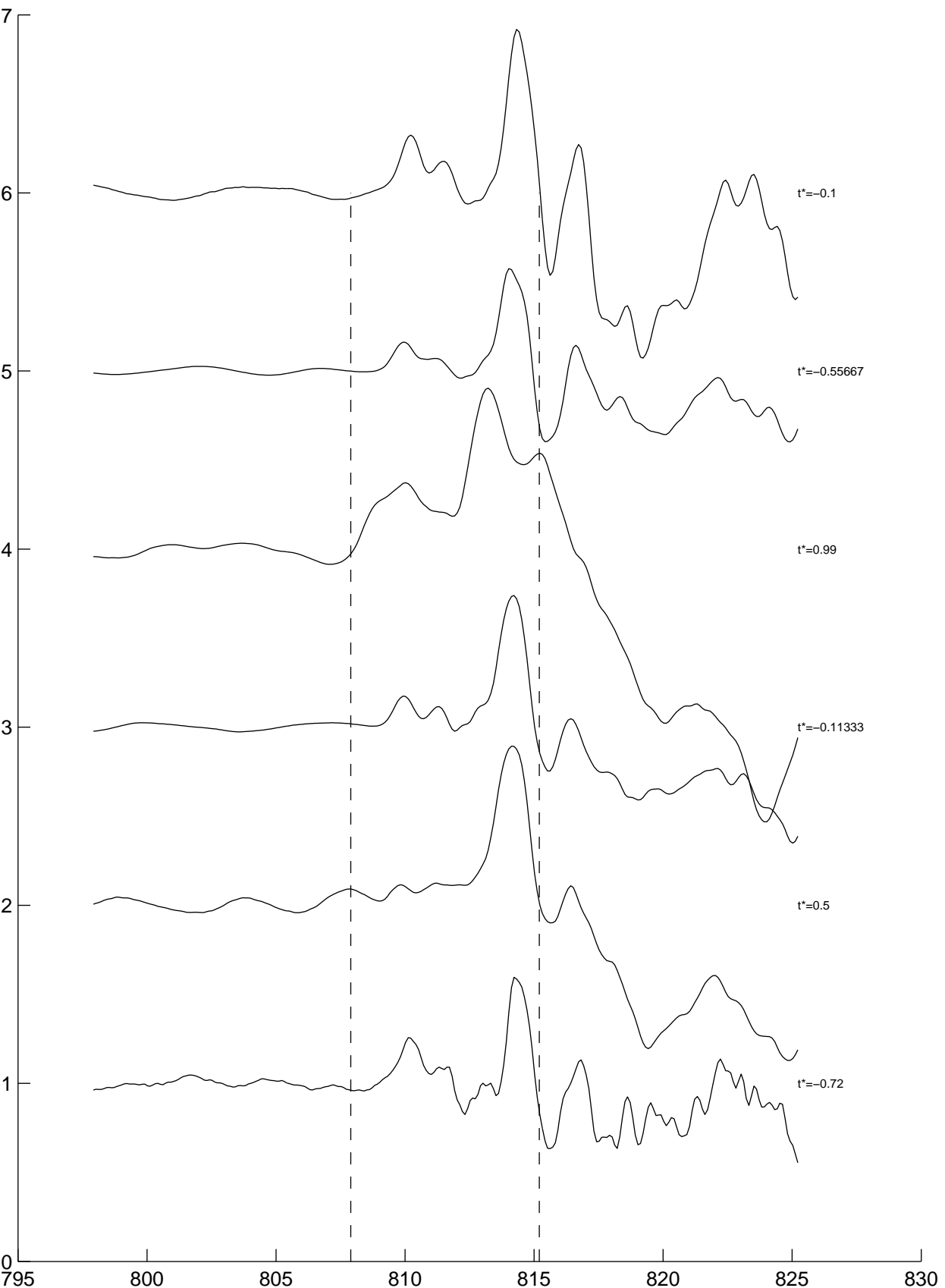
travel time residuals



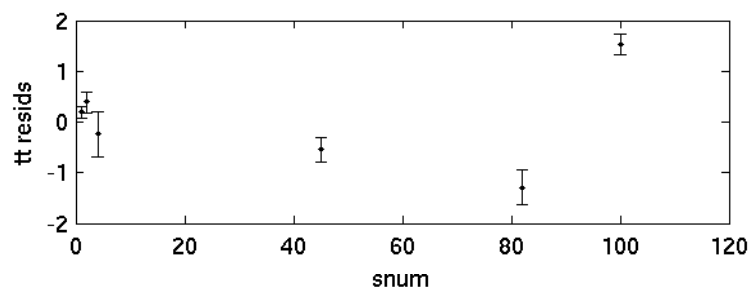
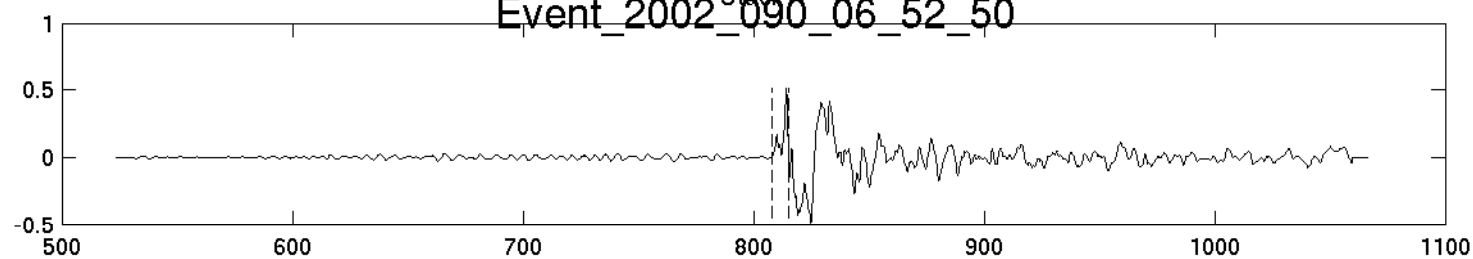
$t^*$  values



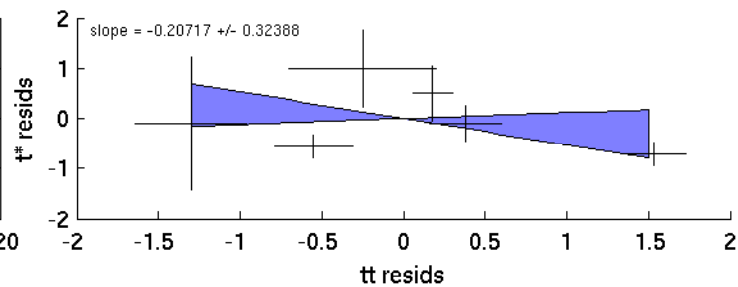
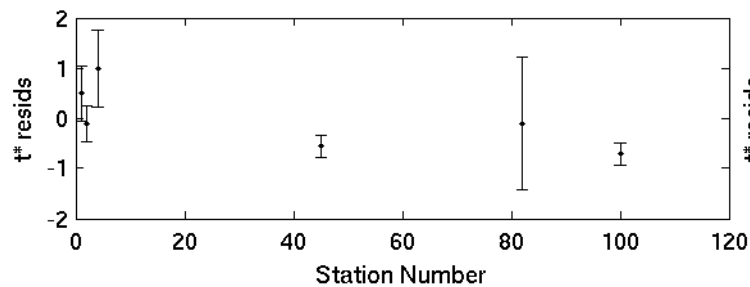
# Event\_2002\_090\_06\_52\_50



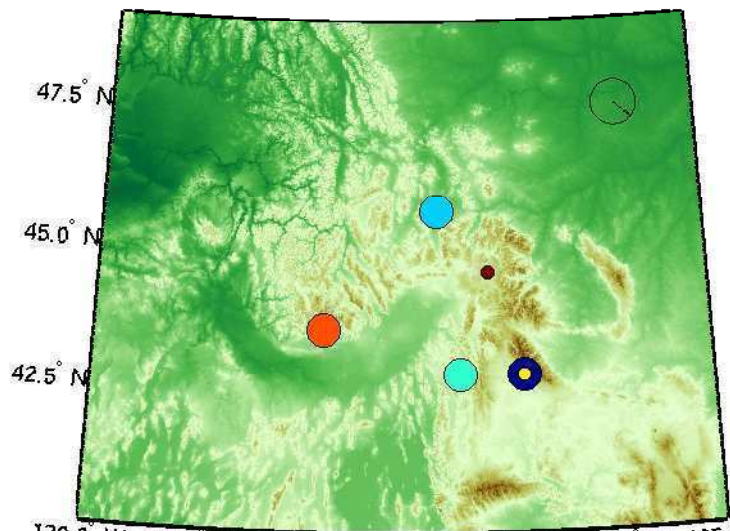
# Event\_2002\_090\_06\_52\_50



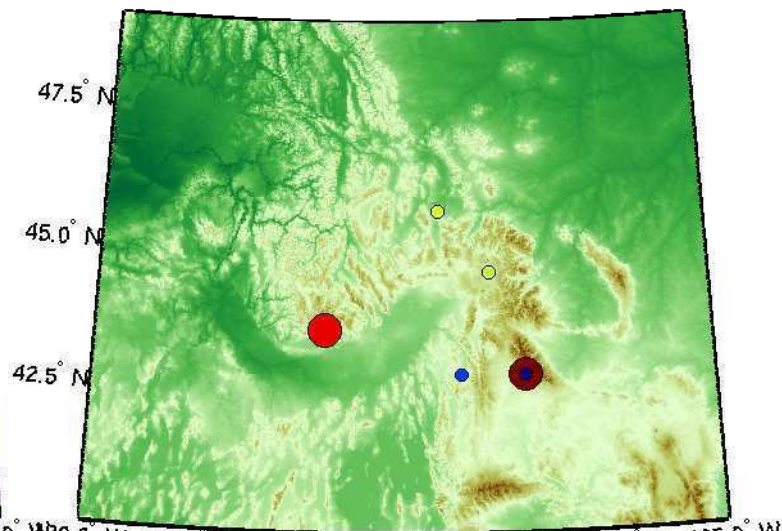
Baz = 312.6727  
Mean xcor value = 0.76833  
Range of  $t^*$  values is 1.71  
Median  $t^*$  err is 0.45479



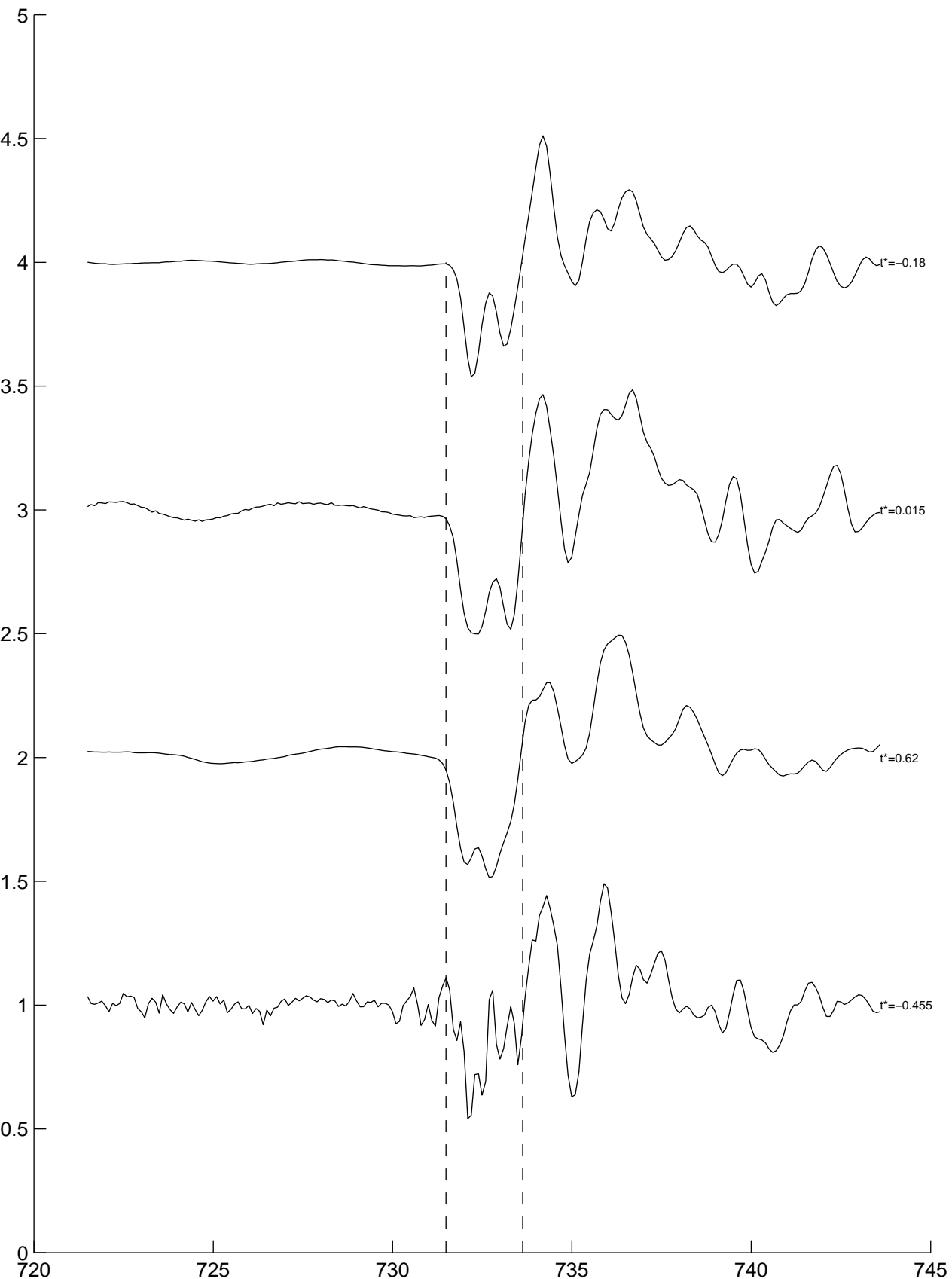
travel time residuals



$t^*$  values



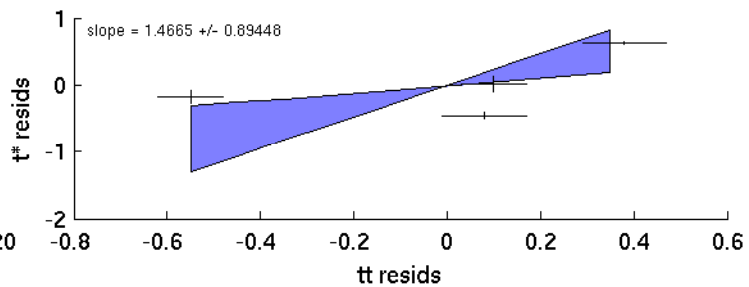
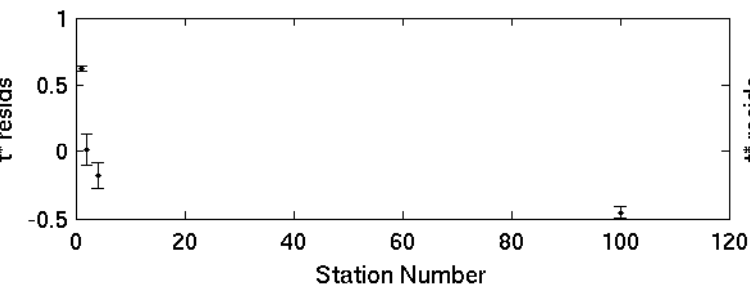
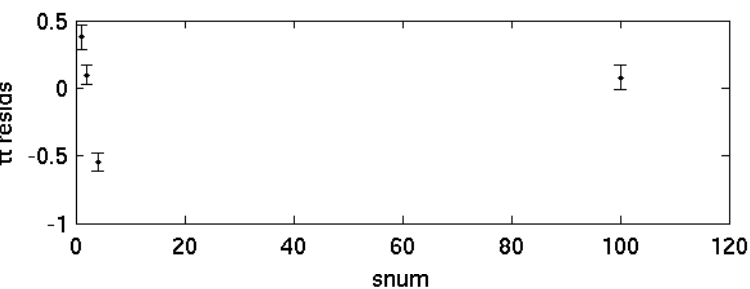
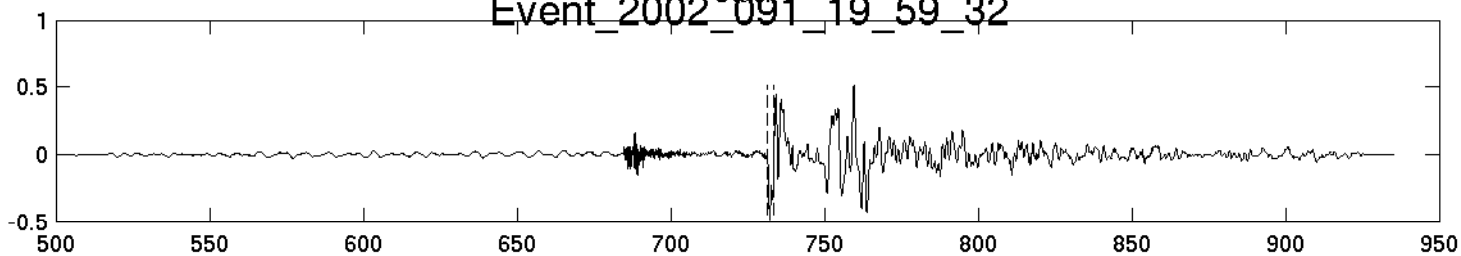
# Event\_2002\_091\_19\_59\_32



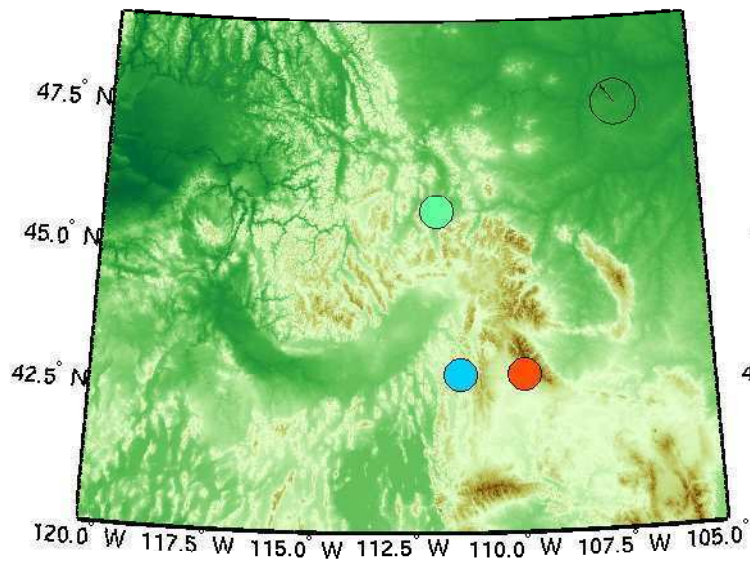


# Event\_2002\_091\_19\_59\_32

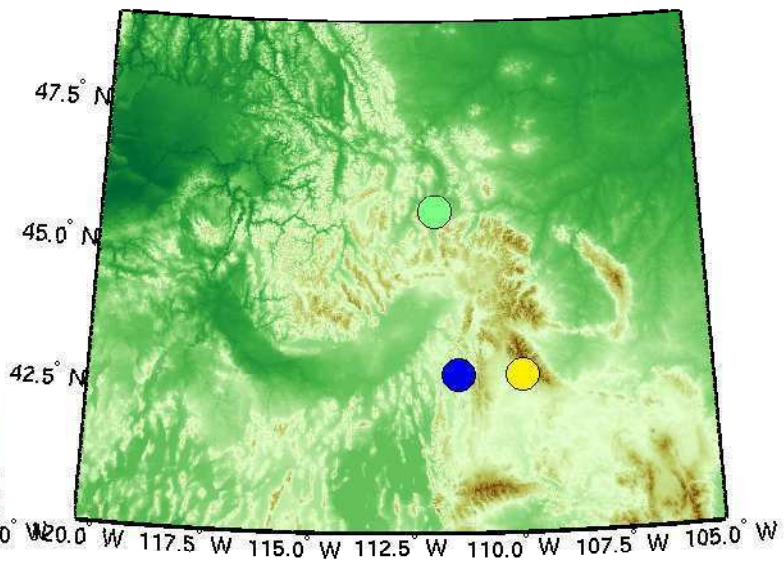
Stack



travel time residuals

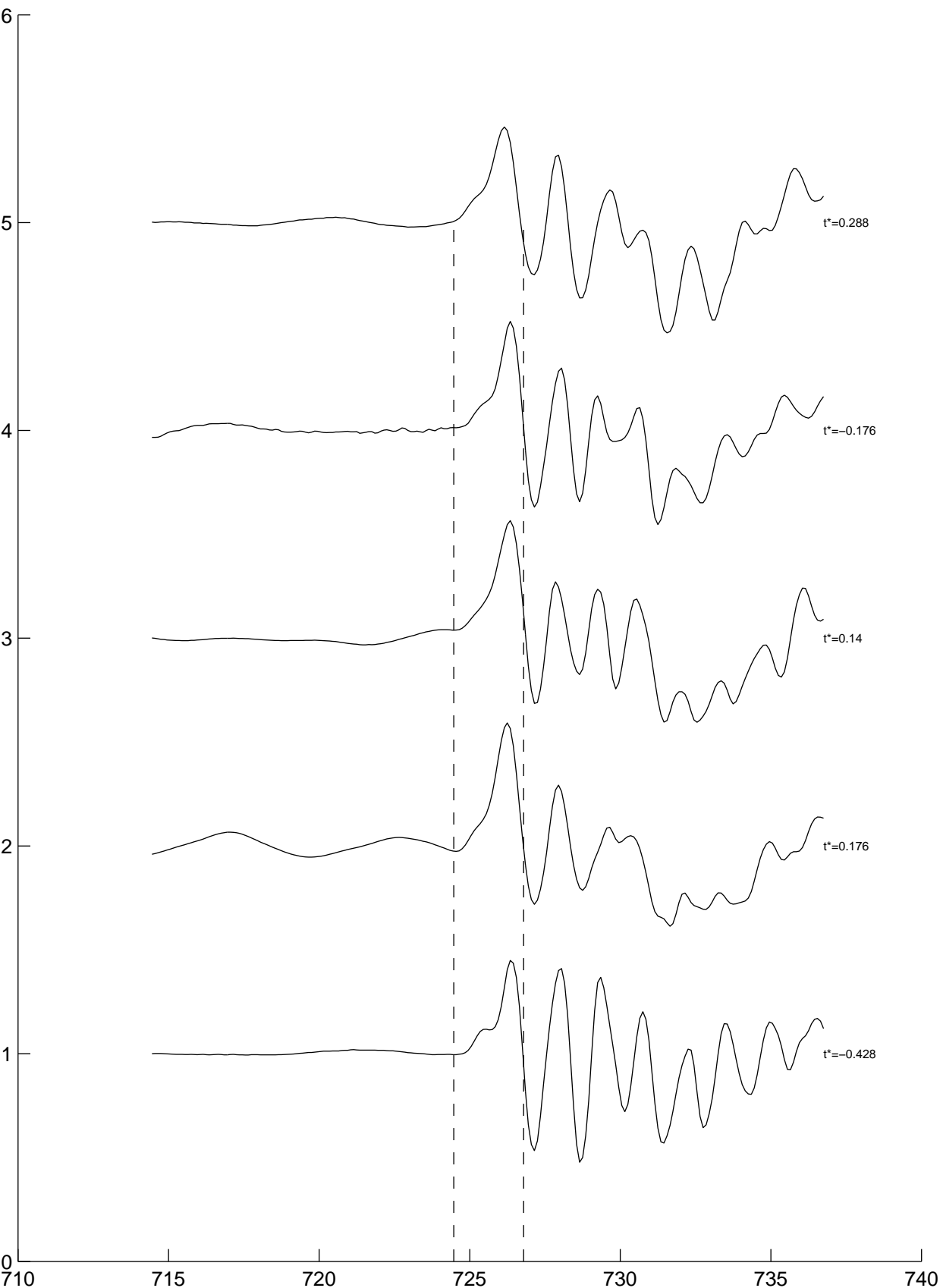


$t^*$  values

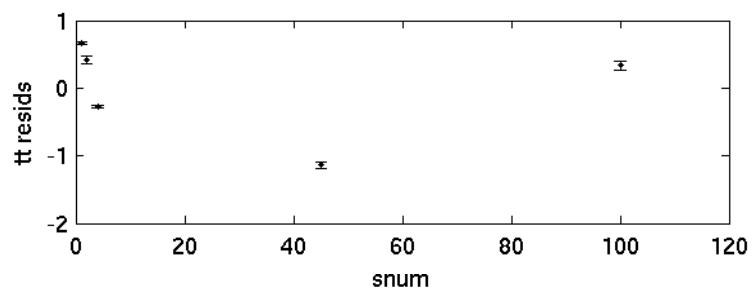
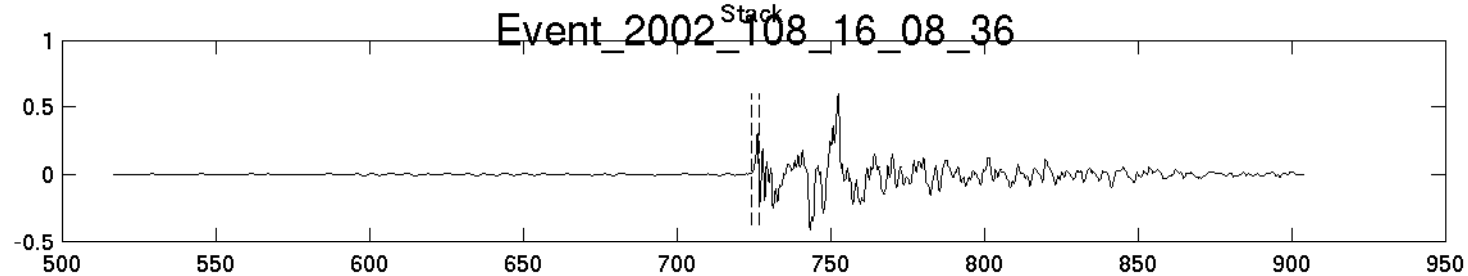




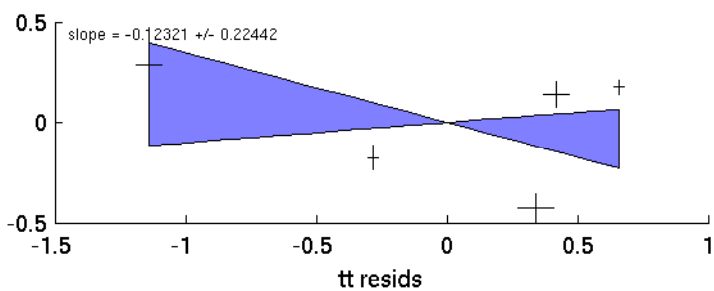
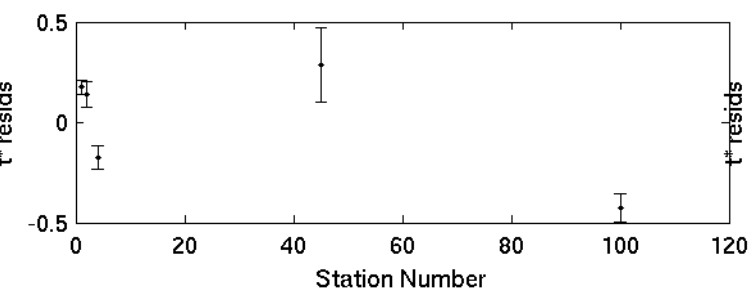
# Event\_2002\_108\_16\_08\_36



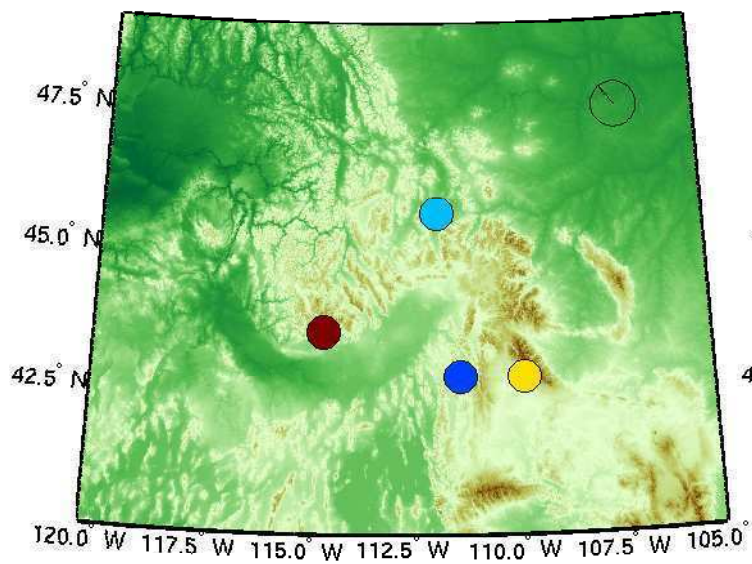
# Event\_2002\_108\_16\_08\_36



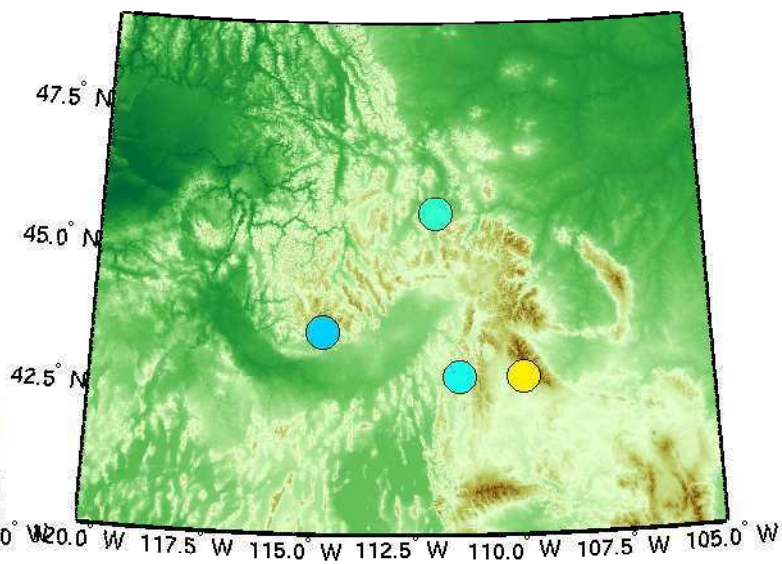
Baz = 144.2339  
 Mean xcor value = 0.704  
 Range of  $t^*$  values is 0.716  
 Median  $t^*$  err is 0.065727



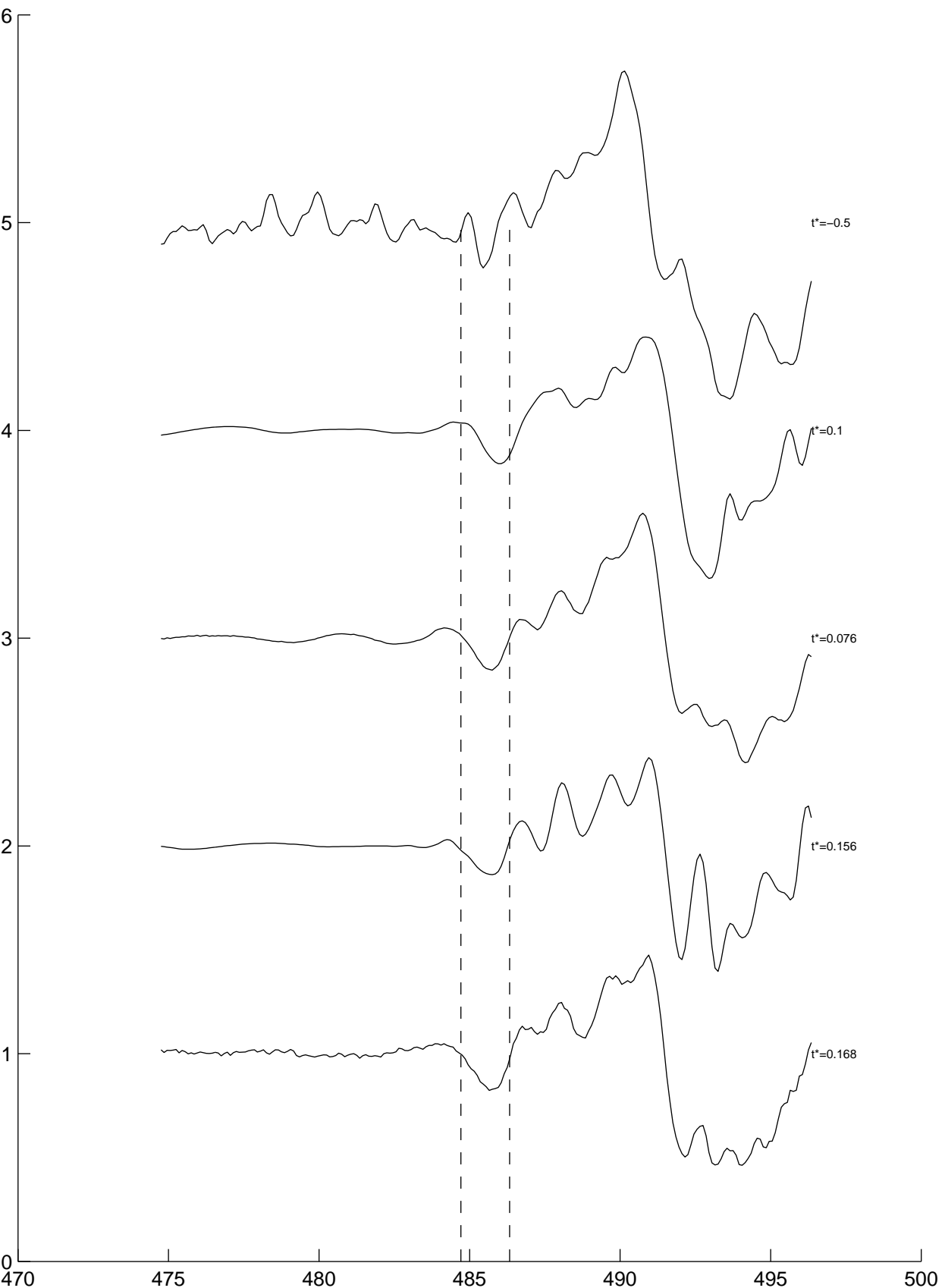
travel time residuals



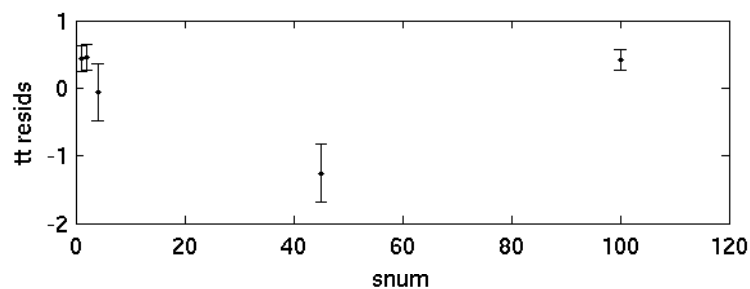
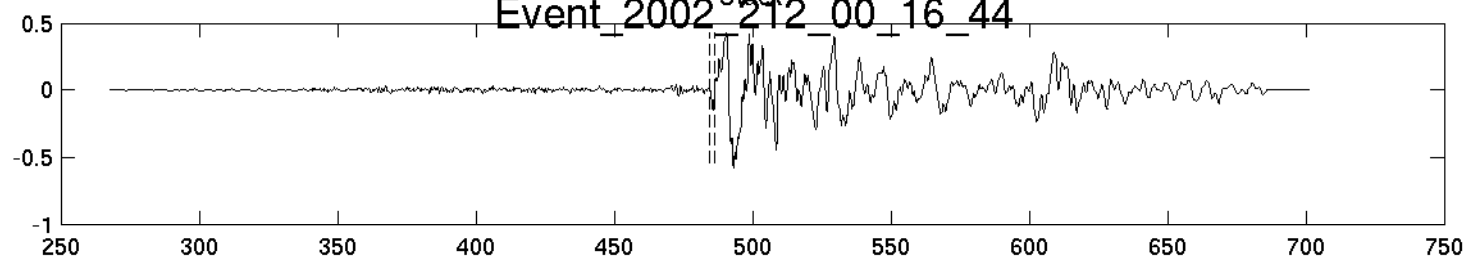
$t^*$  values



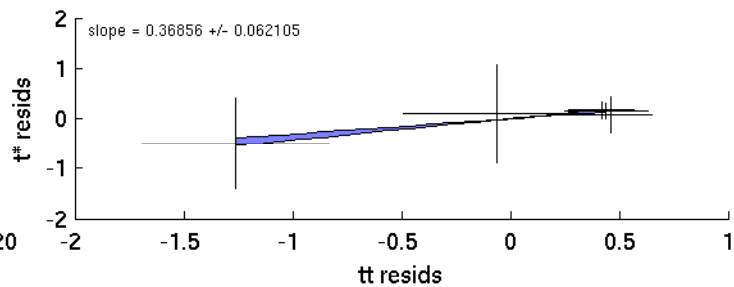
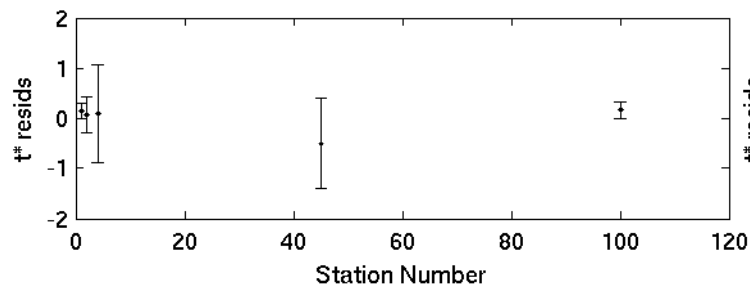
# Event\_2002\_212\_00\_16\_44



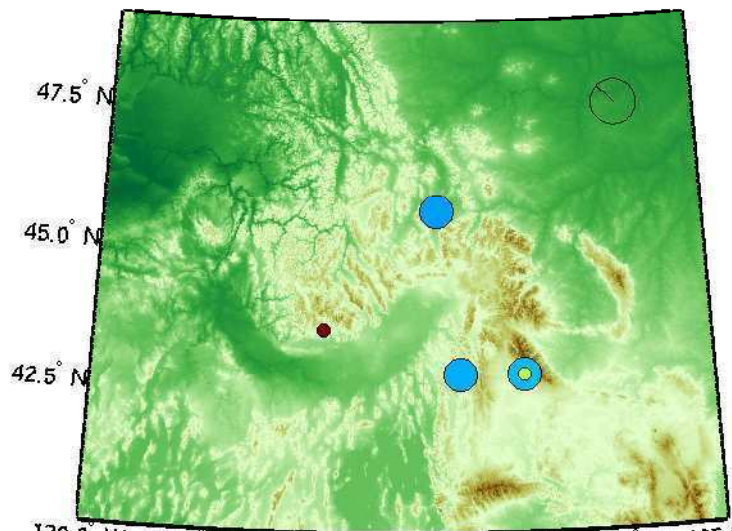
Event 2002\_212\_00\_16\_44



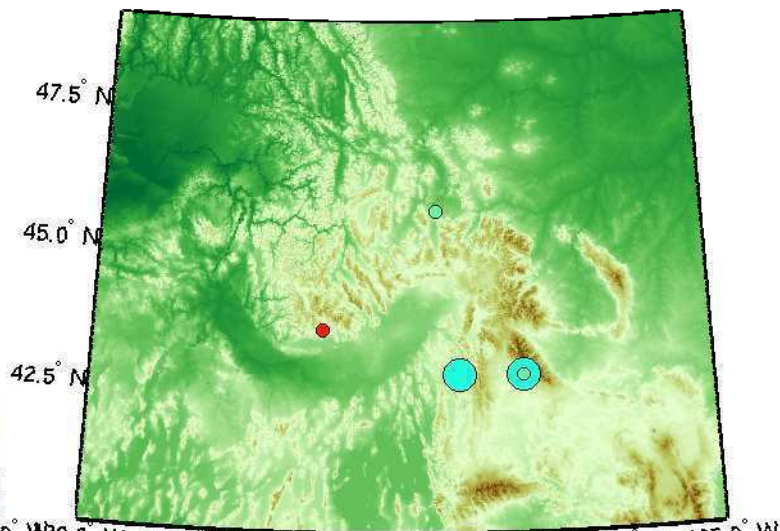
Baz = 136.934  
Mean xcor value = 0.748  
Range of  $t^*$  values is 0.668  
Median  $t^*$  err is 0.34607



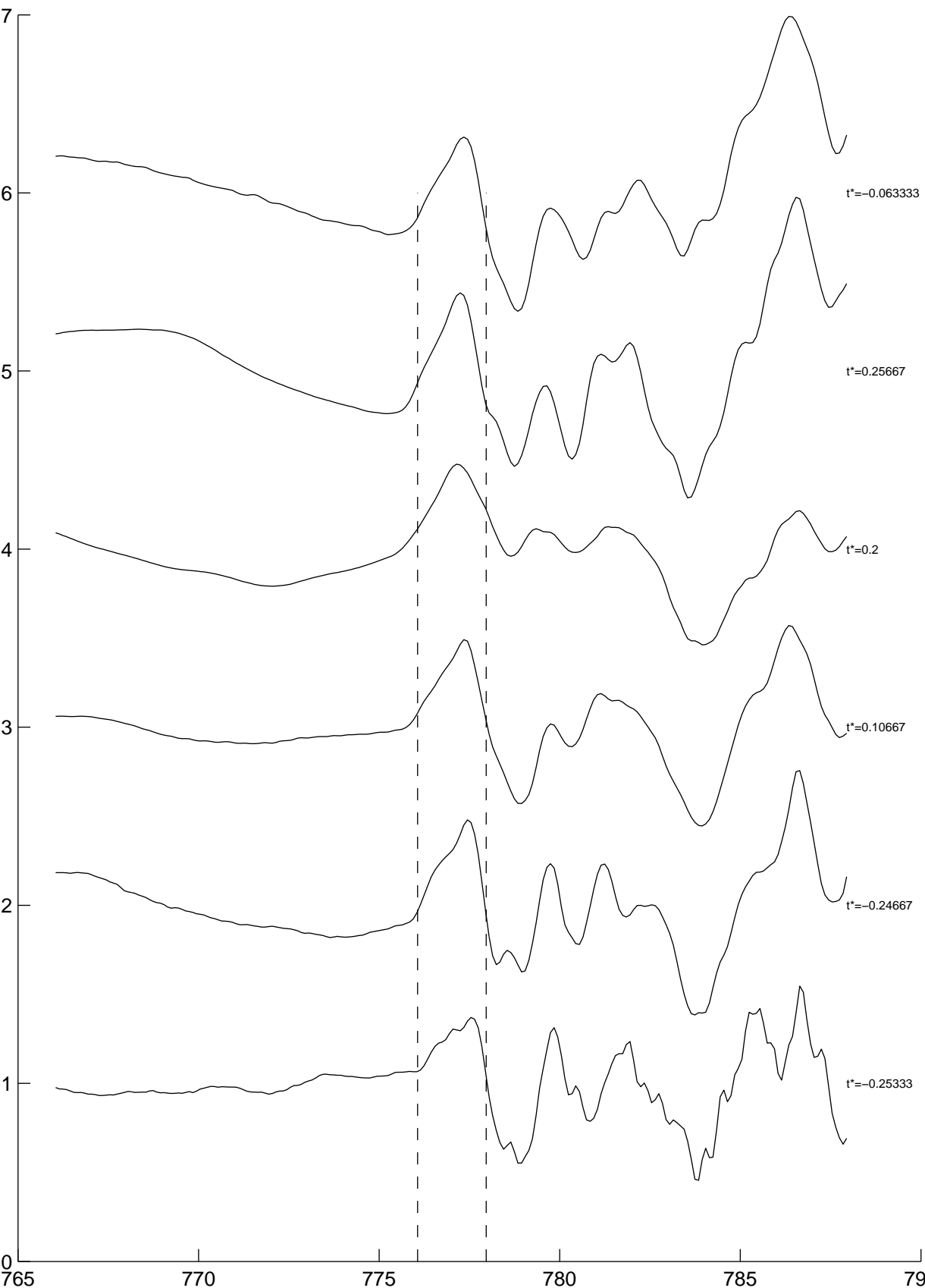
travel time residuals



$t^*$  values

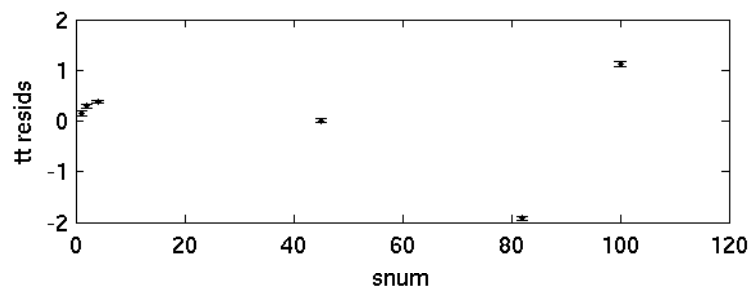
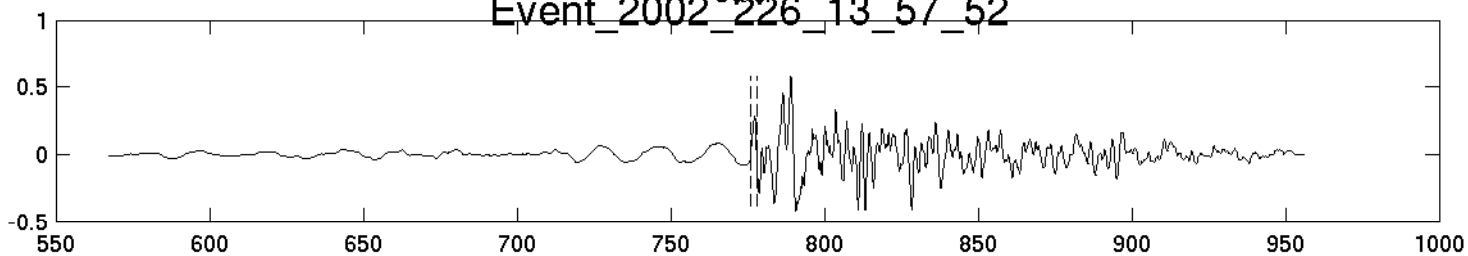


# Event\_2002\_226\_13\_57\_52

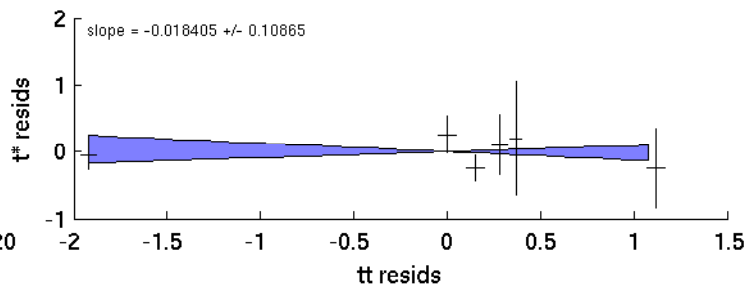
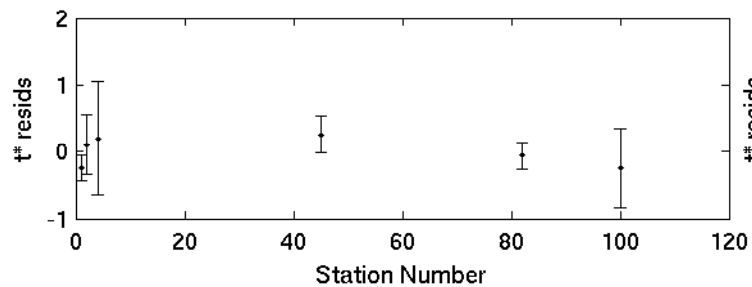


# Event\_2002\_226\_13\_57\_52

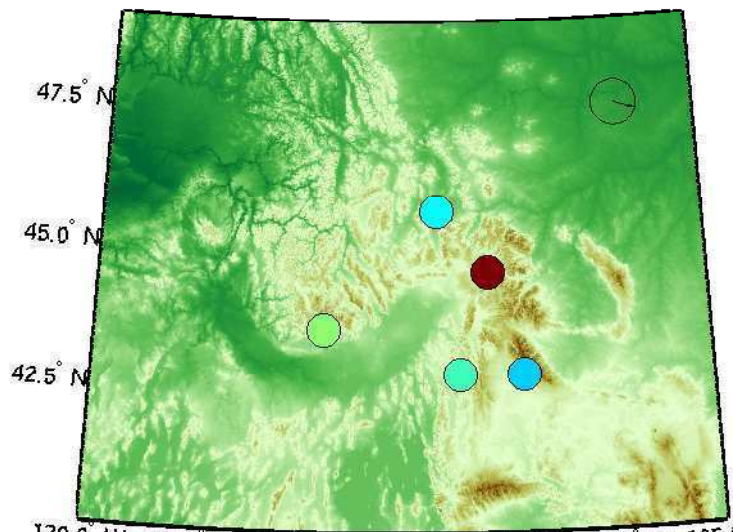
Stack



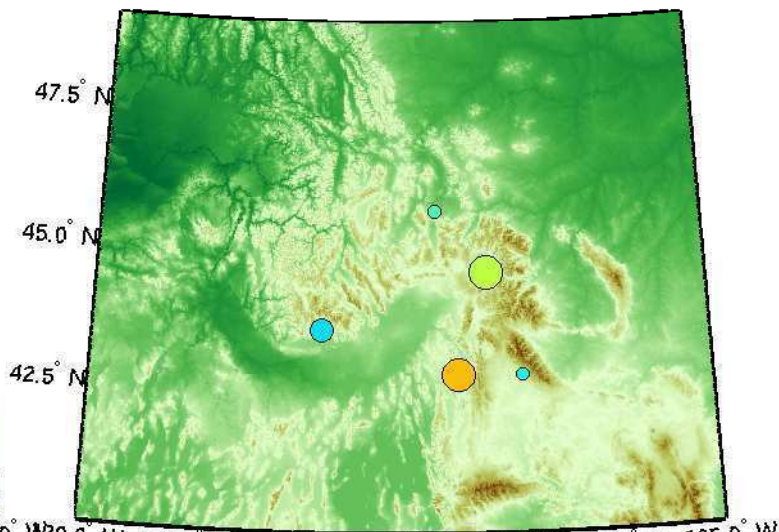
Baz = 288.8627  
Mean xcor value = 0.73333  
Range of  $t^*$  values is 0.51  
Median  $t^*$  err is 0.36727



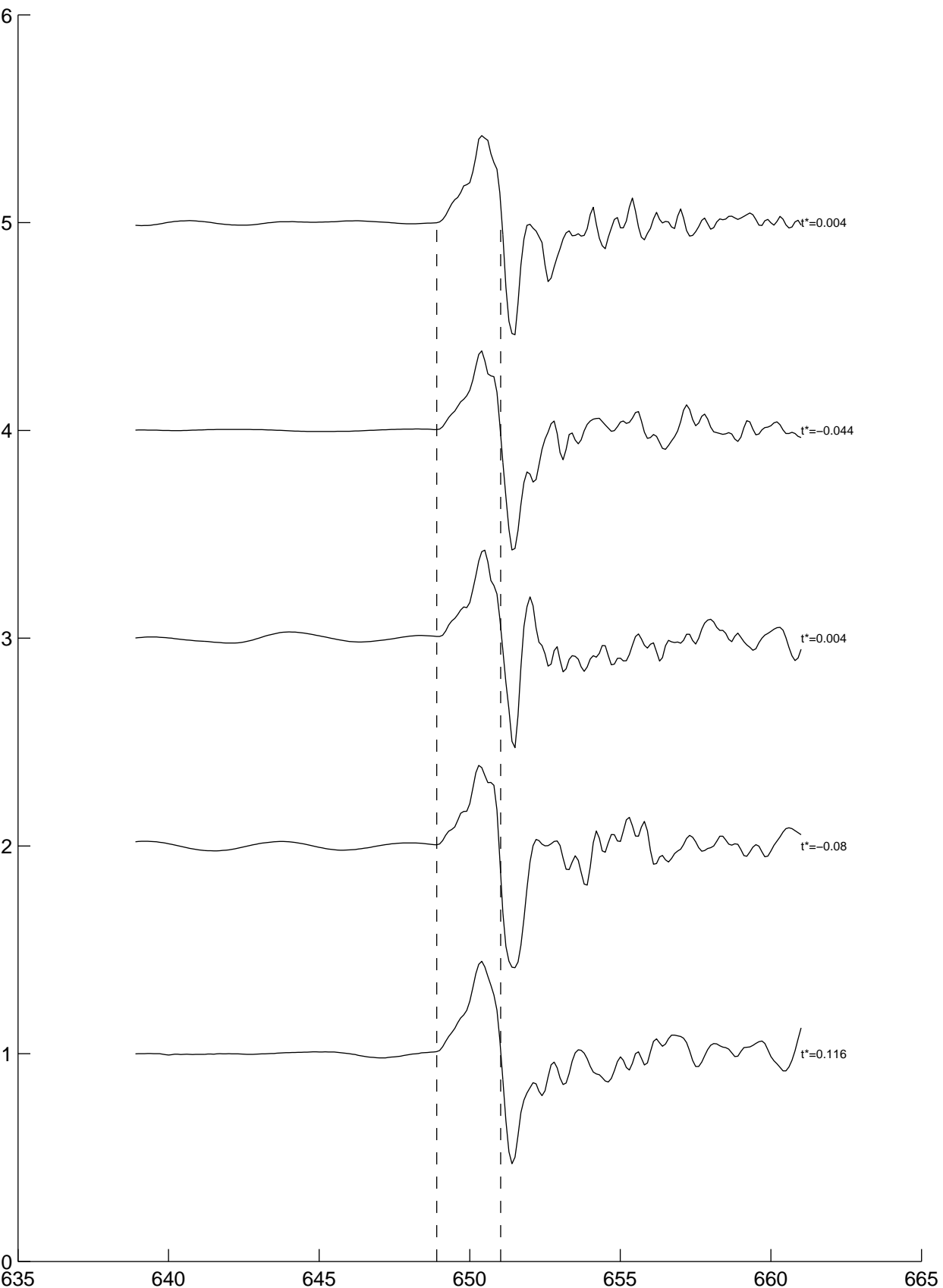
travel time residuals



$t^*$  values

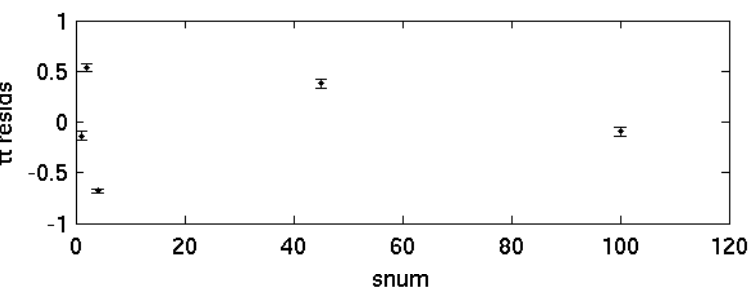
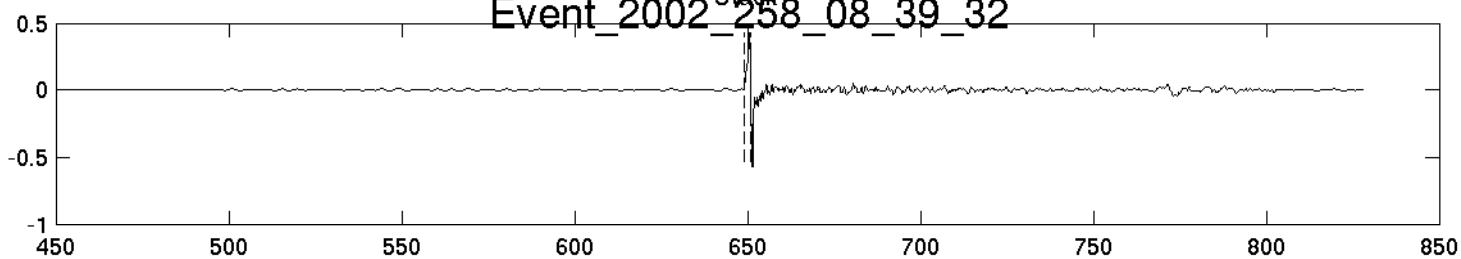


# Event\_2002\_258\_08\_39\_32

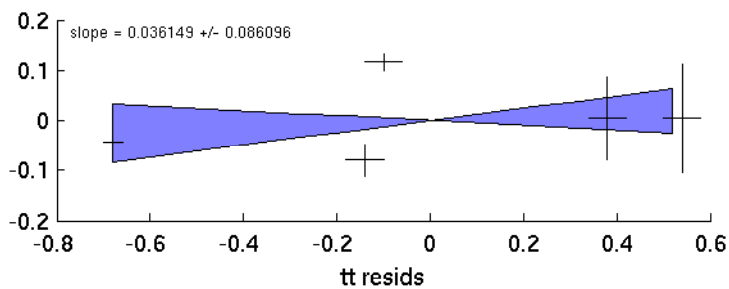
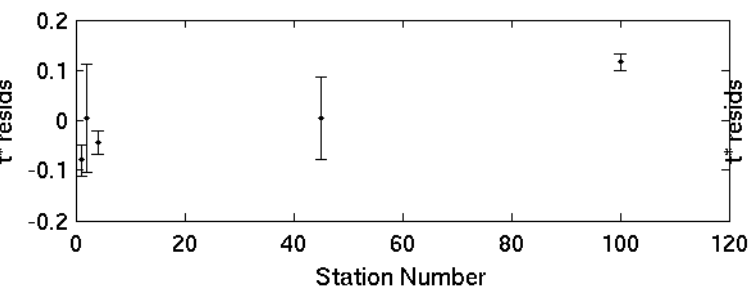




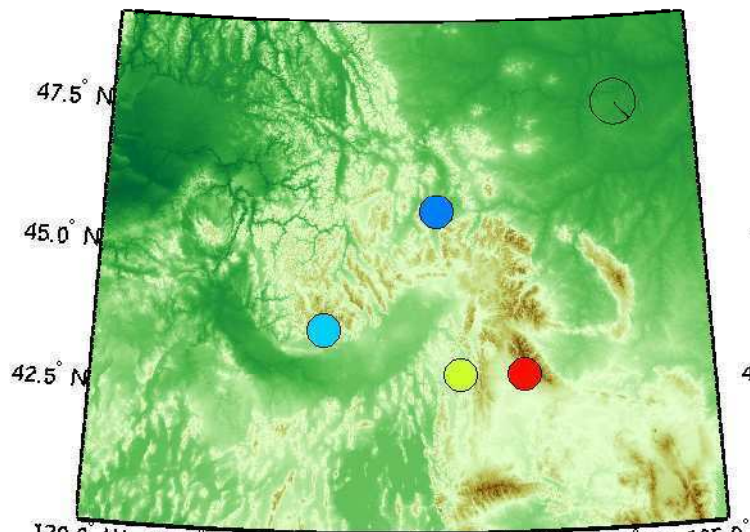
Event\_2002\_258\_08\_39\_32



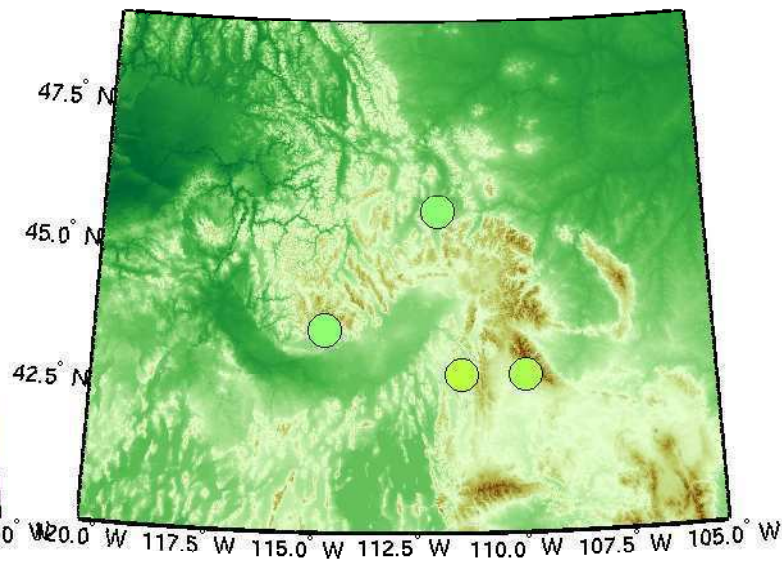
Baz = 319.9782  
 Mean xcor value = 0.688  
 Range of  $t^*$  values is 0.196  
 Median  $t^*$  err is 0.032166



travel time residuals

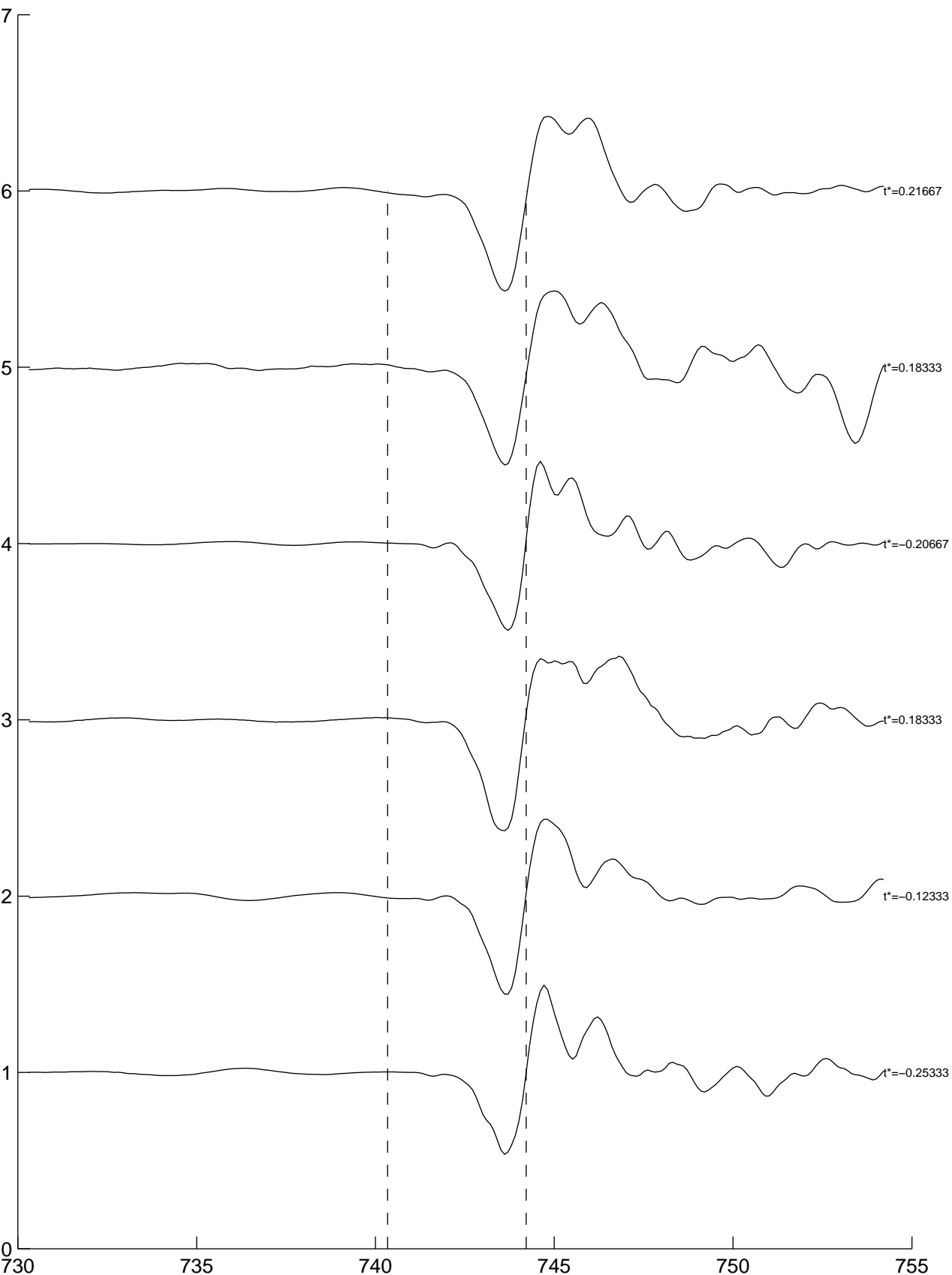


$t^*$  values



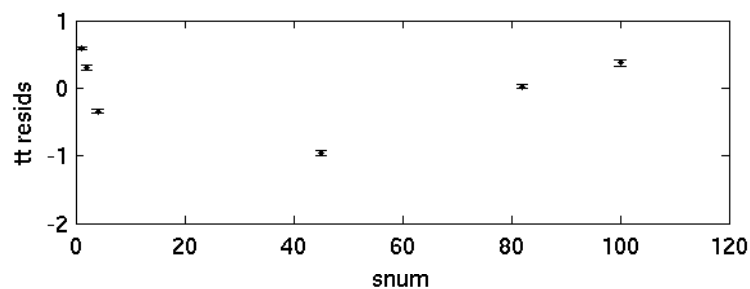
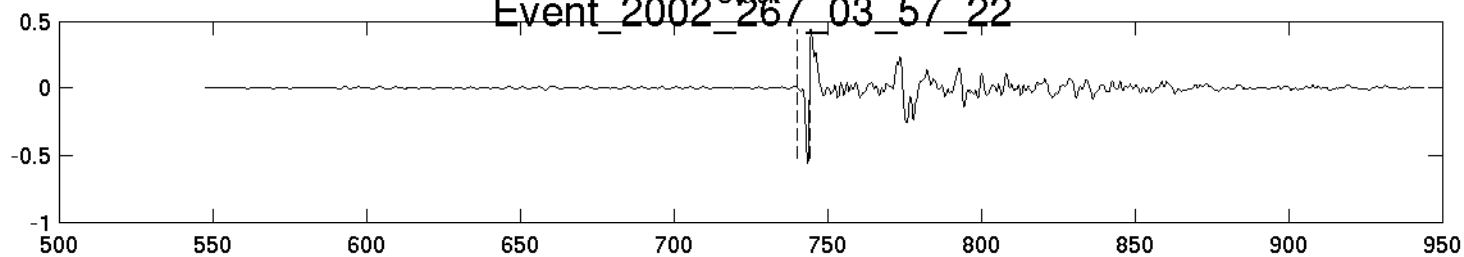


# Event\_2002\_267\_03\_57\_22

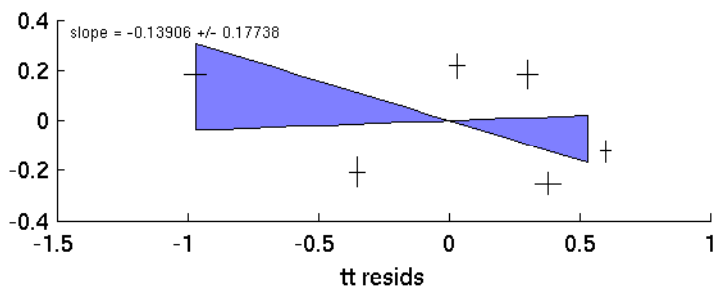
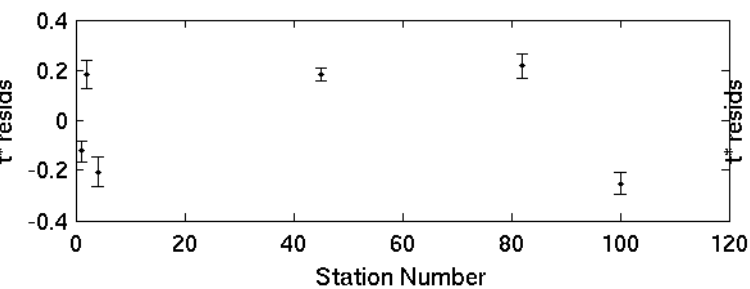


Event\_2002\_267\_03\_57\_22

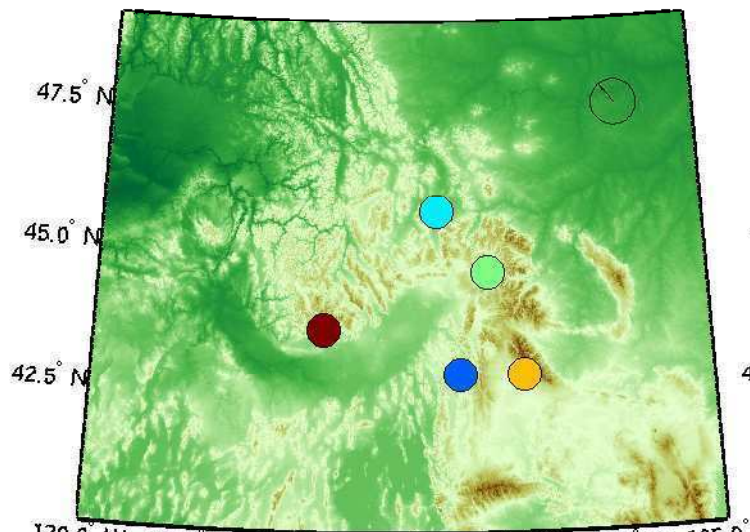
Stack



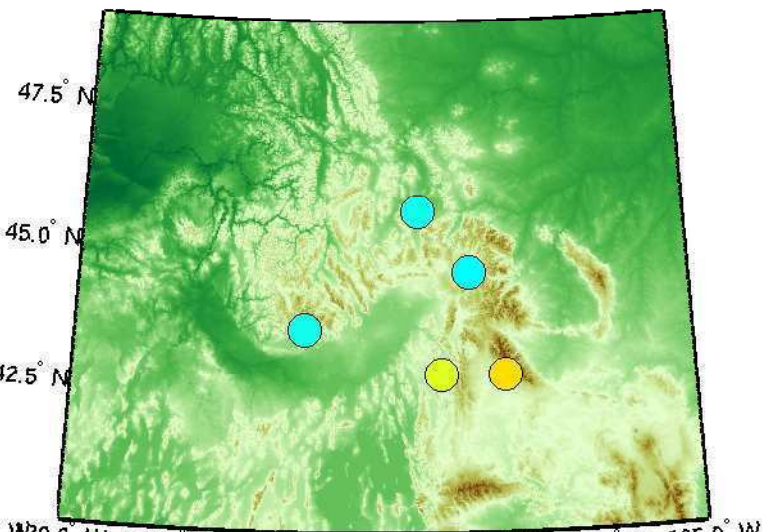
Baz = 144.8143  
Mean xcor value = 0.80167  
Range of  $t^*$  values is 0.47  
Median  $t^*$  err is 0.047277



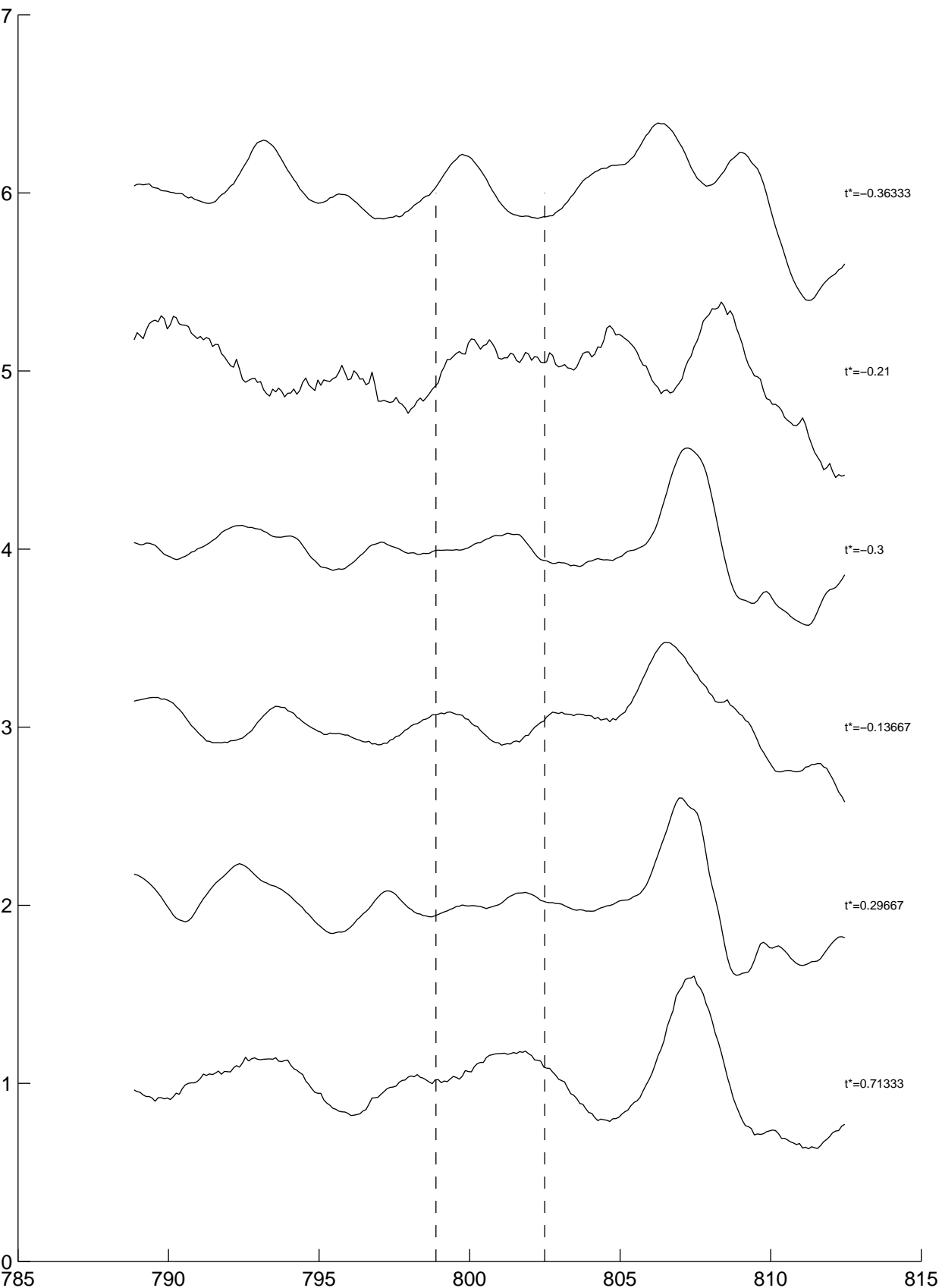
travel time residuals



$t^*$  values

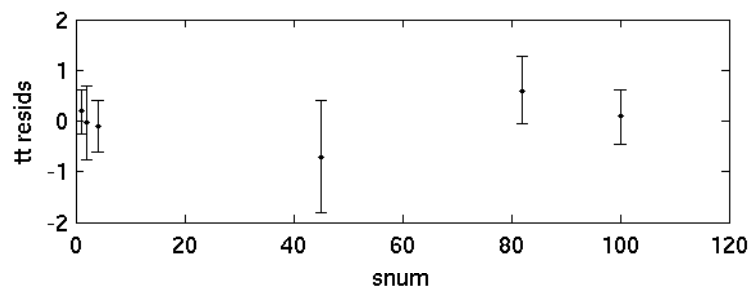
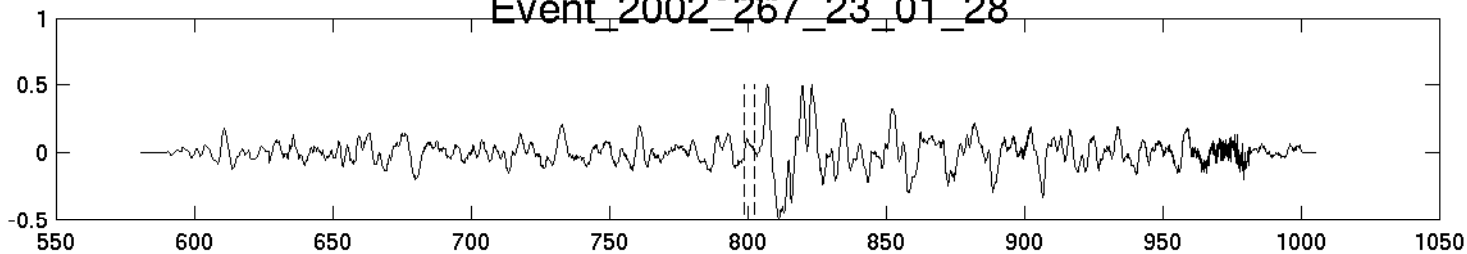


# Event\_2002\_267\_23\_01\_28

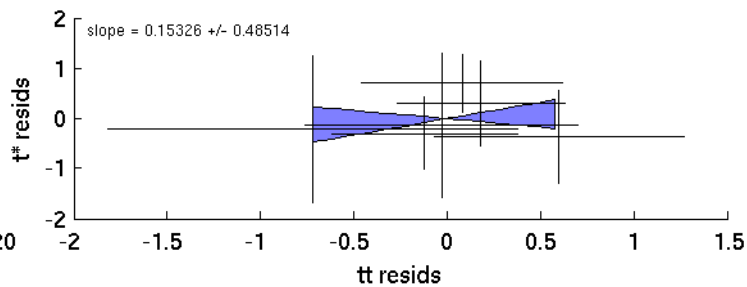
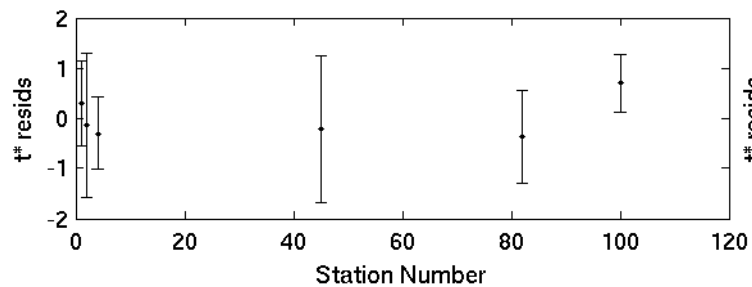


Event 2002\_267\_23\_01\_28

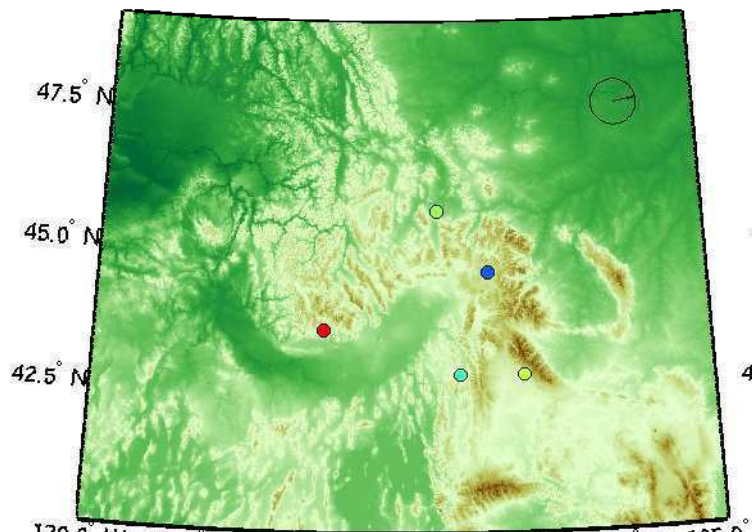
Stack



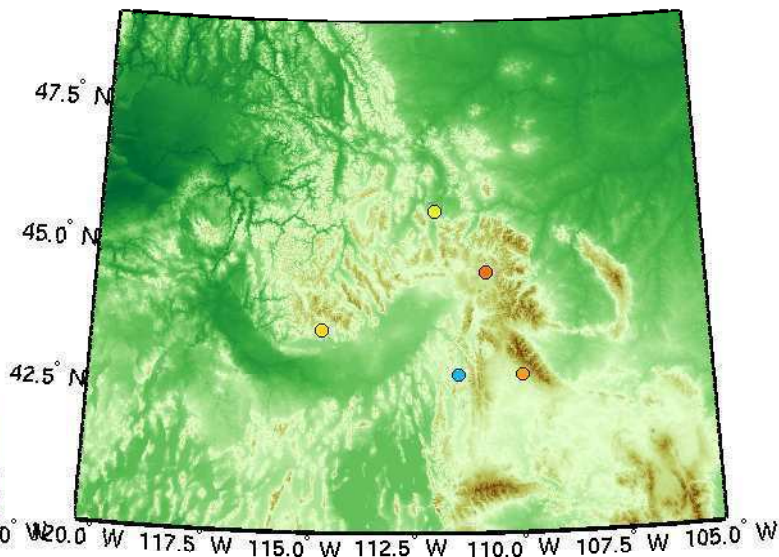
Baz = 260.4322  
Mean xcor value = 0.65833  
Range of  $t^*$  values is 1.0767  
Median  $t^*$  err is 0.89058



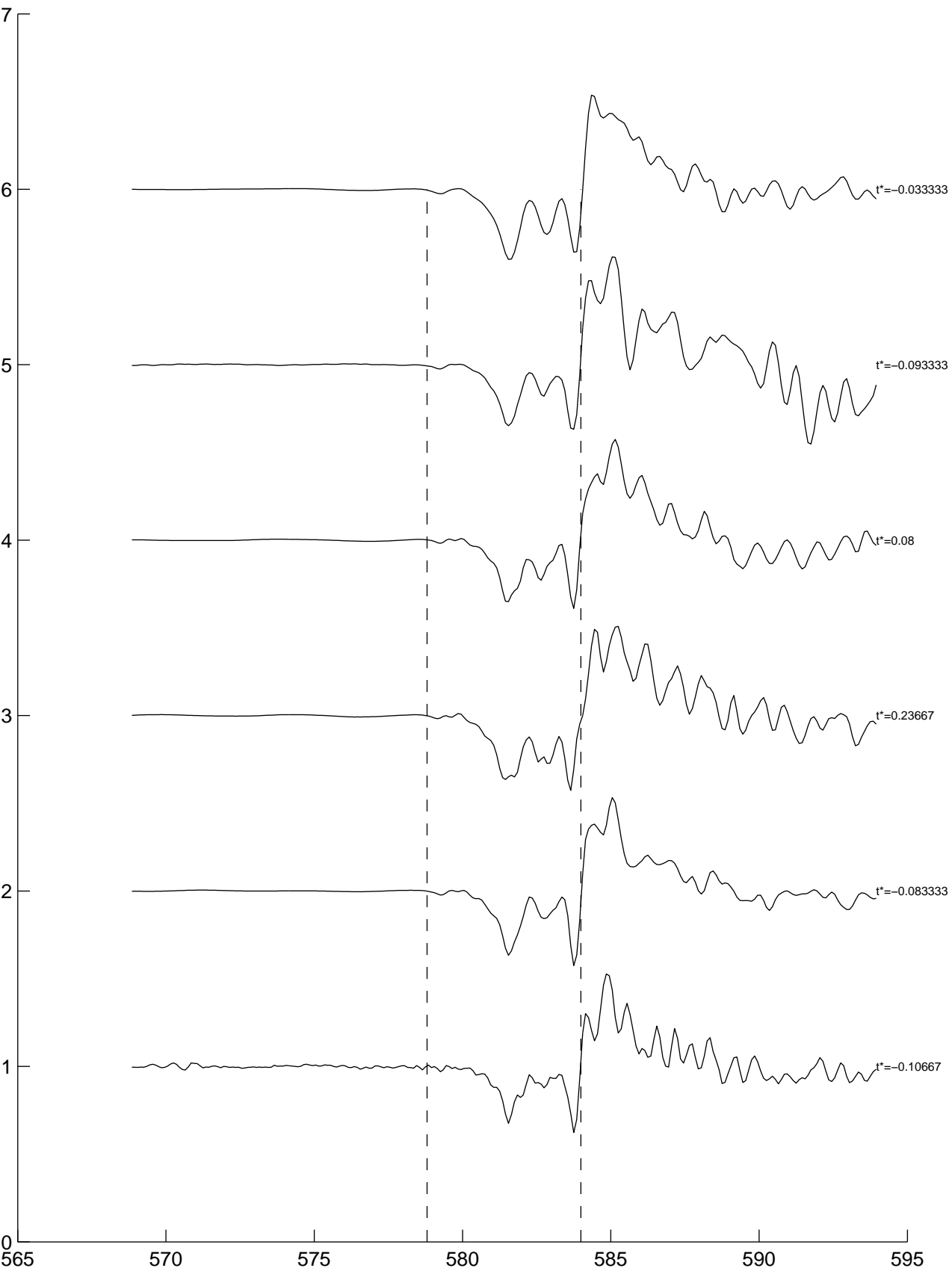
travel time residuals



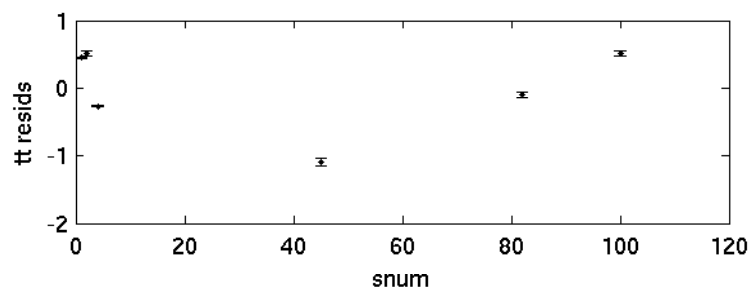
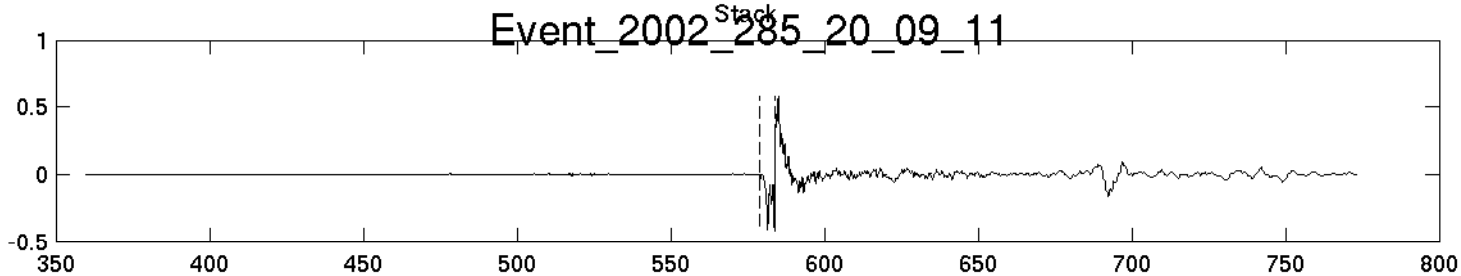
$t^*$  values



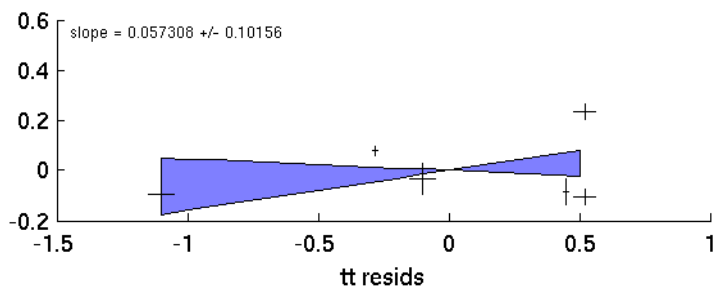
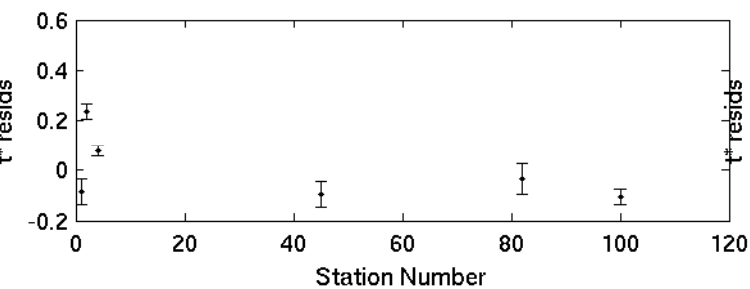
# Event\_2002\_285\_20\_09\_11



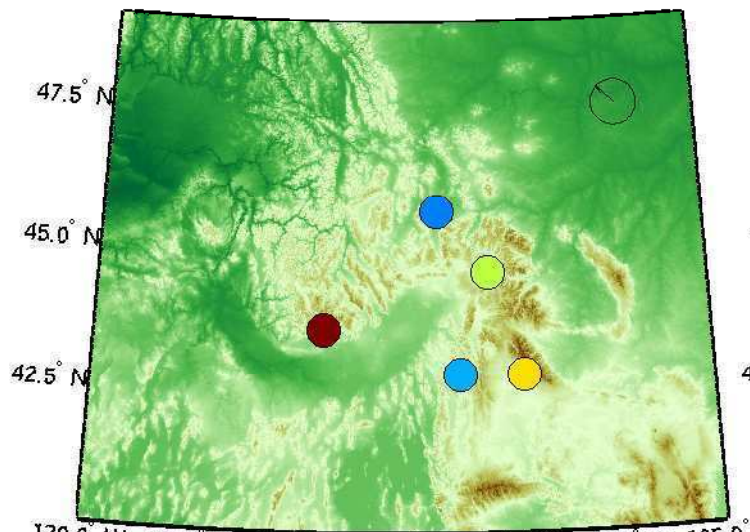
# Event\_2002\_285\_20\_09\_11



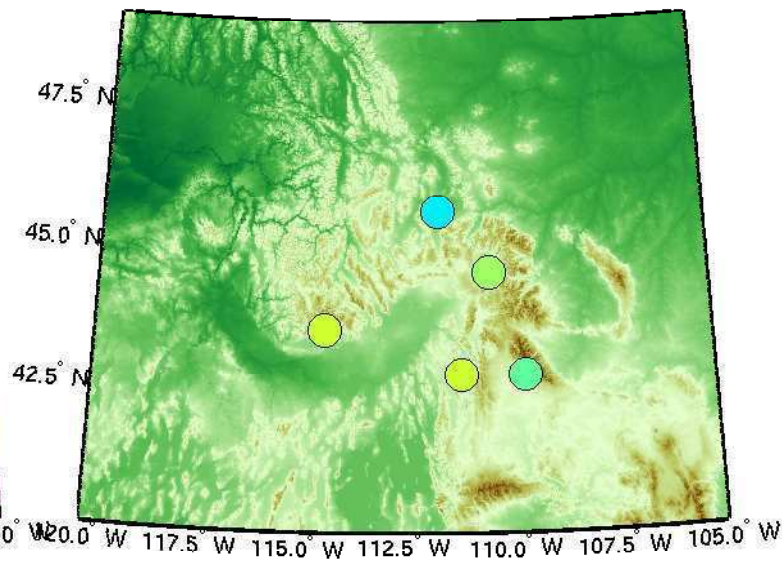
Baz = 134.9976  
 Mean xcor value = 0.745  
 Range of  $t^*$  values is 0.34333  
 Median  $t^*$  err is 0.040207



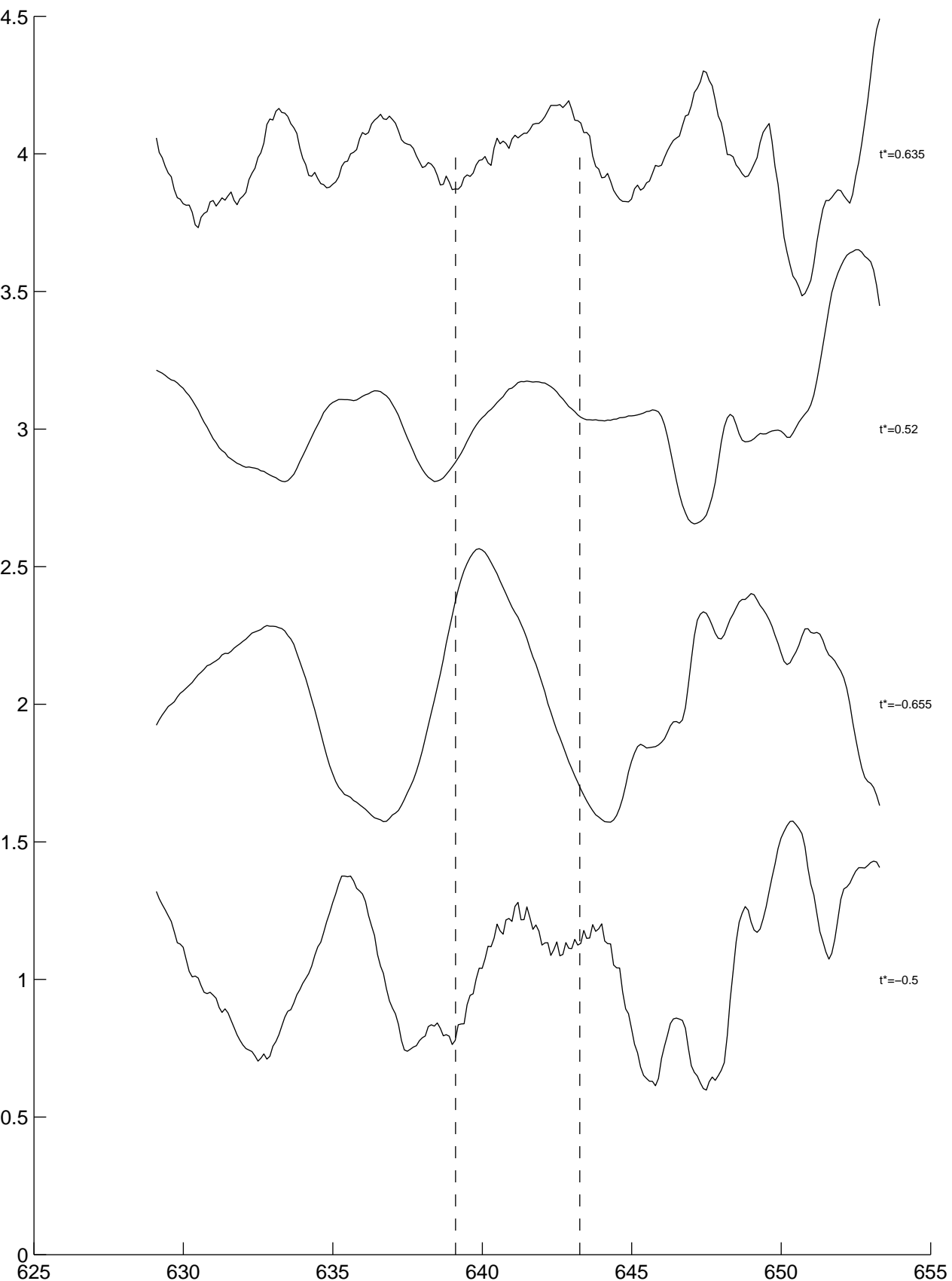
travel time residuals



$t^*$  values



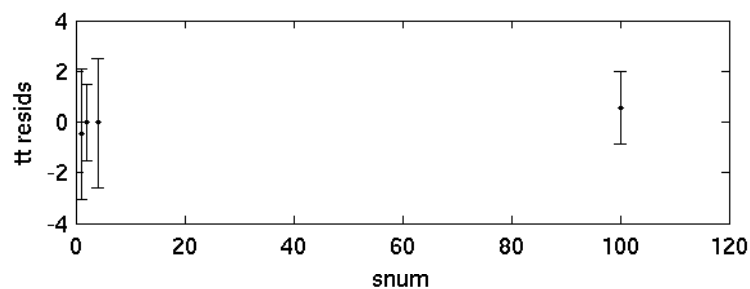
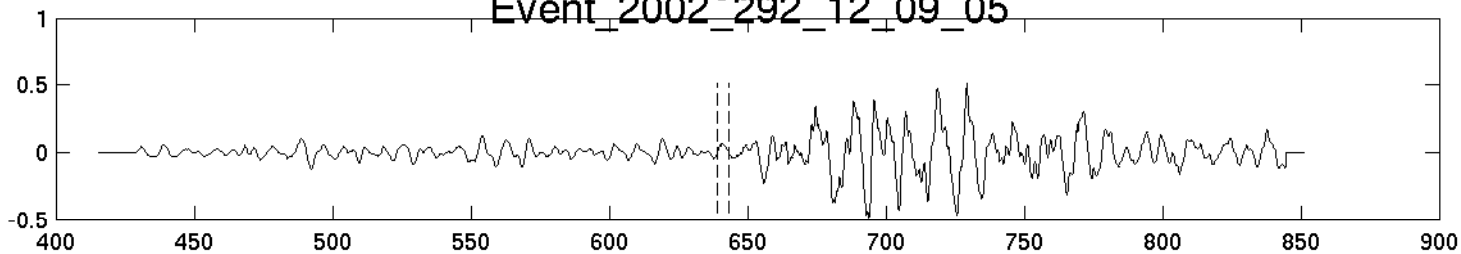
# Event\_2002\_292\_12\_09\_05



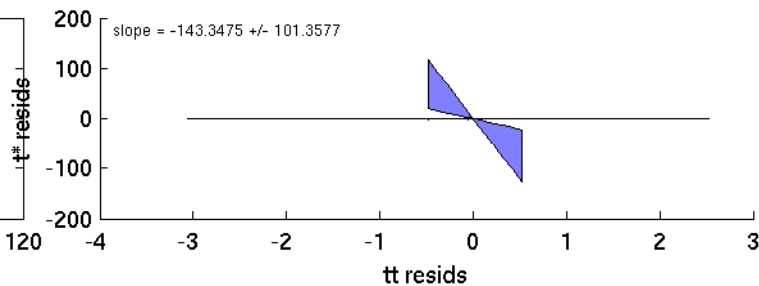
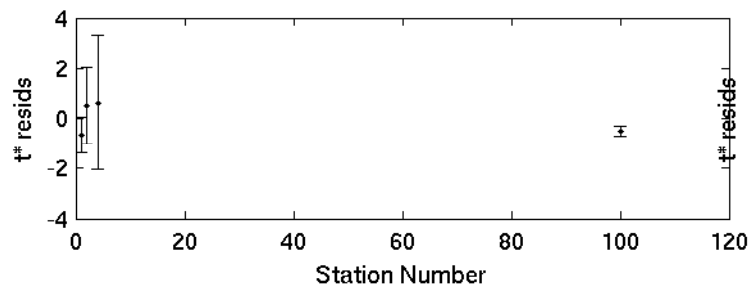


# Event 2002\_292\_12\_09\_05

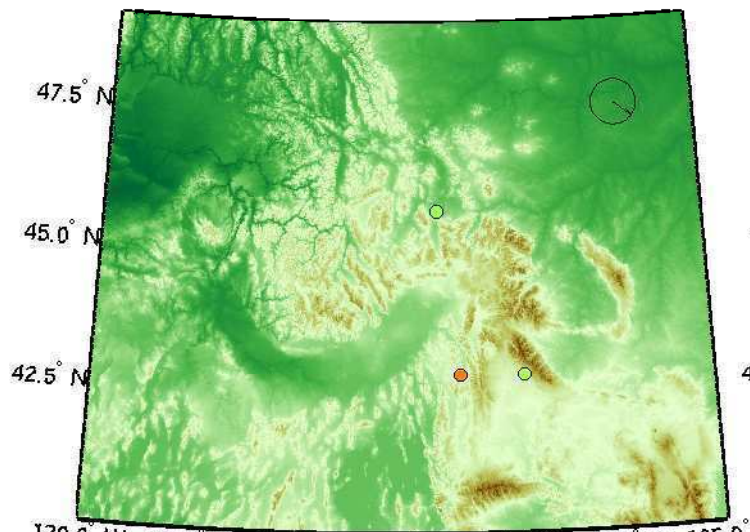
Stack



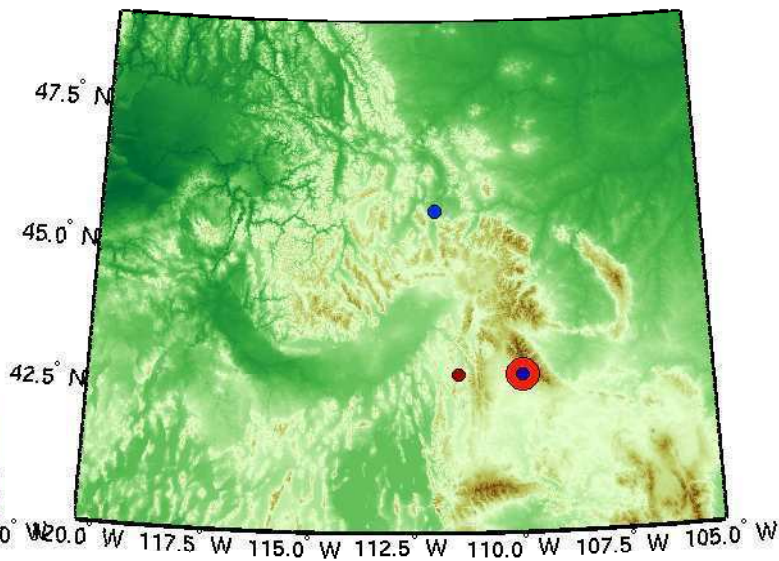
Baz = 309.0708  
Mean xcor value = 0.6475  
Range of  $t^*$  values is 1.29  
Median  $t^*$  err is 1.1208



travel time residuals

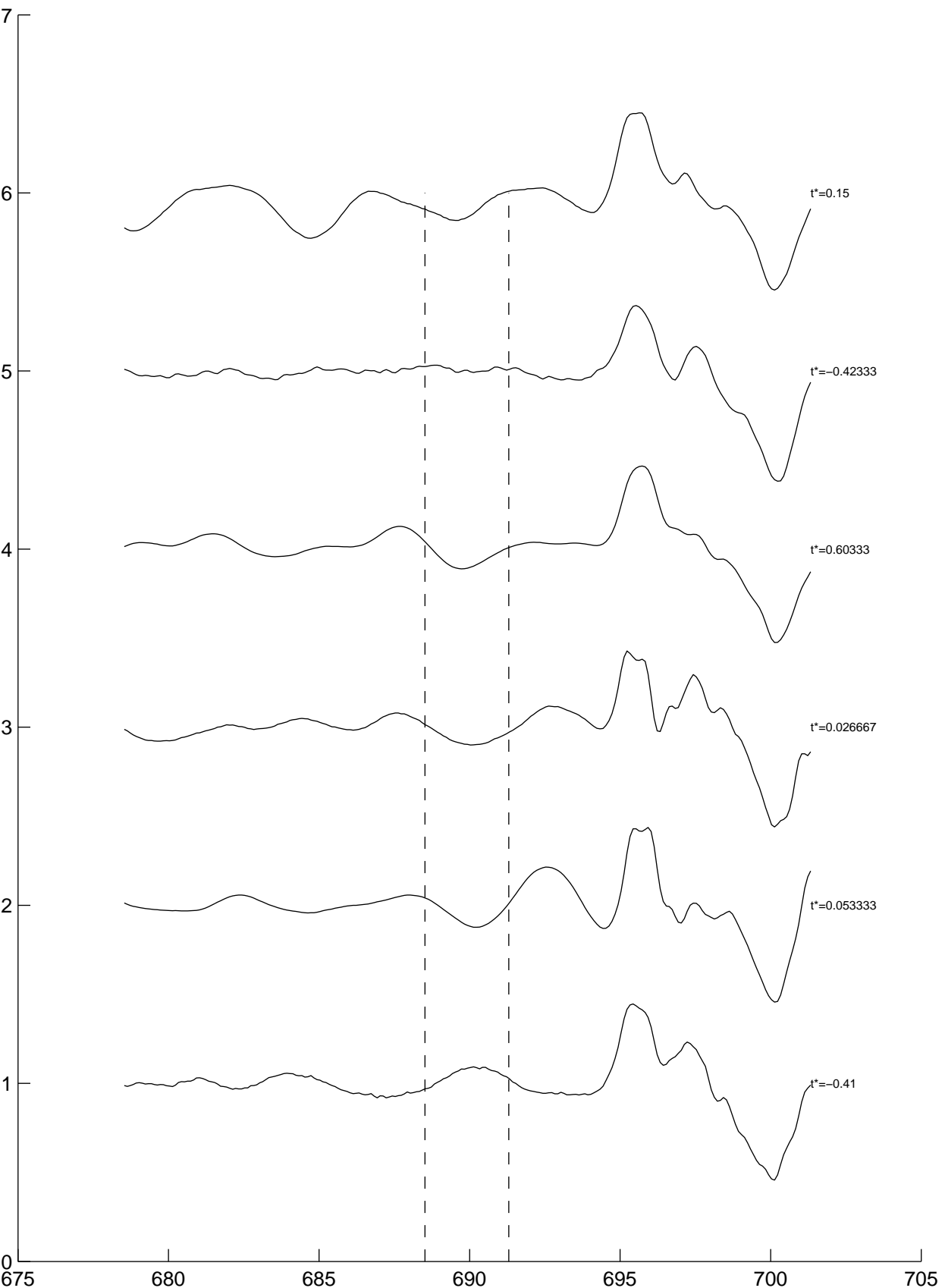


$t^*$  values



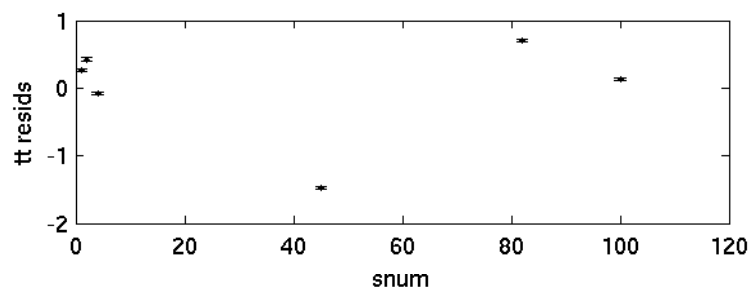
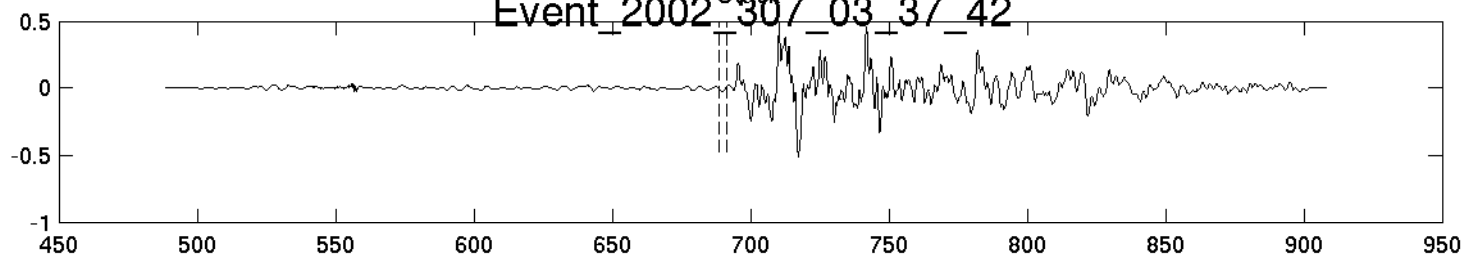


# Event\_2002\_307\_03\_37\_42

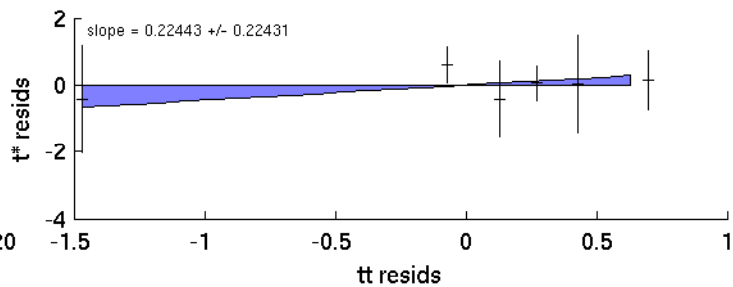
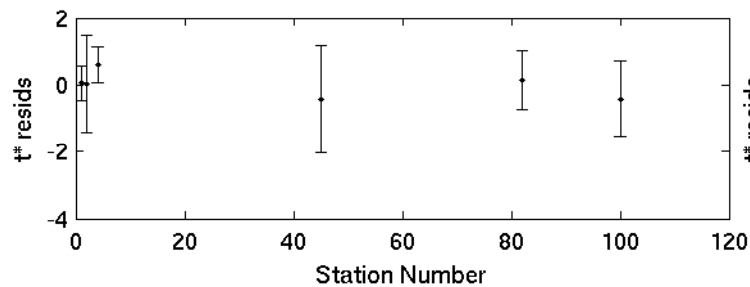


# Event\_2002\_307\_03\_37\_42

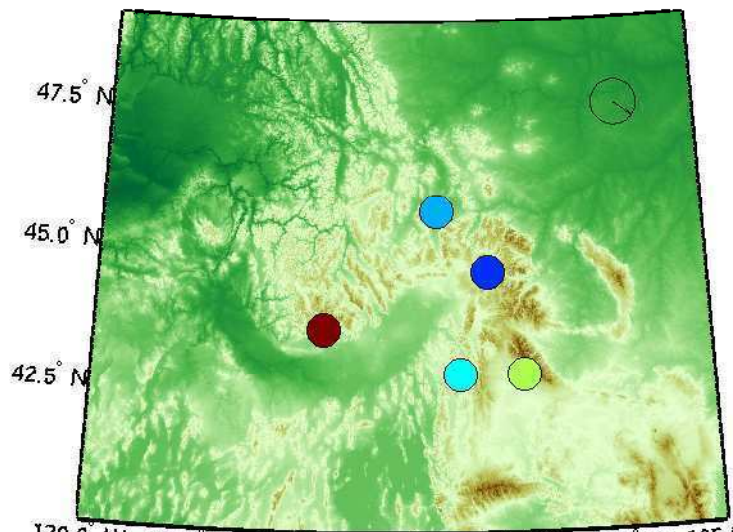
Stack



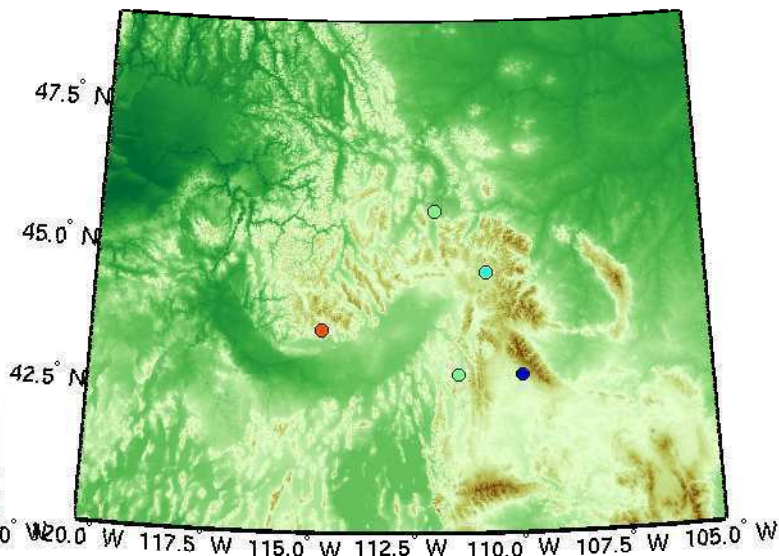
Baz = 308.991  
Mean xcor value = 0.73167  
Range of  $t^*$  values is 1.0267  
Median  $t^*$  err is 1.0033



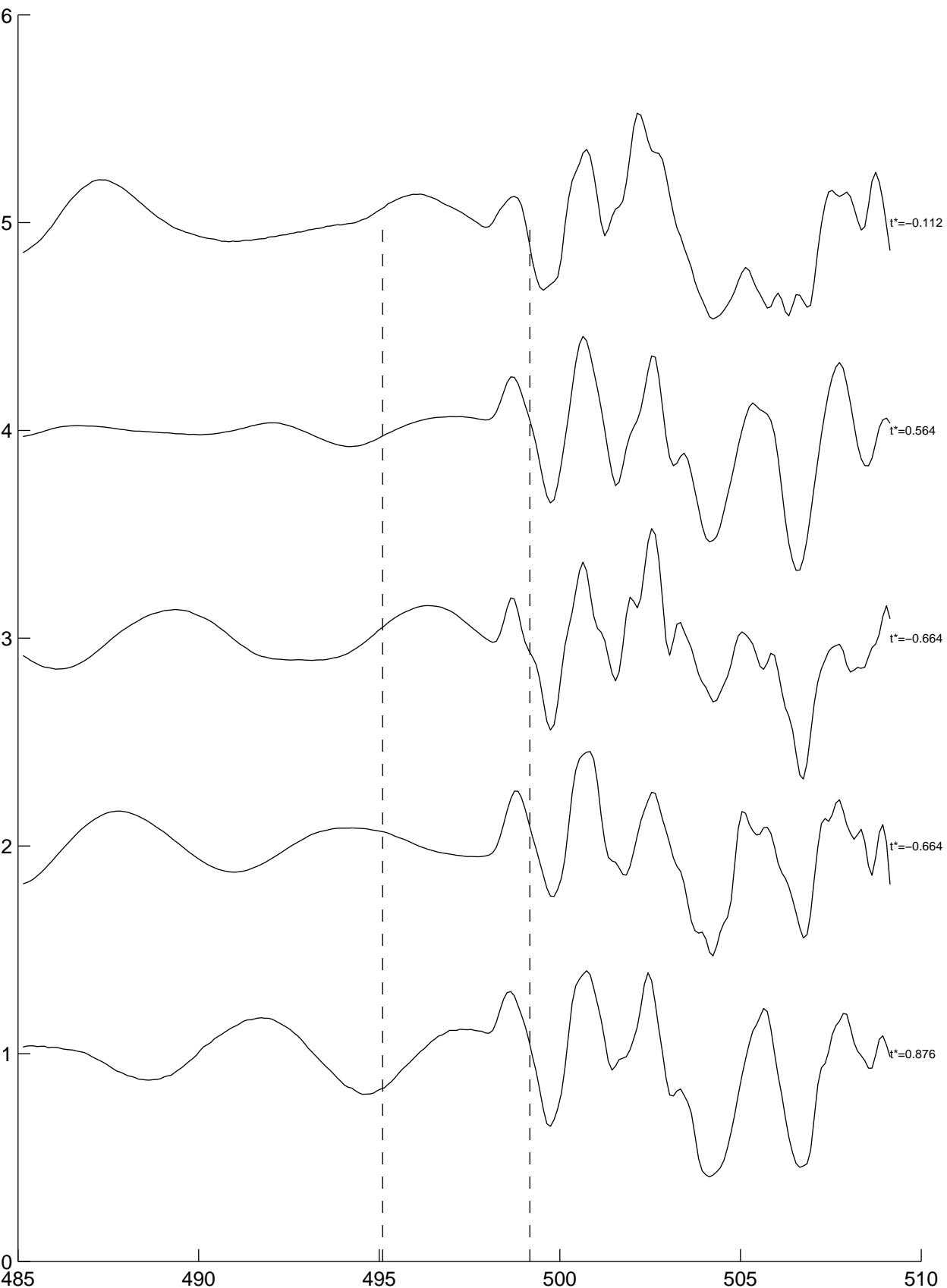
travel time residuals



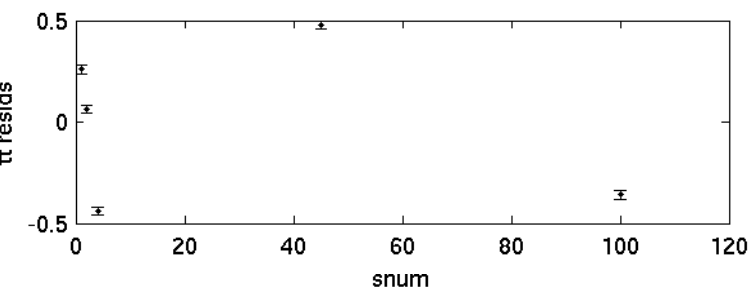
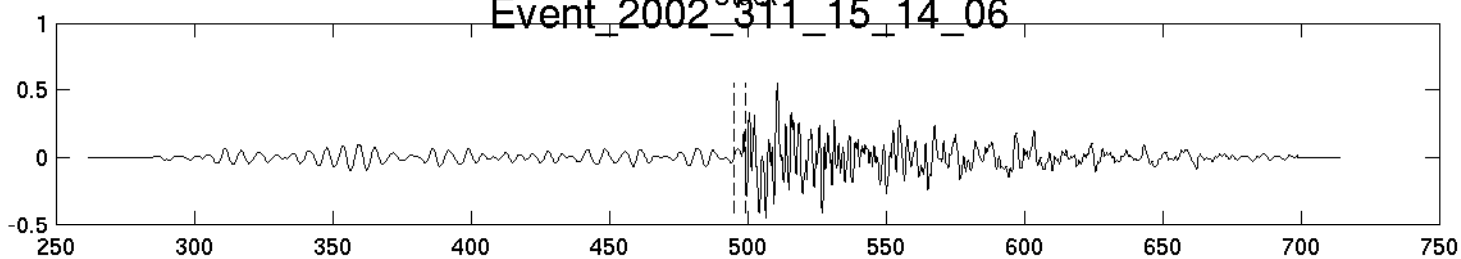
$t^*$  values



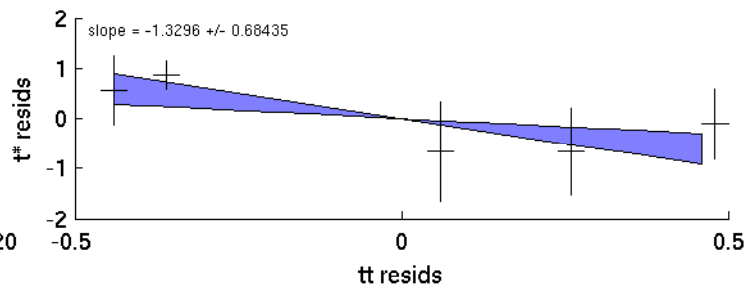
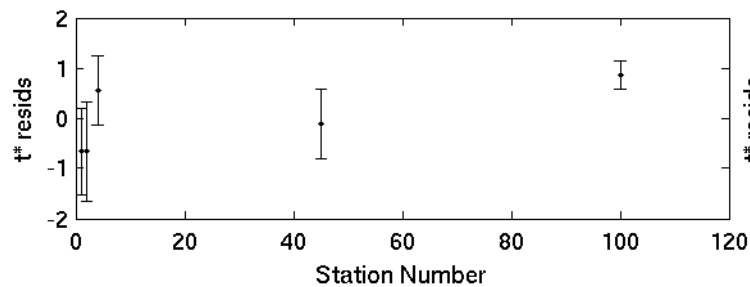
# Event\_2002\_311\_15\_14\_06



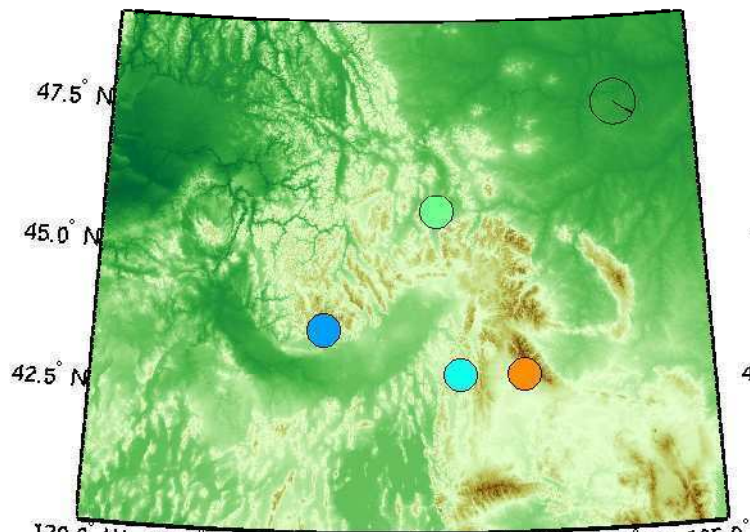
# Event\_2002\_311\_15\_14\_06



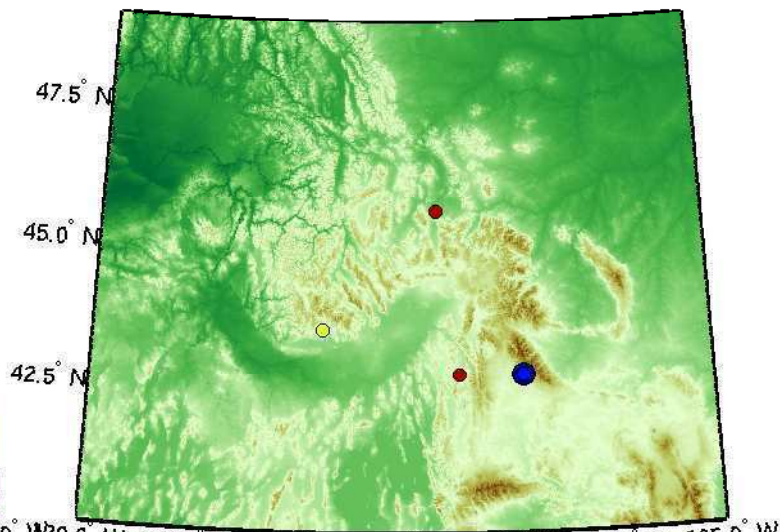
Baz = 304.558  
 Mean xcor value = 0.68  
 Range of  $t^*$  values is 1.54  
 Median  $t^*$  err is 0.70262



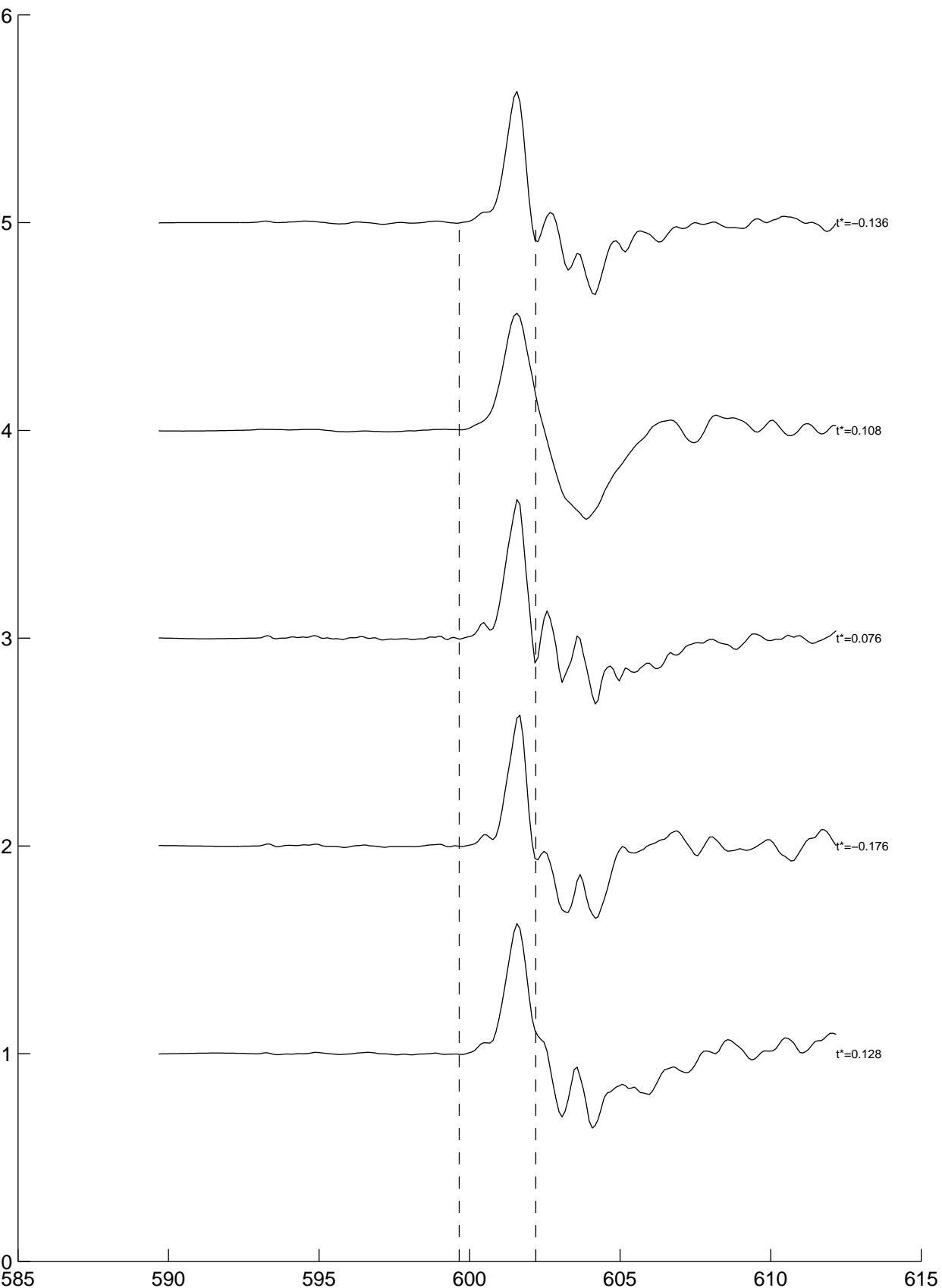
travel time residuals



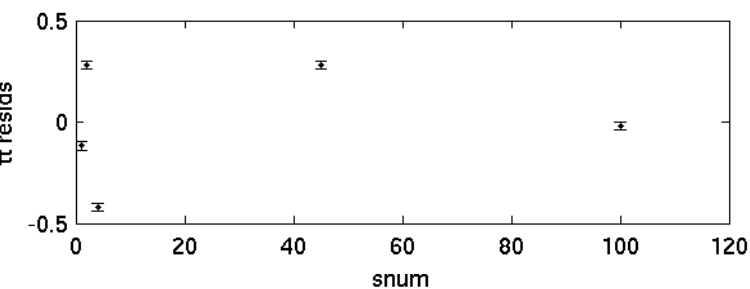
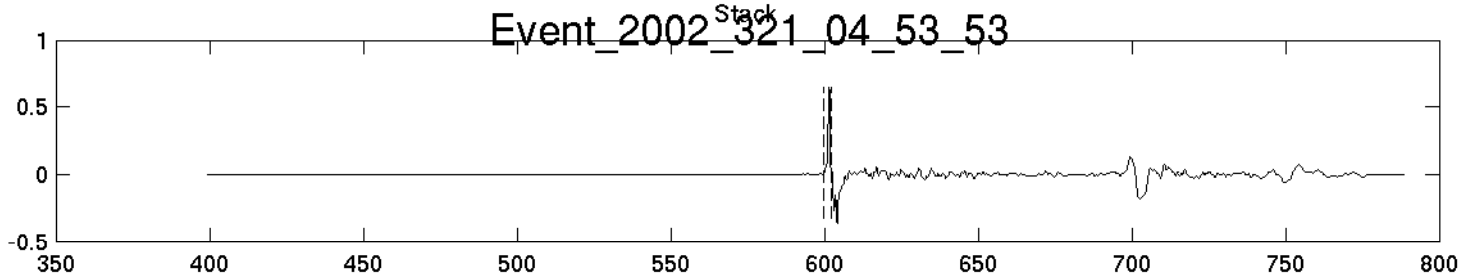
$t^*$  values



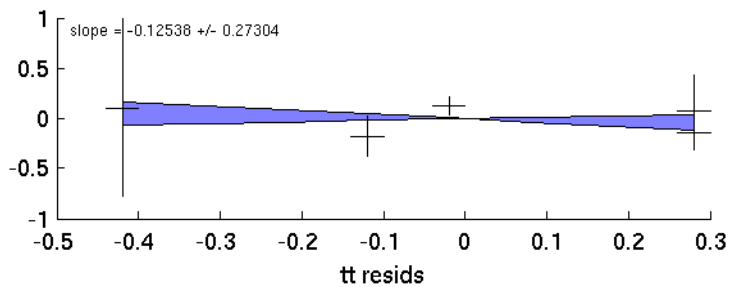
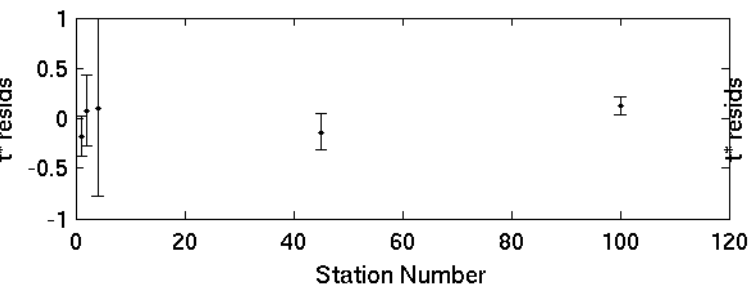
# Event\_2002\_321\_04\_53\_53



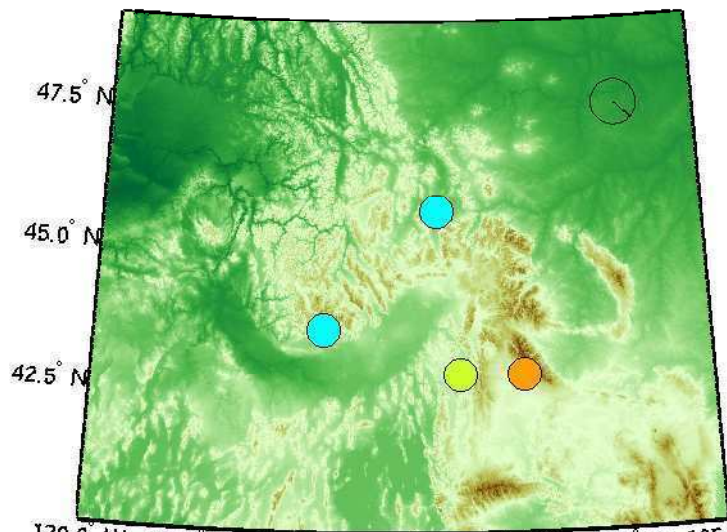
# Event\_2002\_321\_04\_53\_53



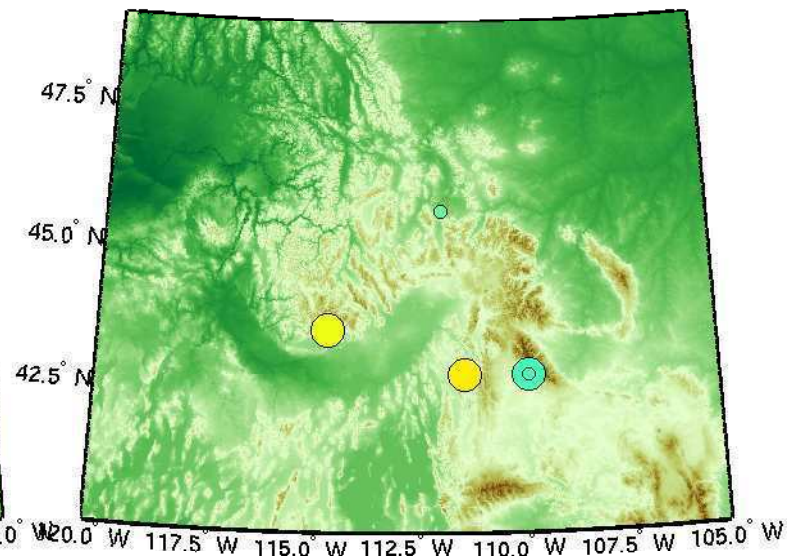
Baz = 313.8075  
 Mean xcor value = 0.776  
 Range of  $t^*$  values is 0.304  
 Median  $t^*$  err is 0.20101



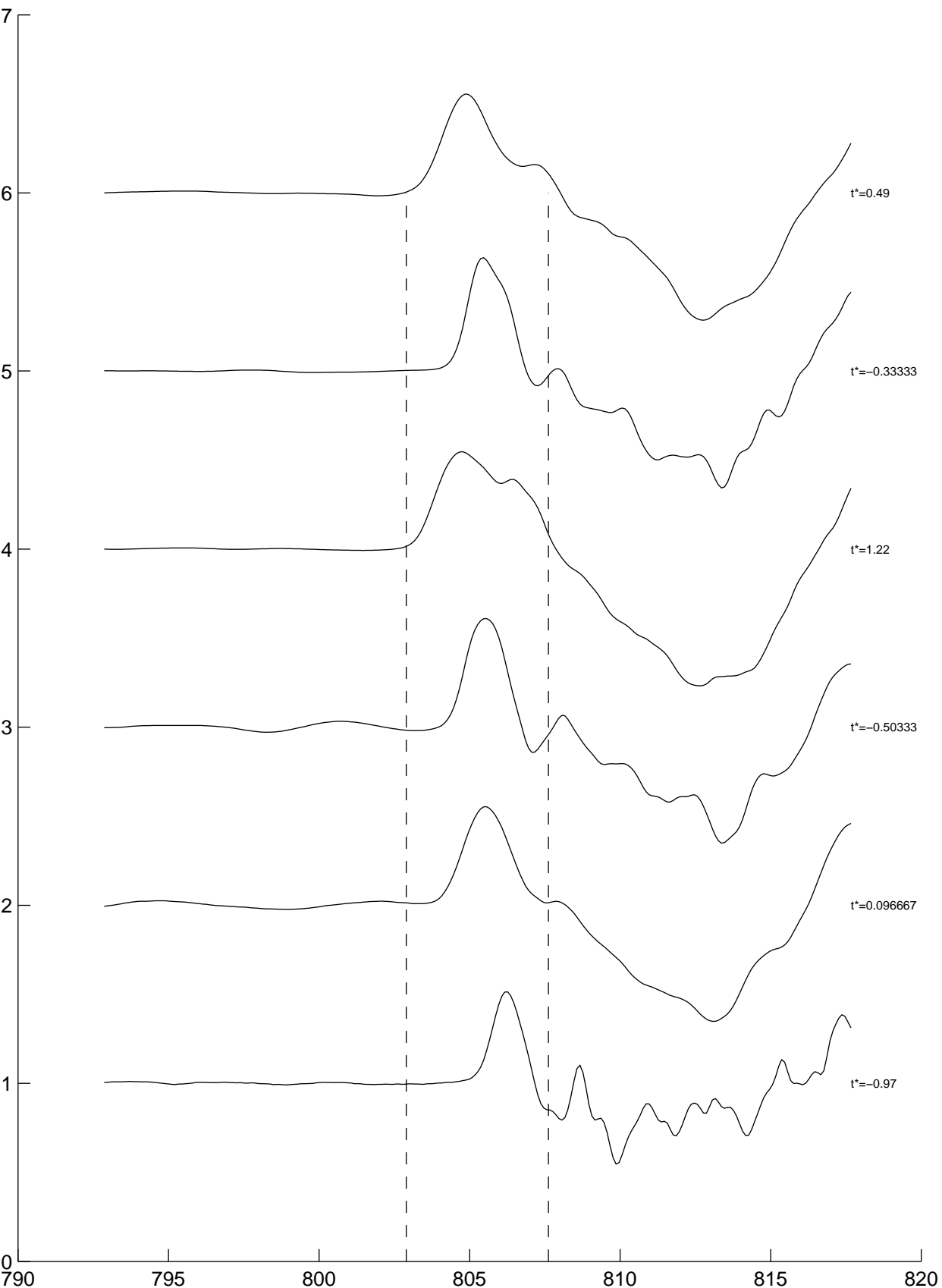
travel time residuals



$t^*$  values

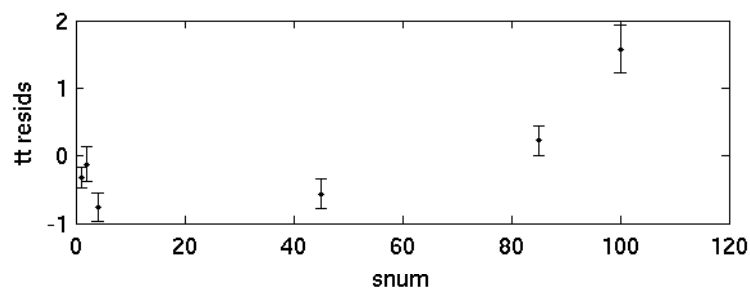
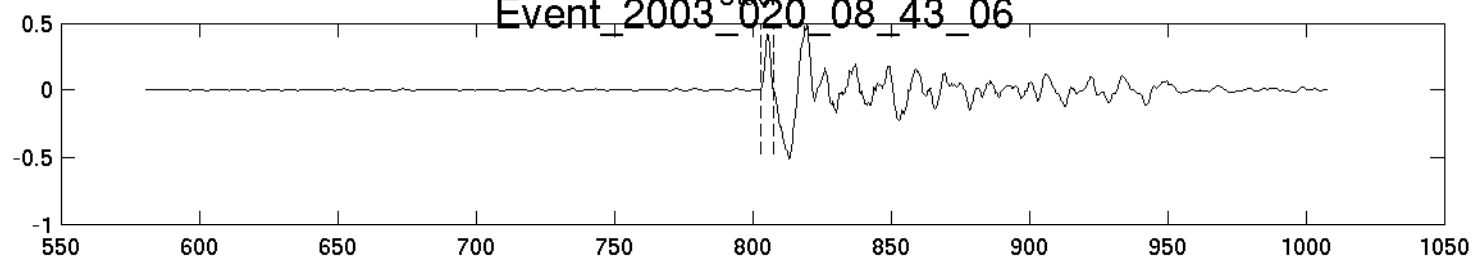


# Event\_2003\_020\_08\_43\_06

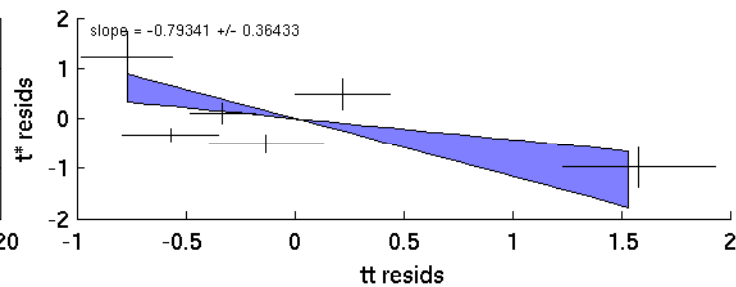
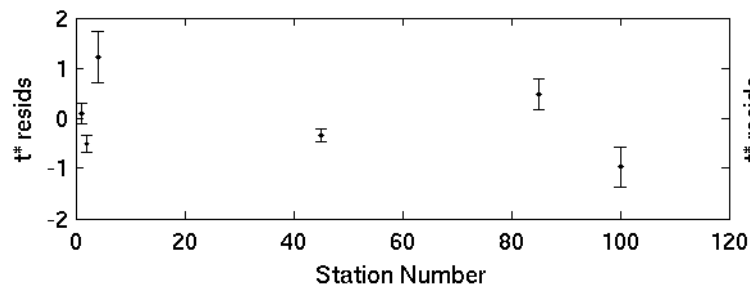




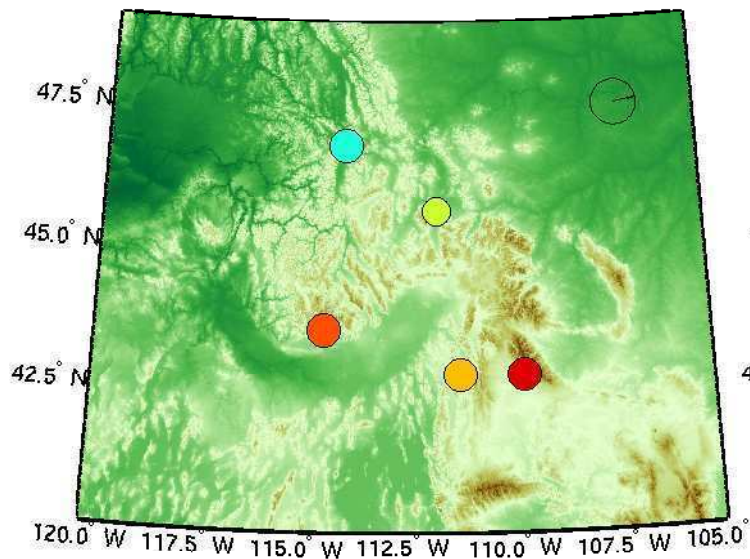
Event\_2003\_020\_08\_43\_06



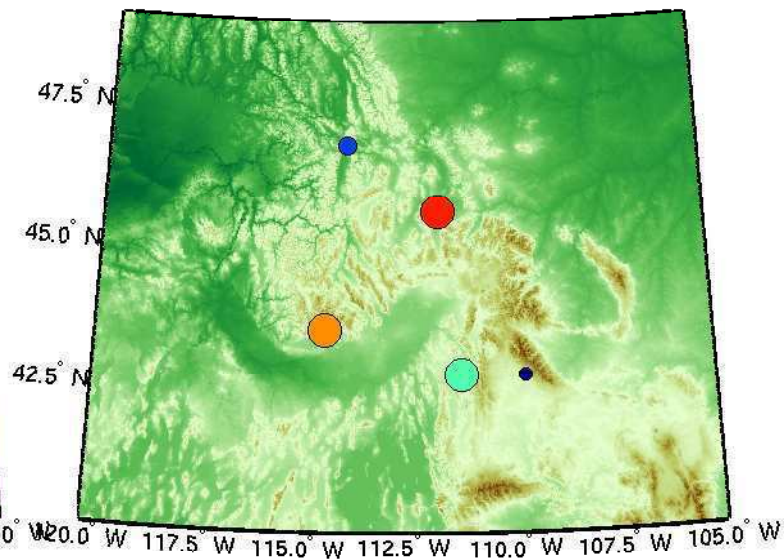
Baz = 260.7106  
Mean xcor value = 0.875  
Range of  $t^*$  values is 2.19  
Median  $t^*$  err is 0.25341



travel time residuals

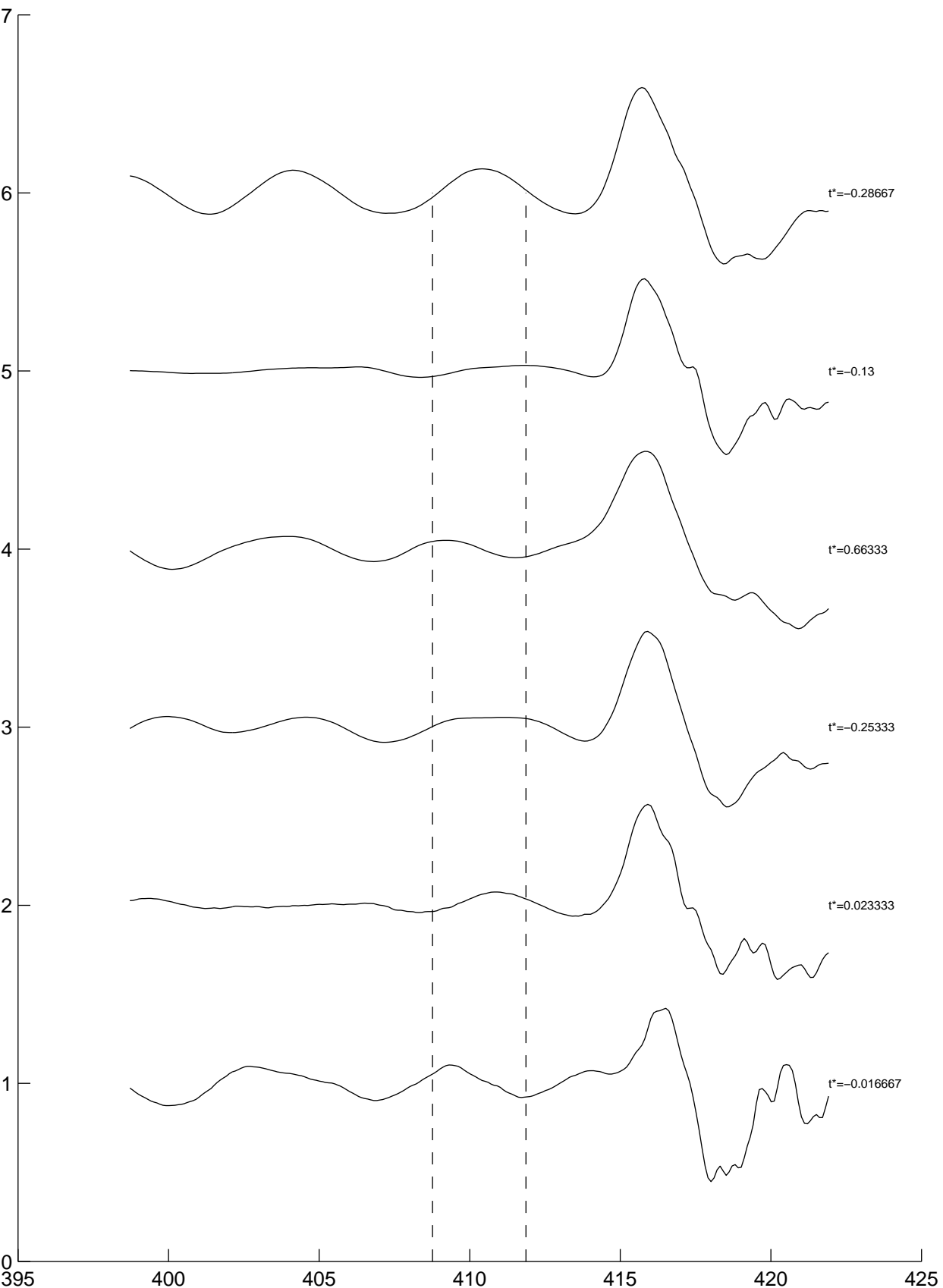


$t^*$  values

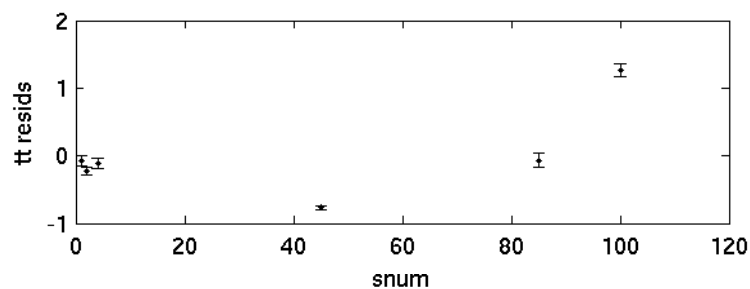
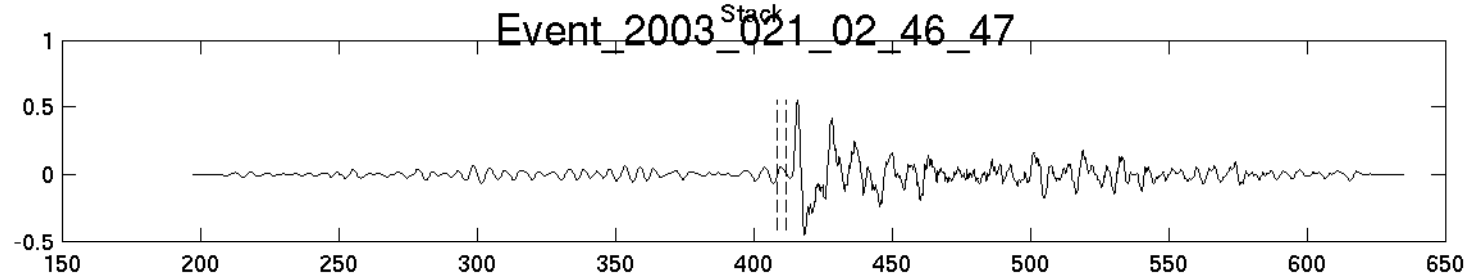




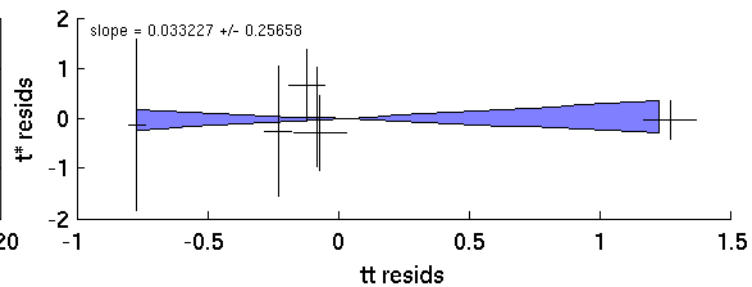
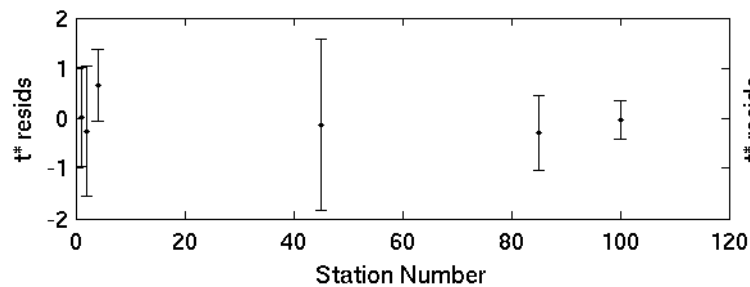
# Event\_2003\_021\_02\_46\_47



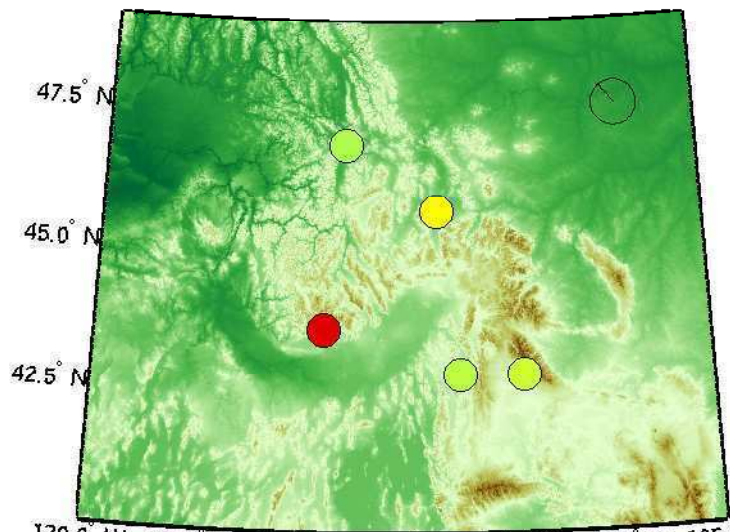
# Event\_2003\_02\_21\_02\_46\_47



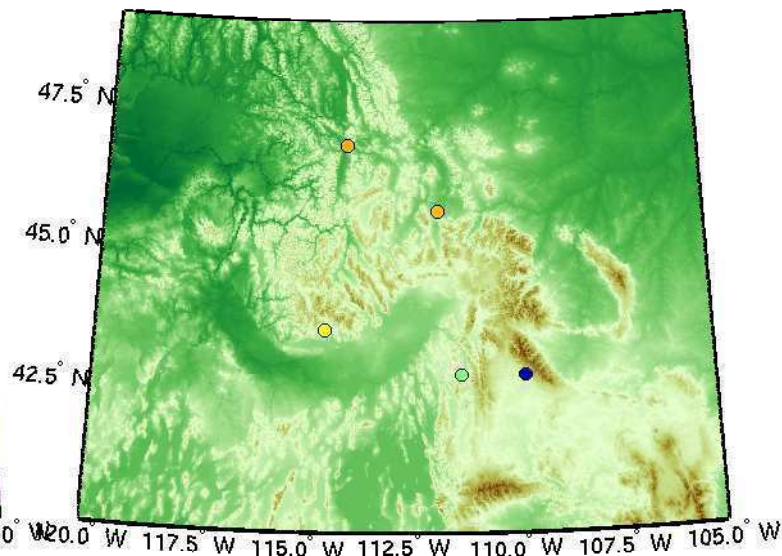
Baz = 143.1075  
Mean xcor value = 0.80833  
Range of  $t^*$  values is 0.95  
Median  $t^*$  err is 0.6741



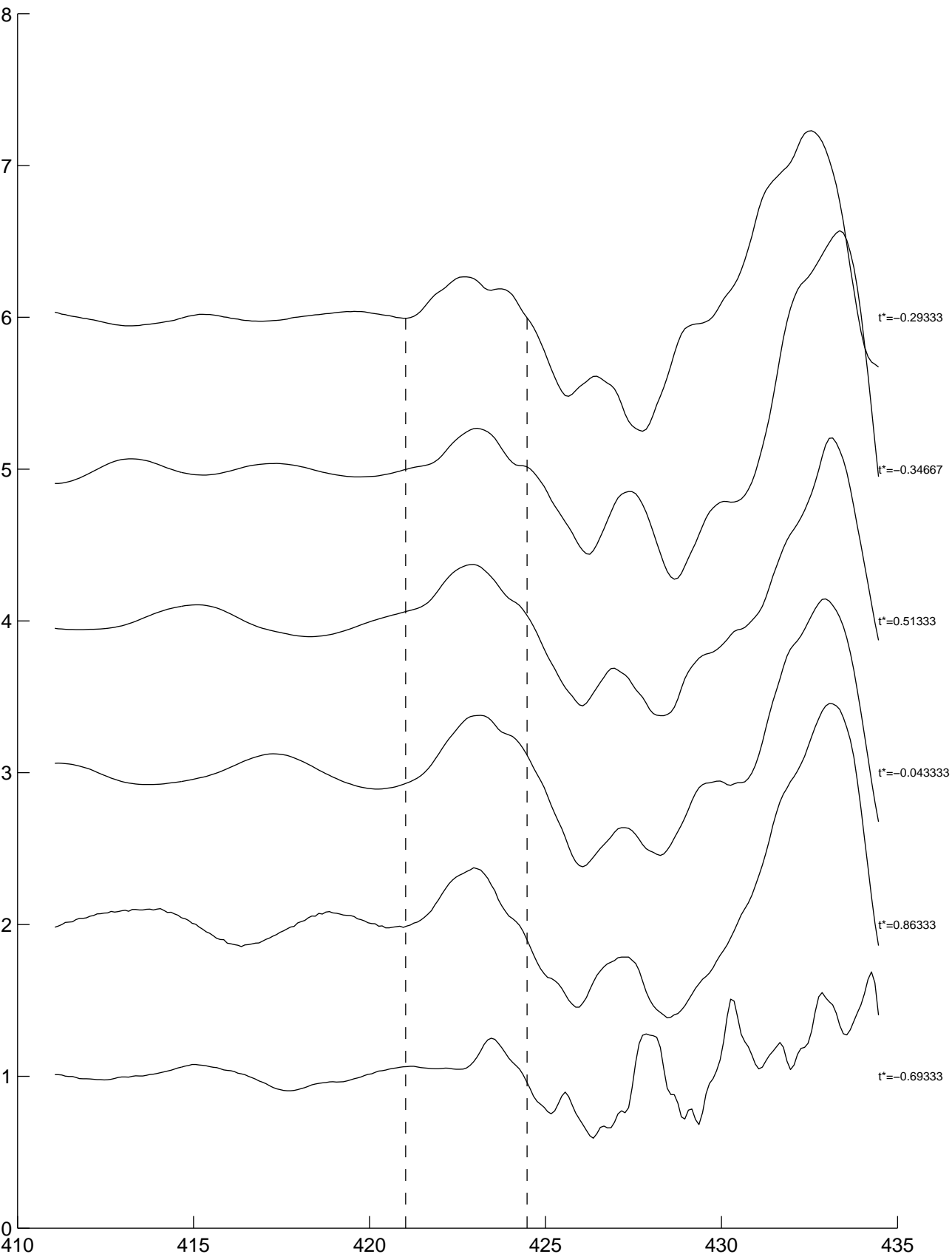
travel time residuals



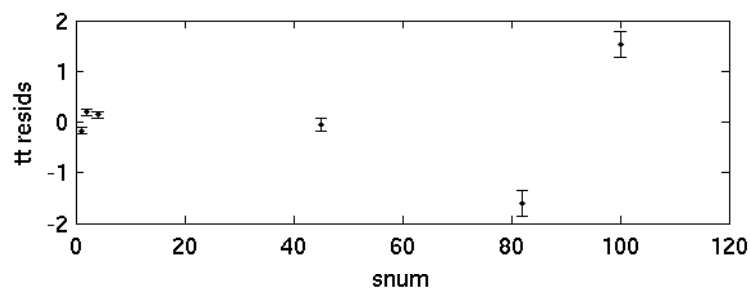
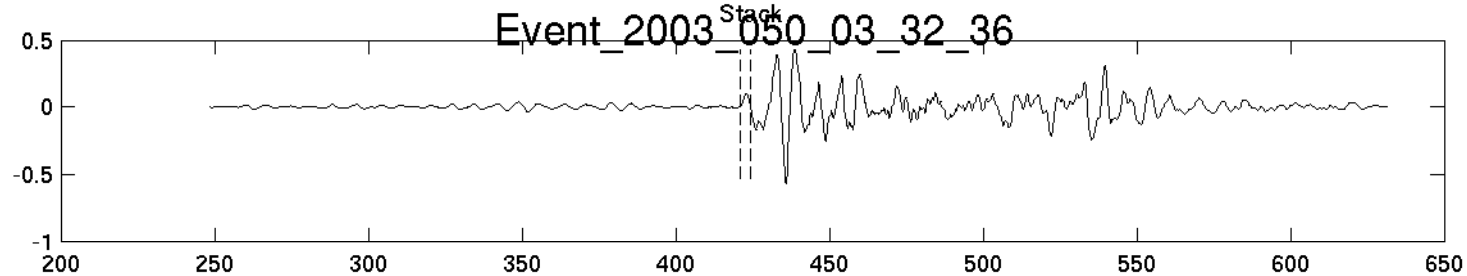
$t^*$  values



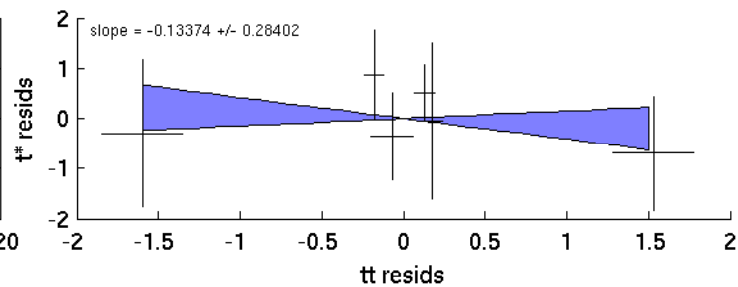
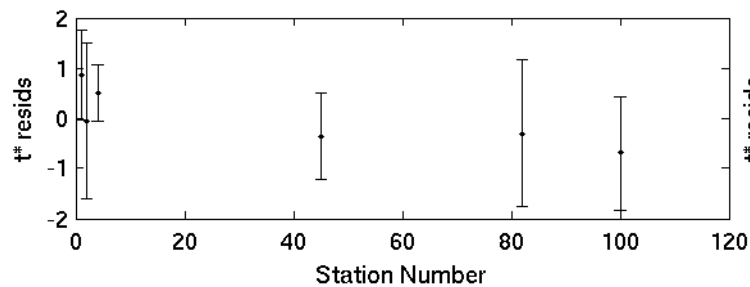
# Event\_2003\_050\_03\_32\_36



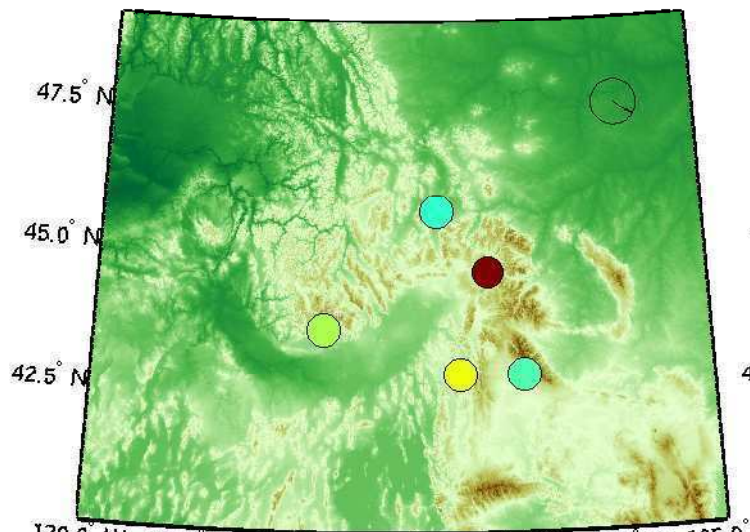
# Event\_2003\_050\_03\_32\_36



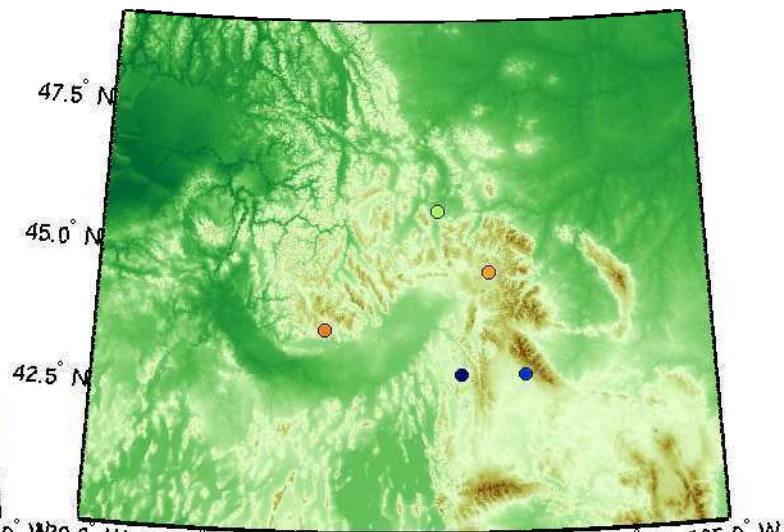
Baz = 305.4069  
 Mean xcor value = 0.82167  
 Range of  $t^*$  values is 1.5567  
 Median  $t^*$  err is 1.0142



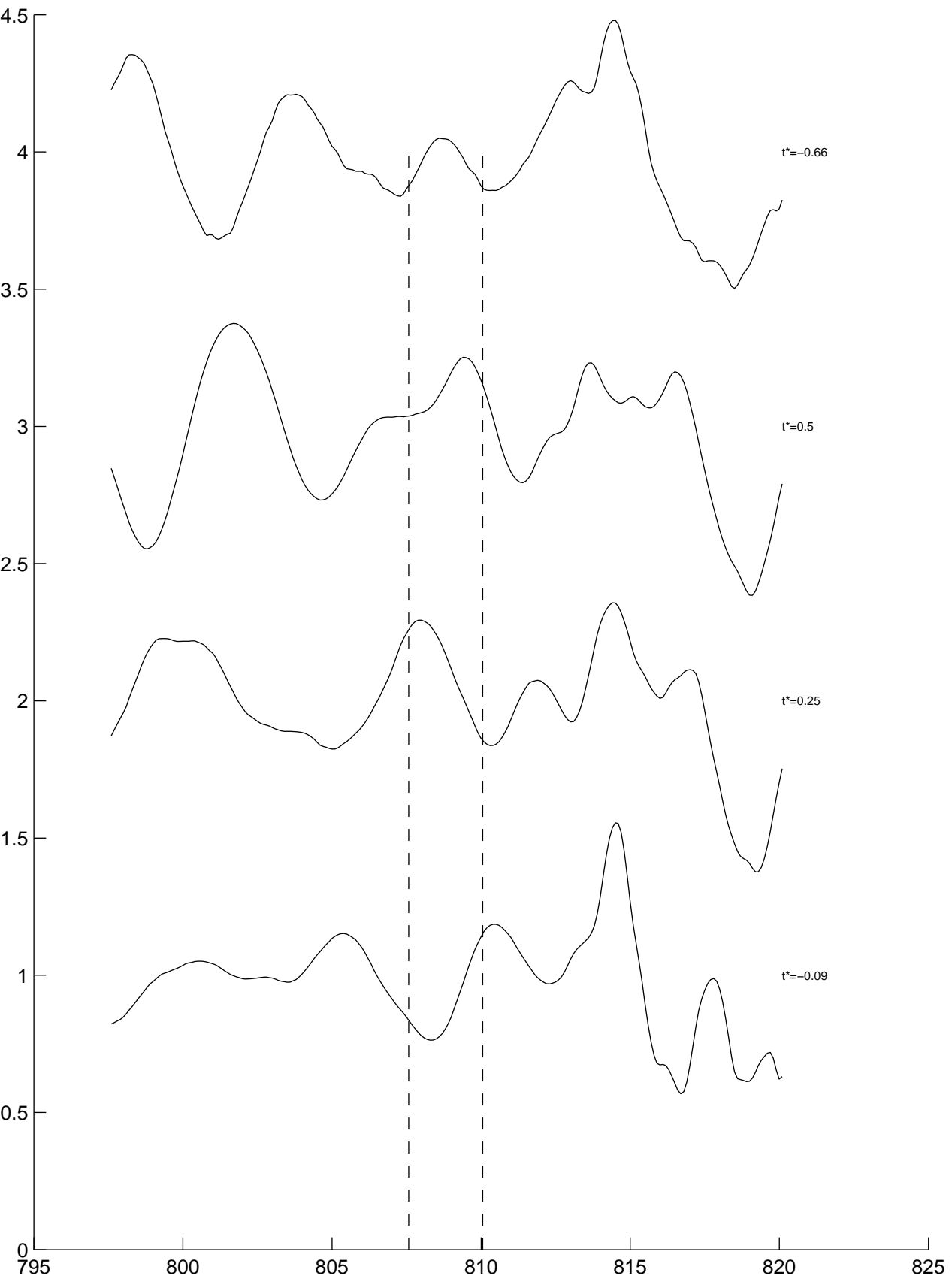
travel time residuals



$t^*$  values

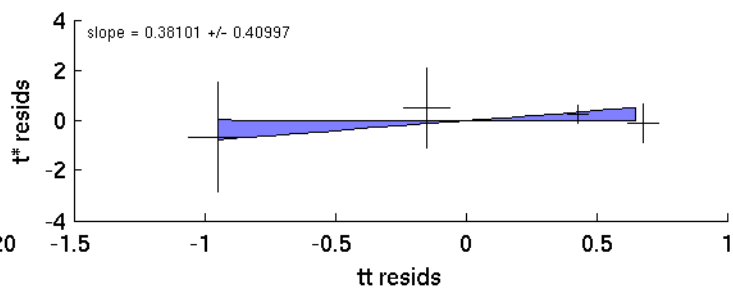
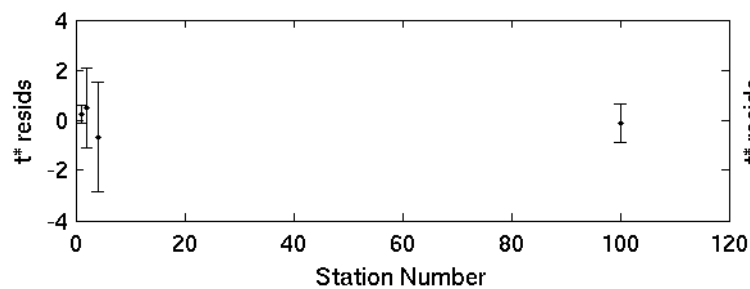
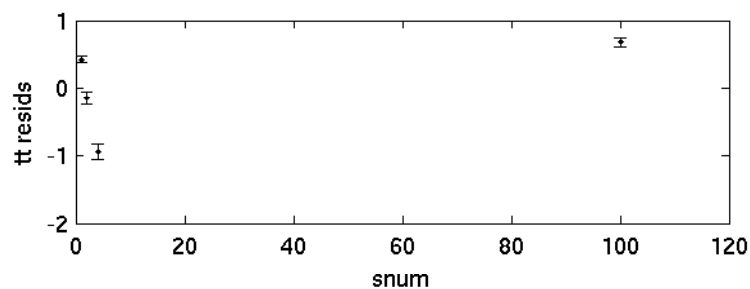
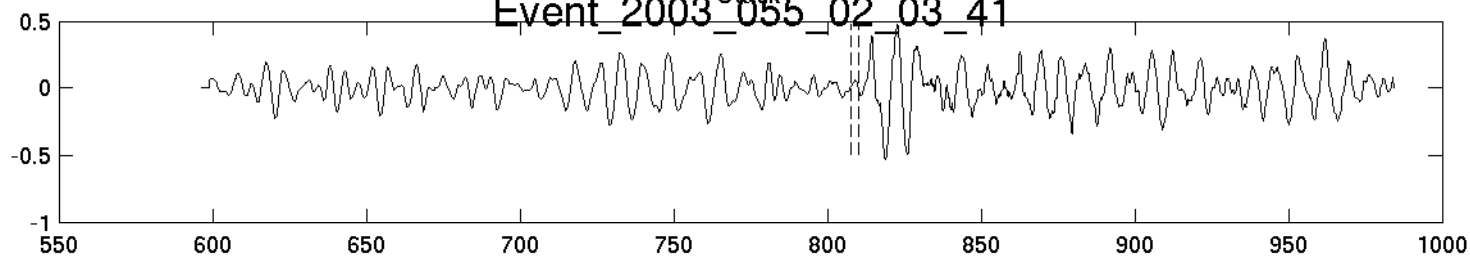


# Event\_2003\_055\_02\_03\_41

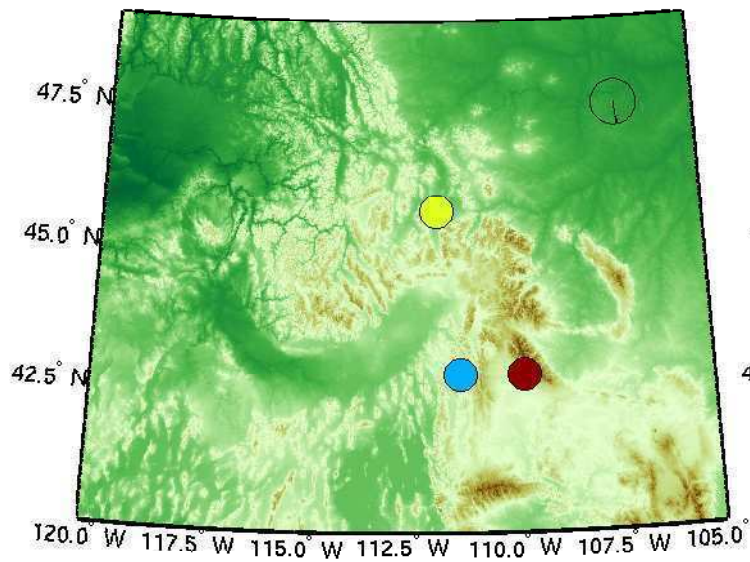


# Event\_2003\_055\_02\_03\_41

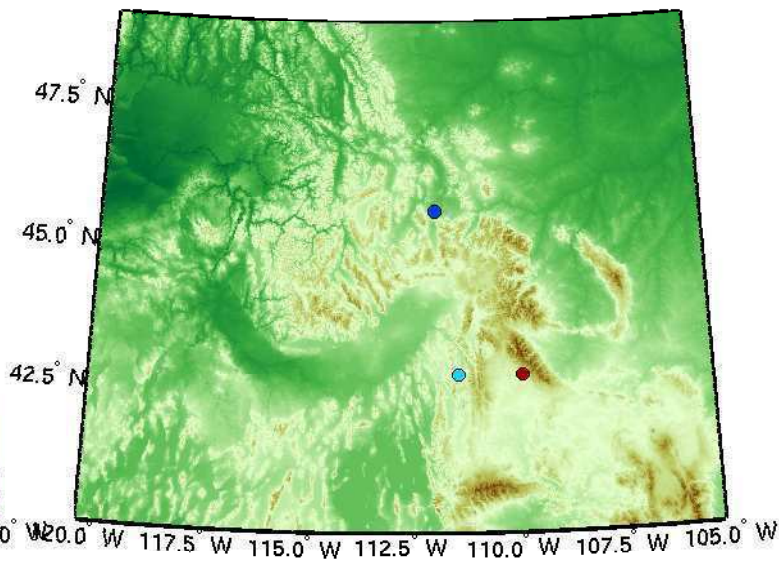
Stack



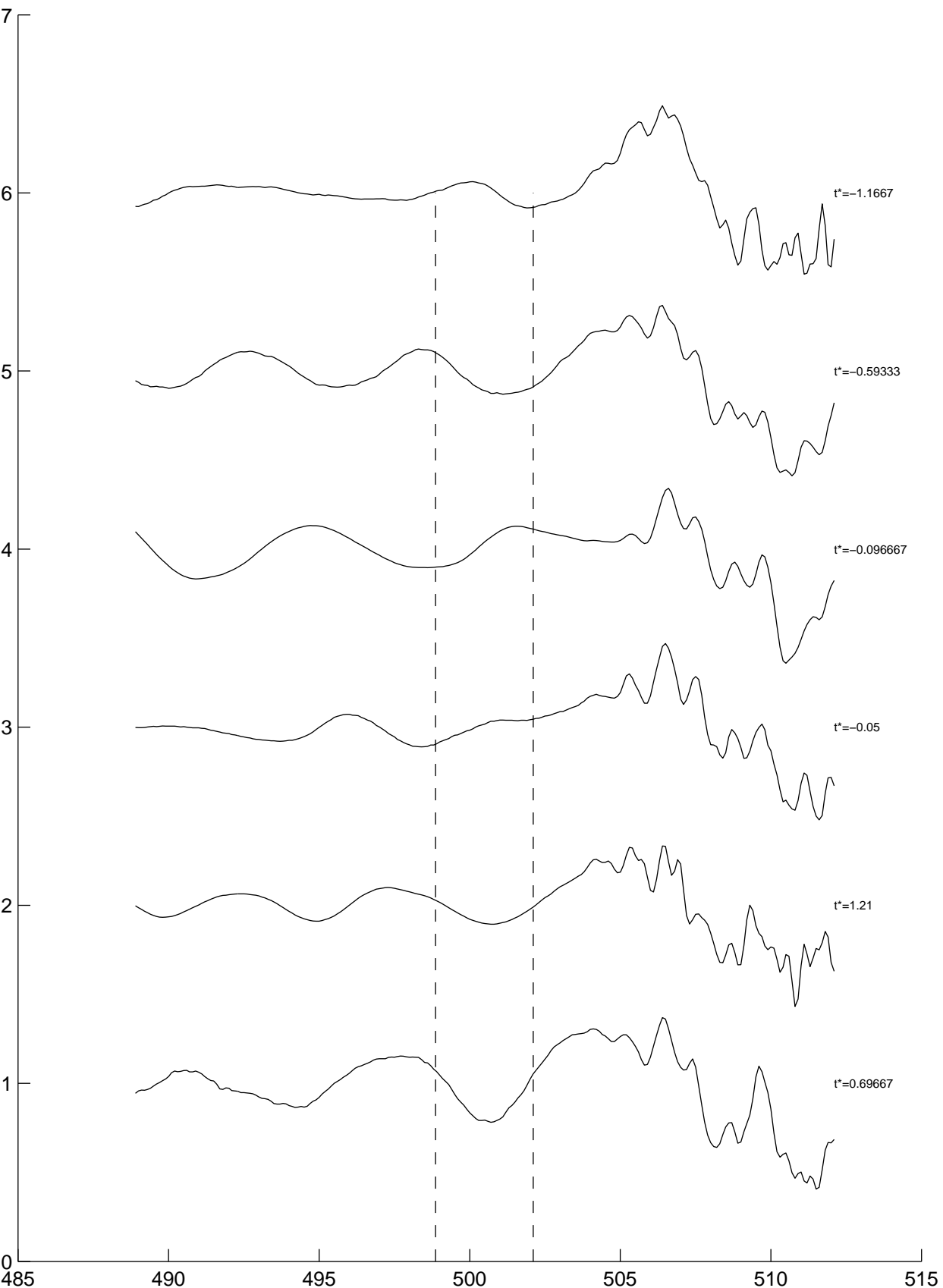
travel time residuals



$t^*$  values

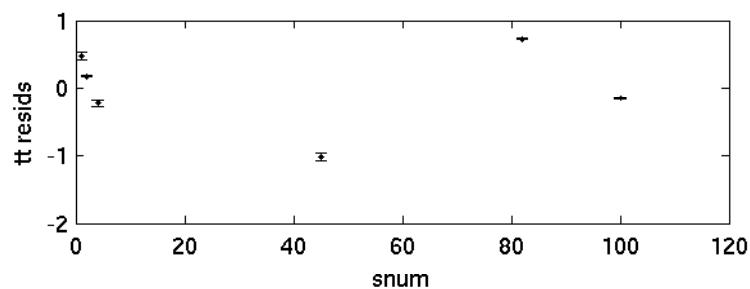
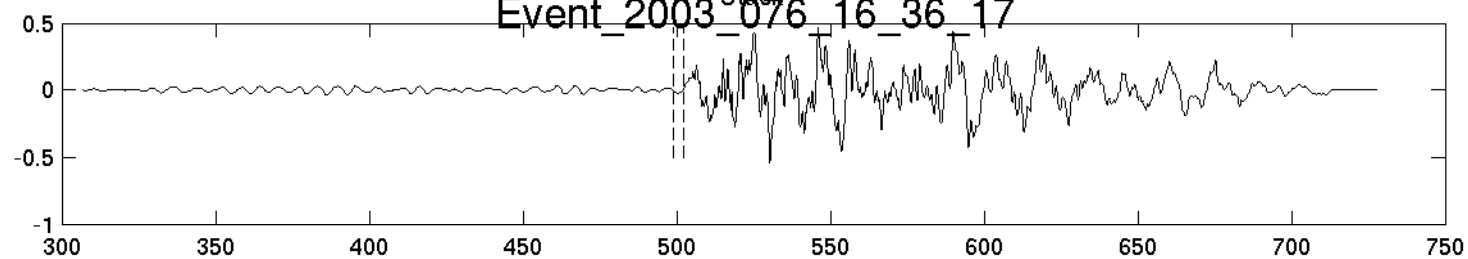


# Event\_2003\_076\_16\_36\_17

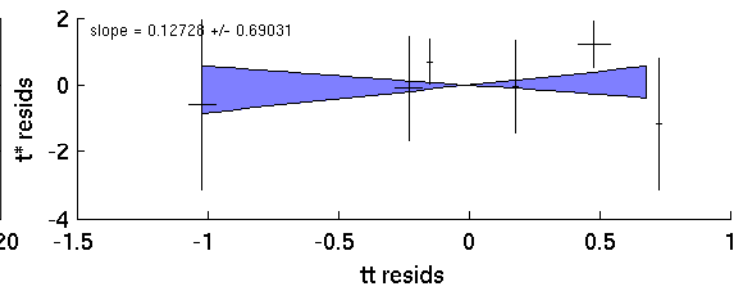
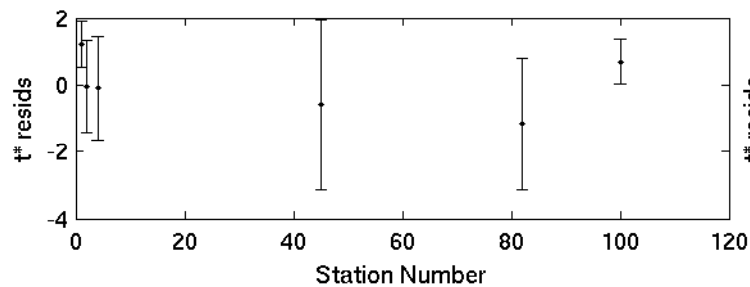




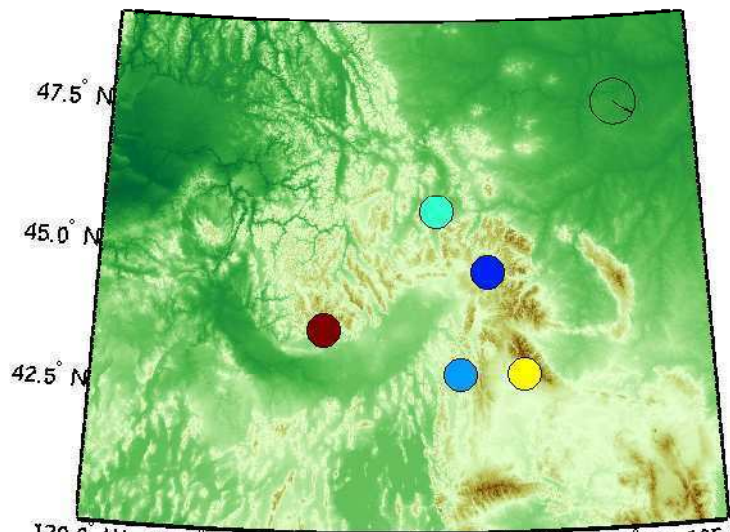
# Event\_2003\_076\_16\_36\_17



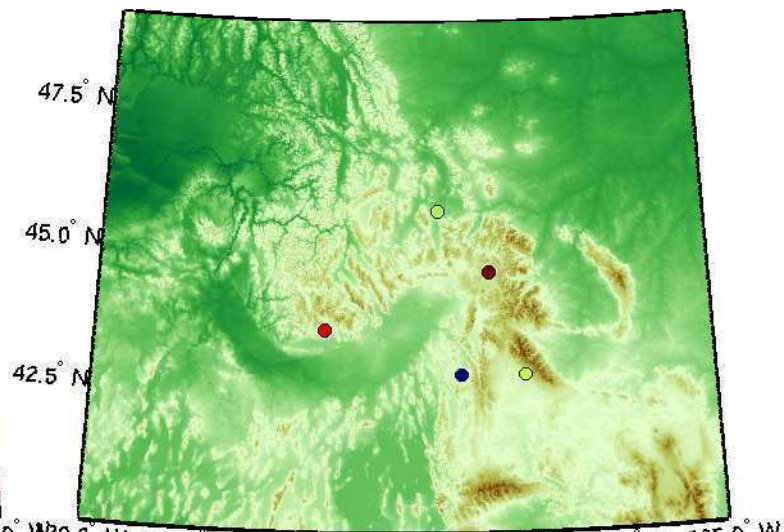
Baz = 305.0601  
 Mean xcor value = 0.64333  
 Range of  $t^*$  values is 2.3767  
 Median  $t^*$  err is 1.4648



travel time residuals

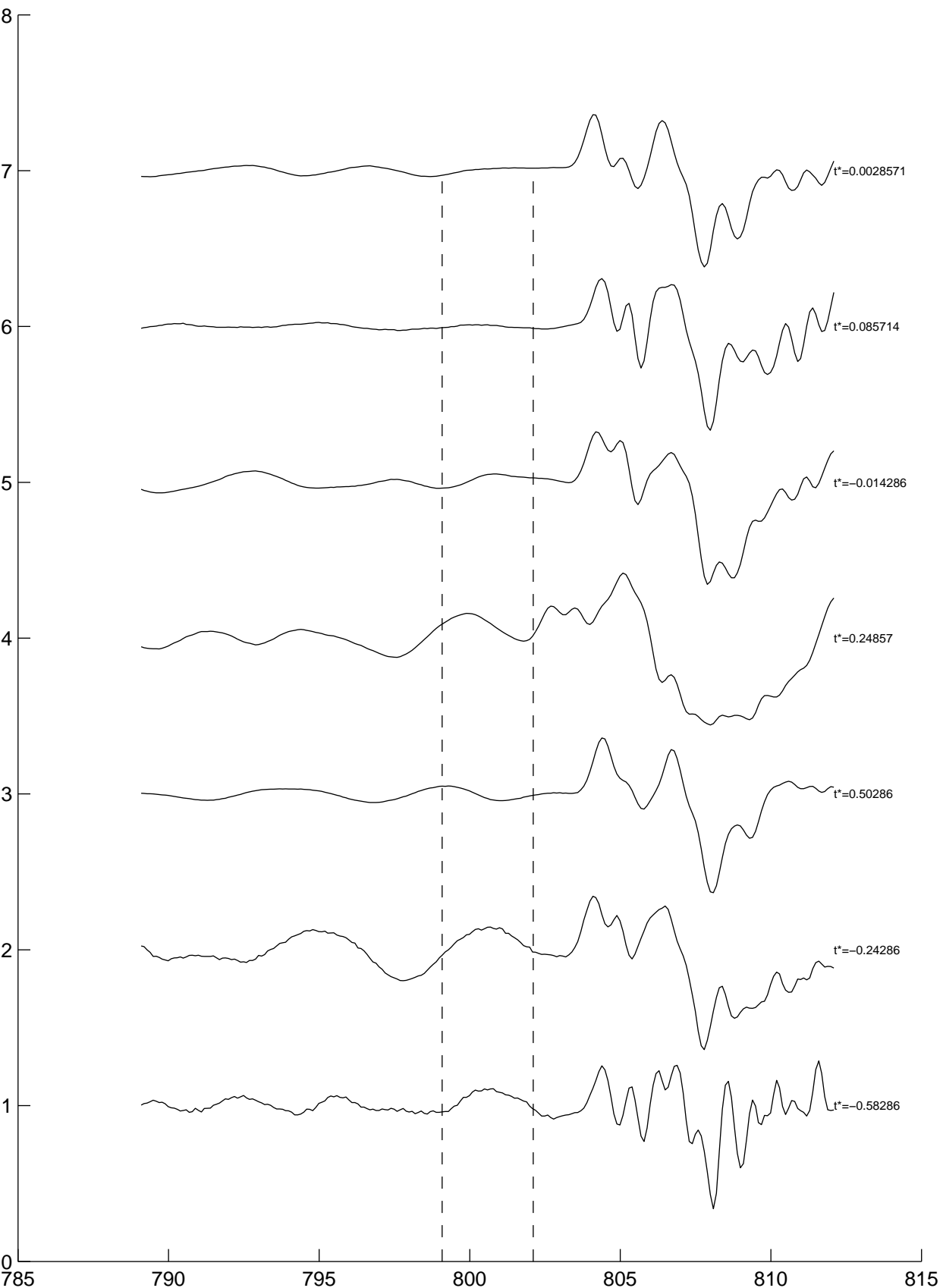


$t^*$  values



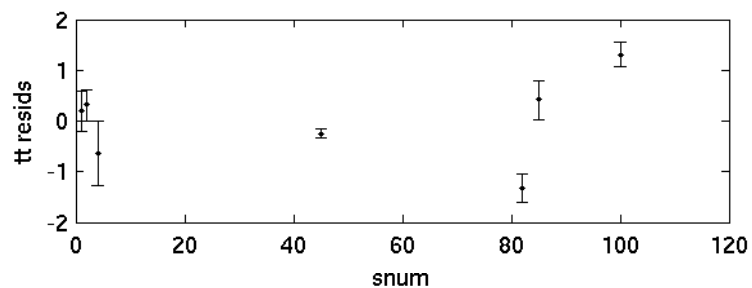
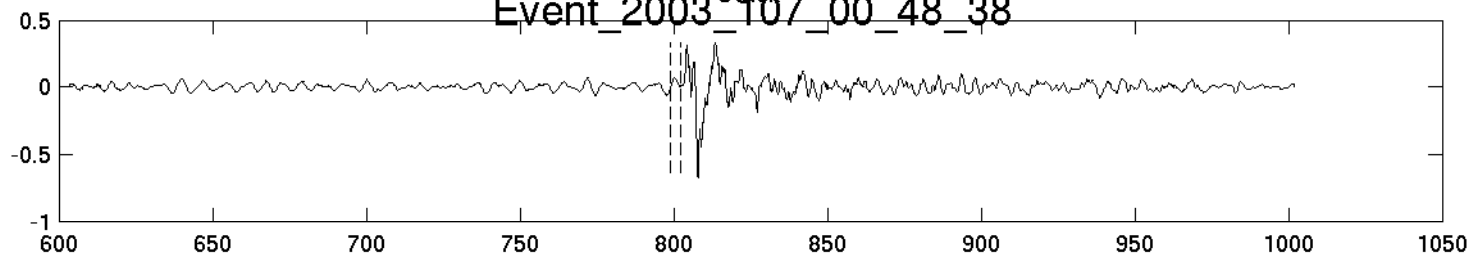


# Event\_2003\_107\_00\_48\_38

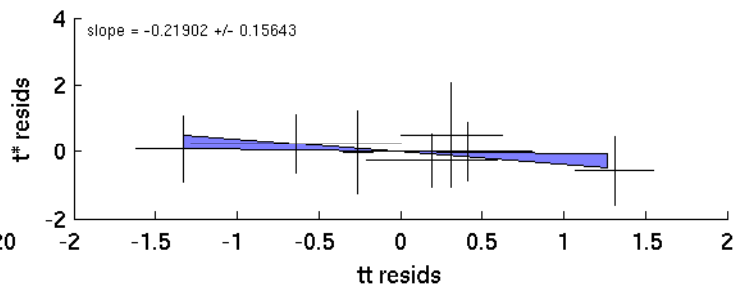
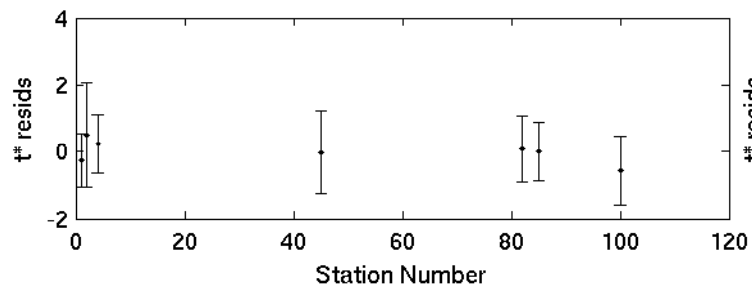


# Event\_2003\_107\_00\_48\_38

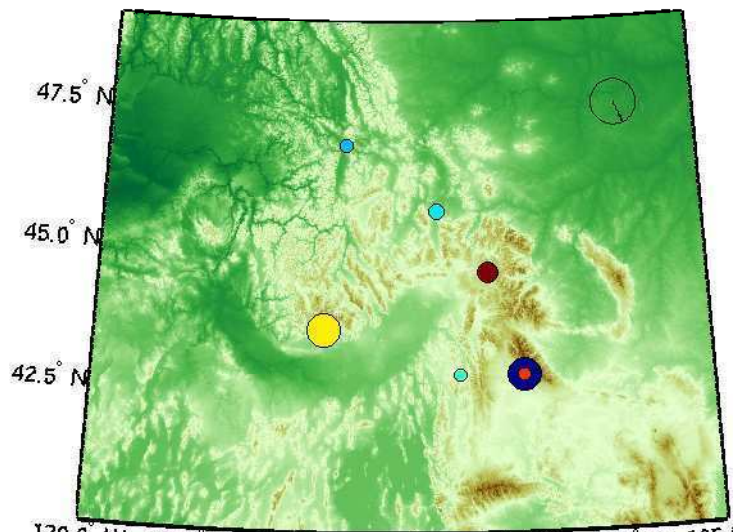
Stack



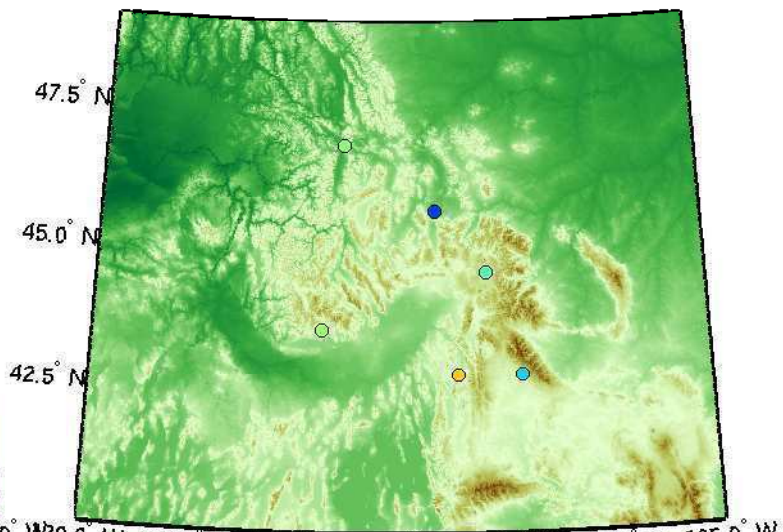
Baz = 338.0754  
Mean xcor value = 0.71143  
Range of  $t^*$  values is 1.0857  
Median  $t^*$  err is 0.99366



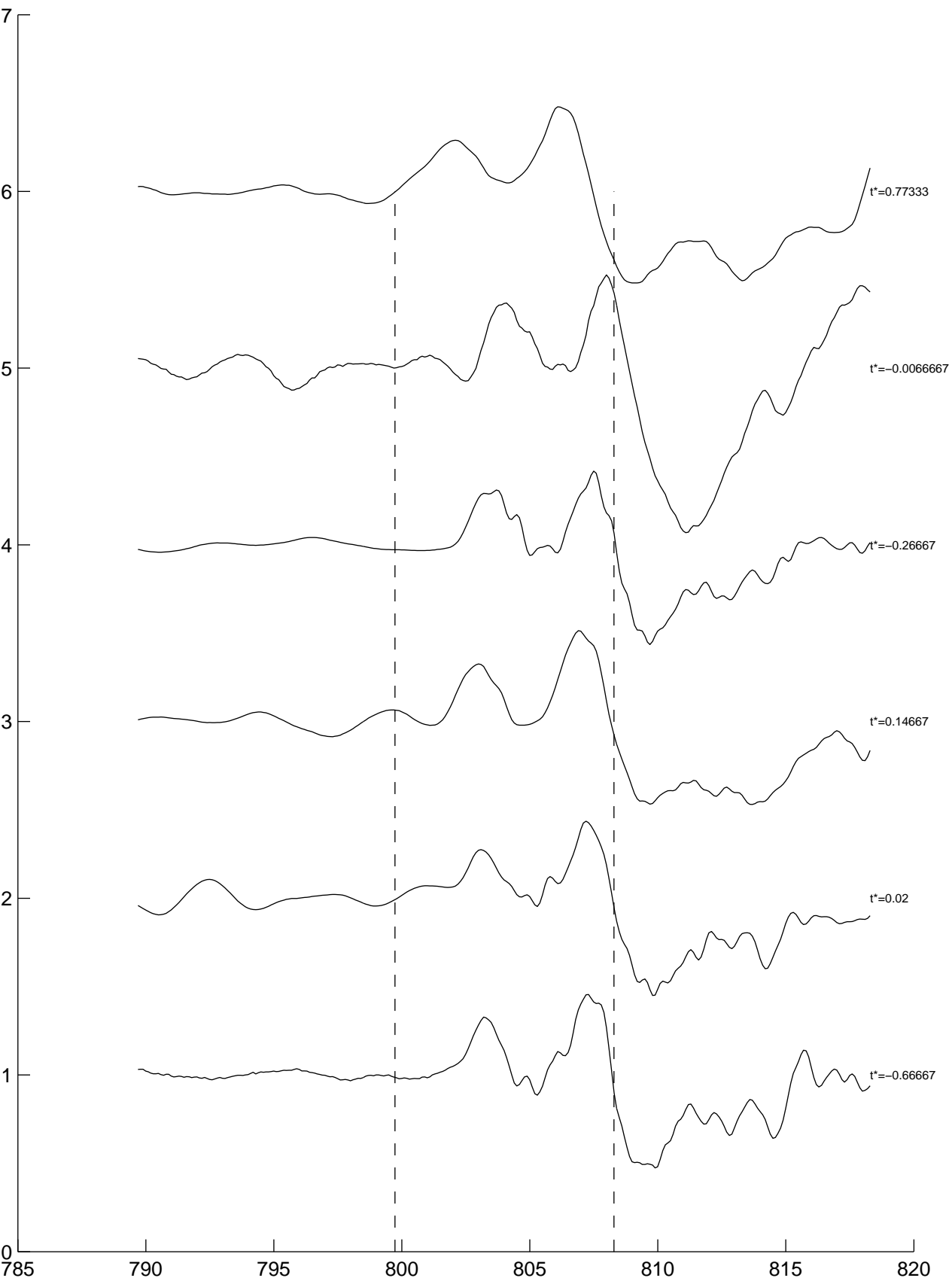
travel time residuals



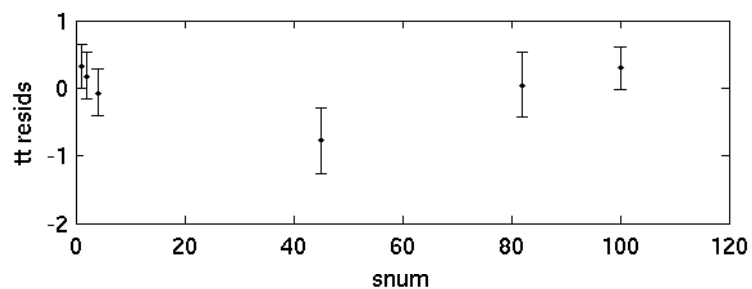
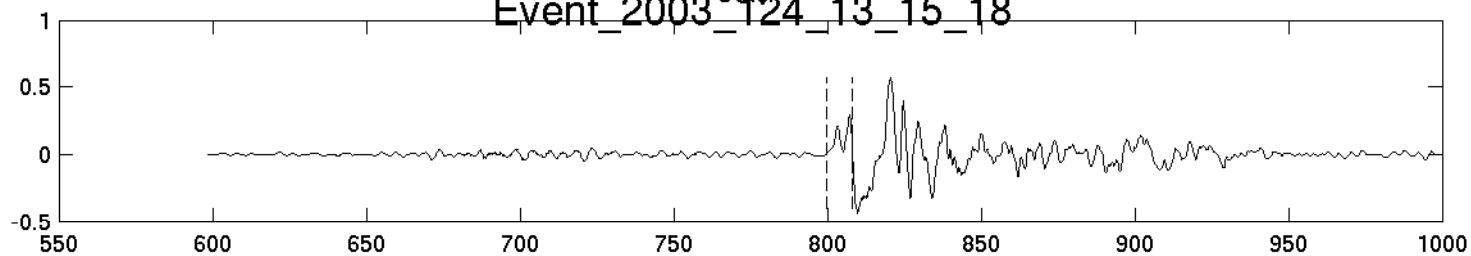
$t^*$  values



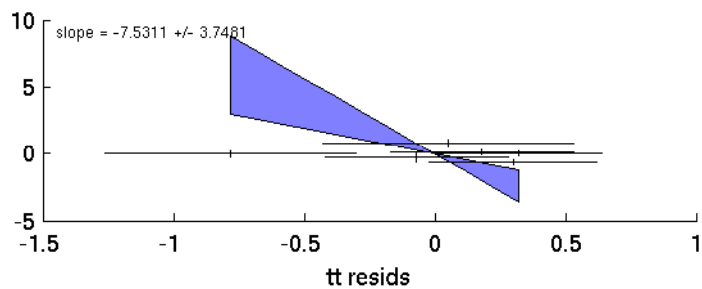
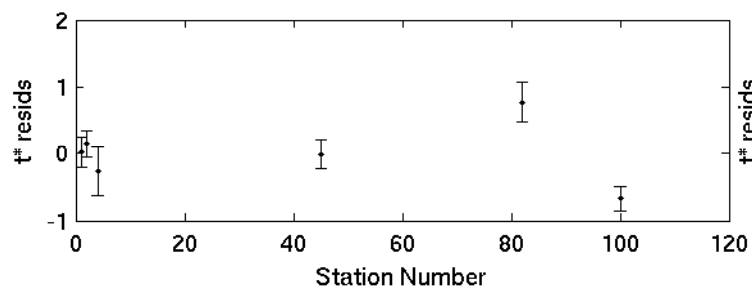
# Event\_2003\_124\_13\_15\_18



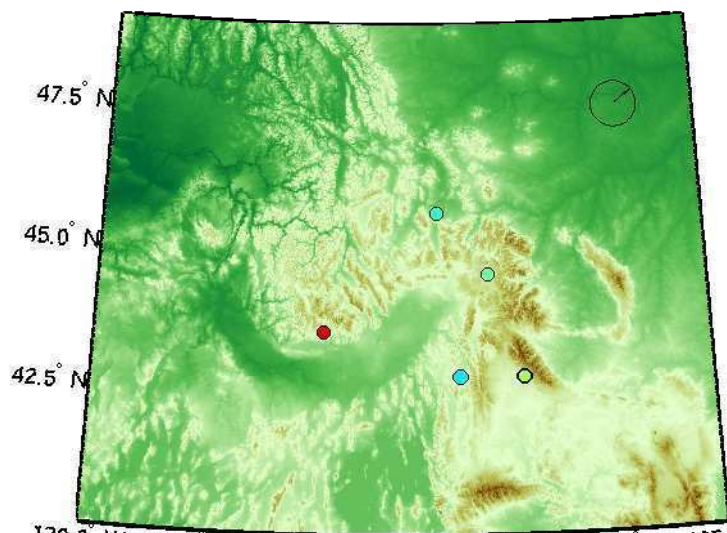
# Event\_2003\_12\_13\_15\_18<sup>Stack</sup>



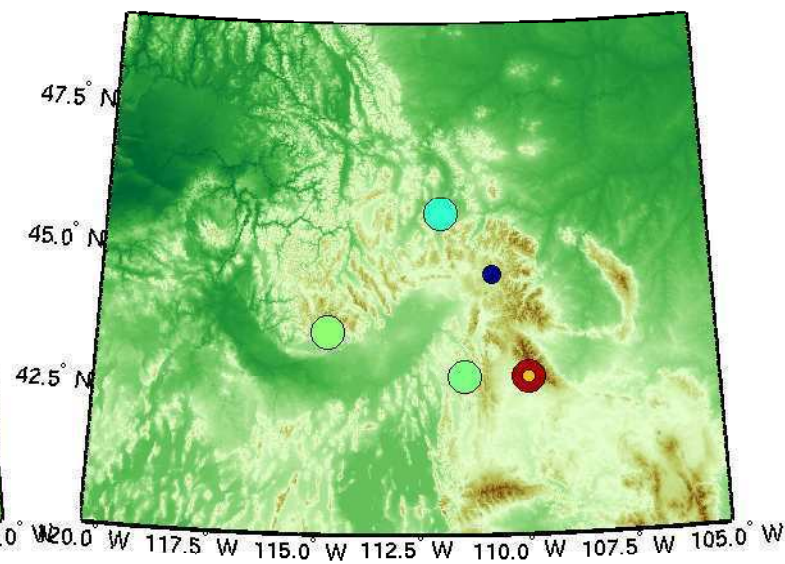
Baz = 232.7387  
 Mean xcor value = 0.77667  
 Range of  $t^*$  values is 1.44  
 Median  $t^*$  err is 0.22413



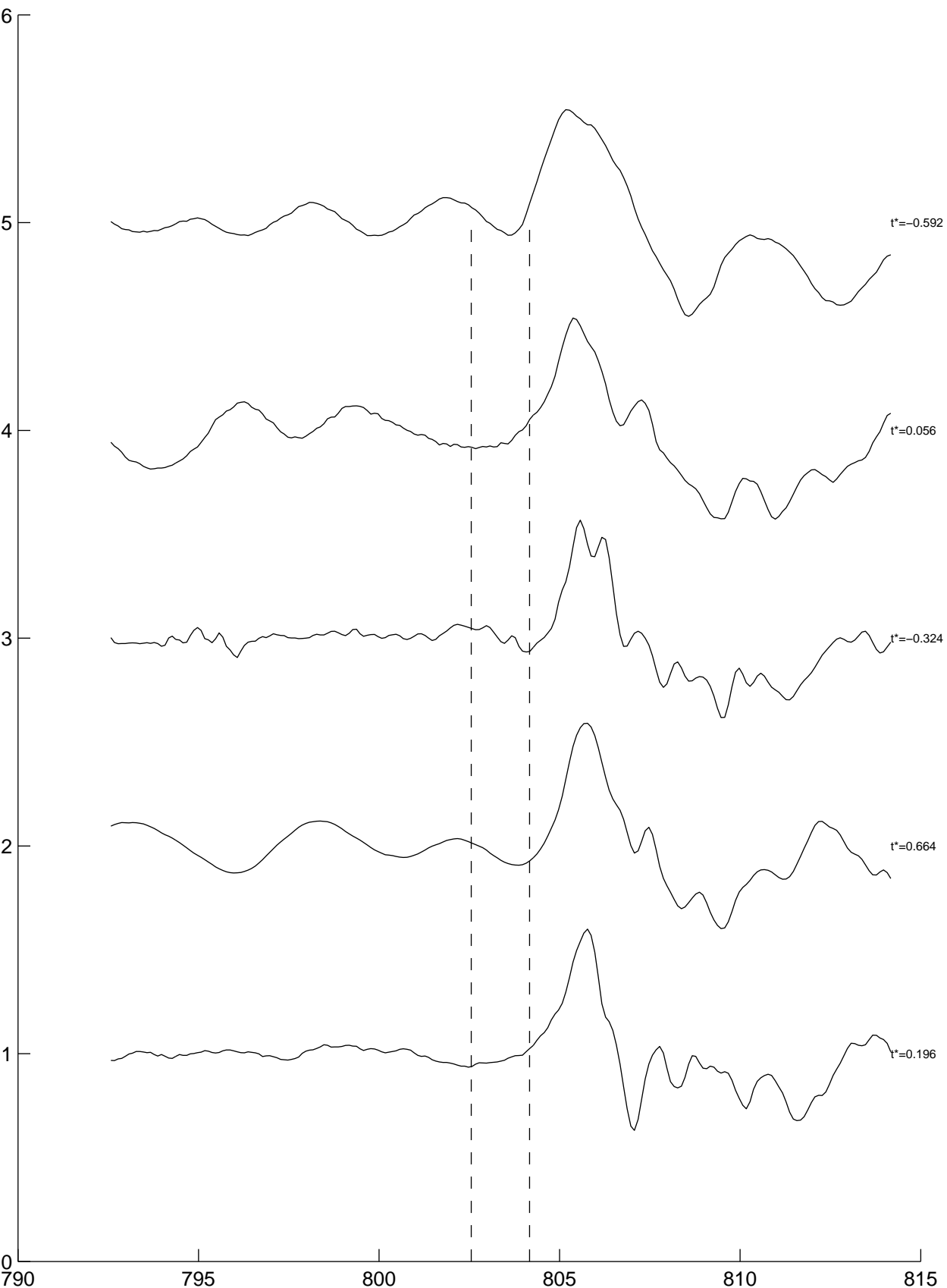
travel time residuals



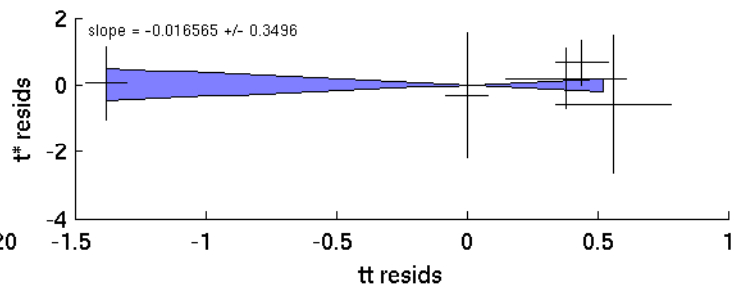
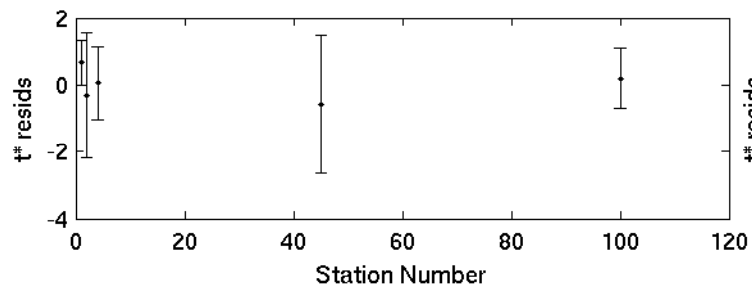
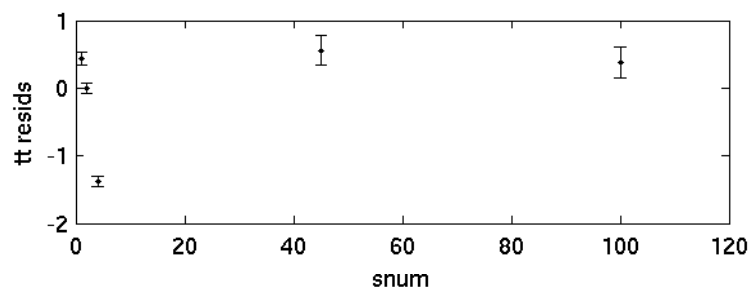
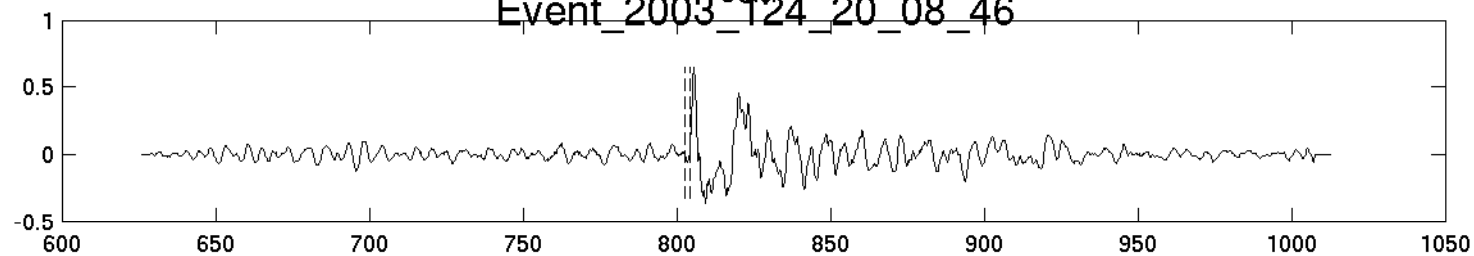
$t^*$  values



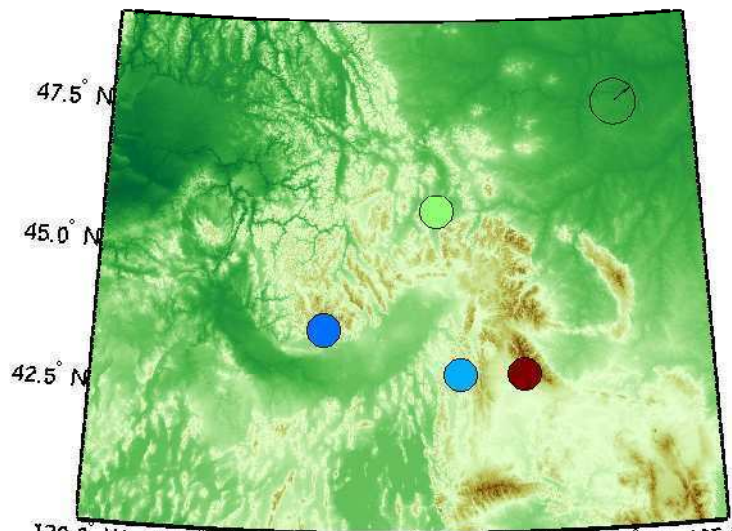
# Event\_2003\_124\_20\_08\_46



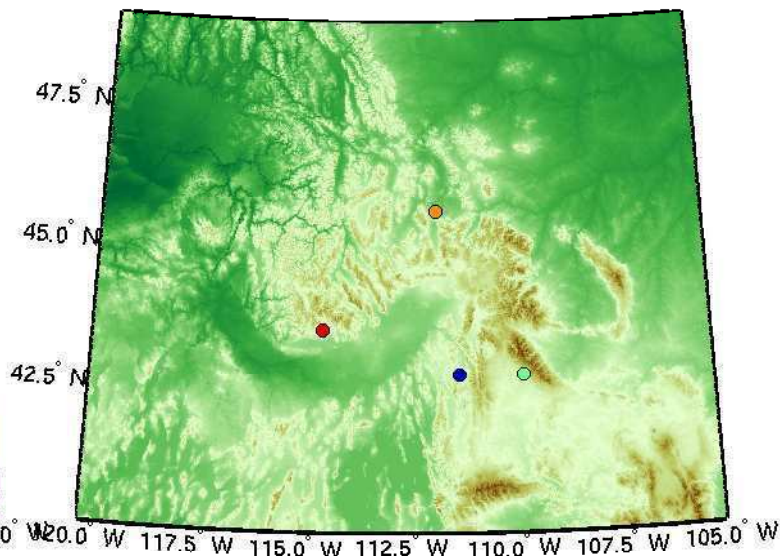
# Event\_2003\_124\_20\_08\_46<sup>Stack</sup>



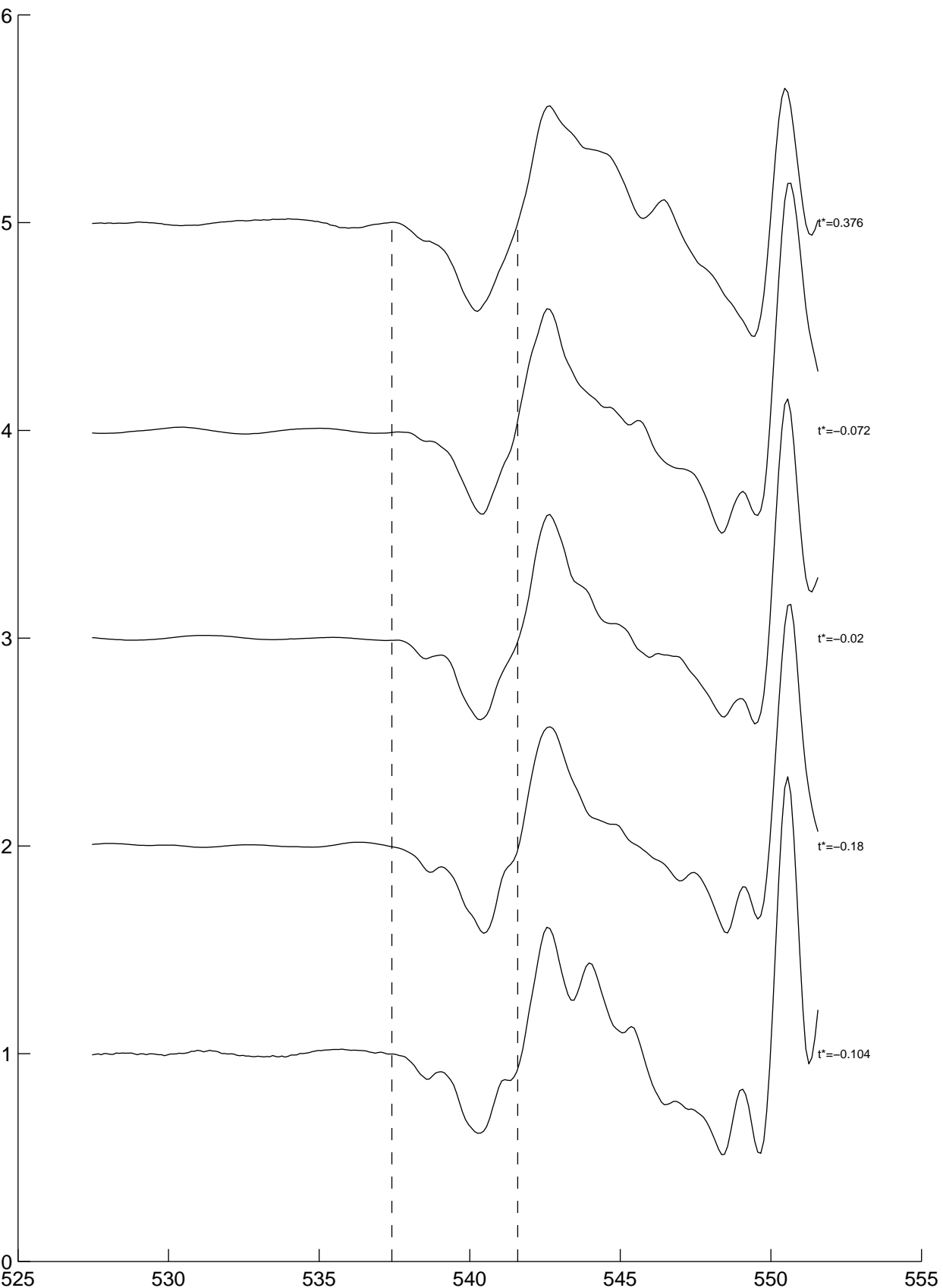
travel time residuals



$t^*$  values



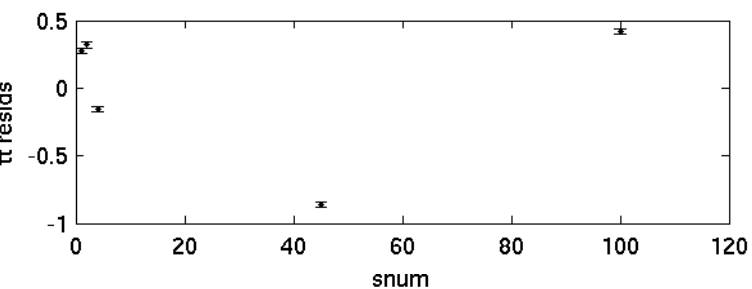
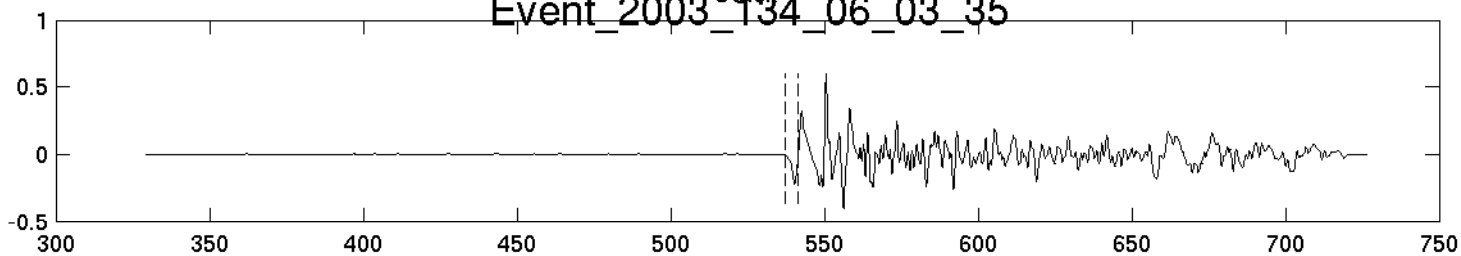
# Event\_2003\_134\_06\_03\_35



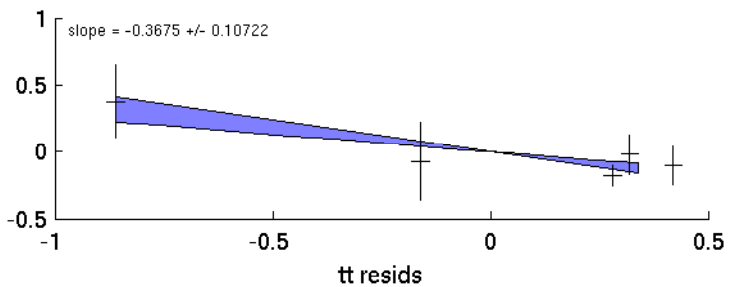
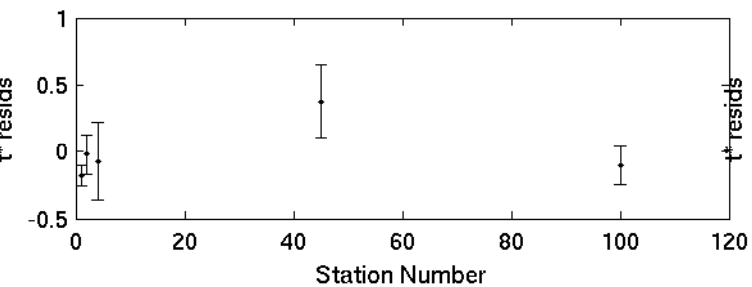


# Event\_2003\_134\_06\_03\_35

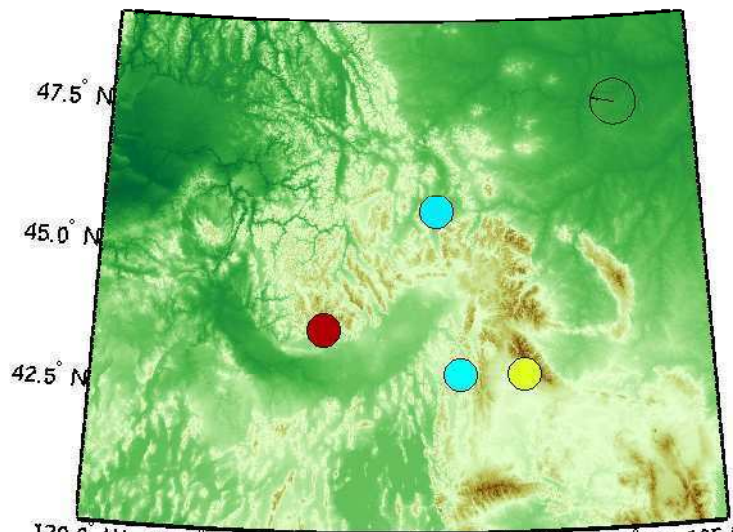
Stack



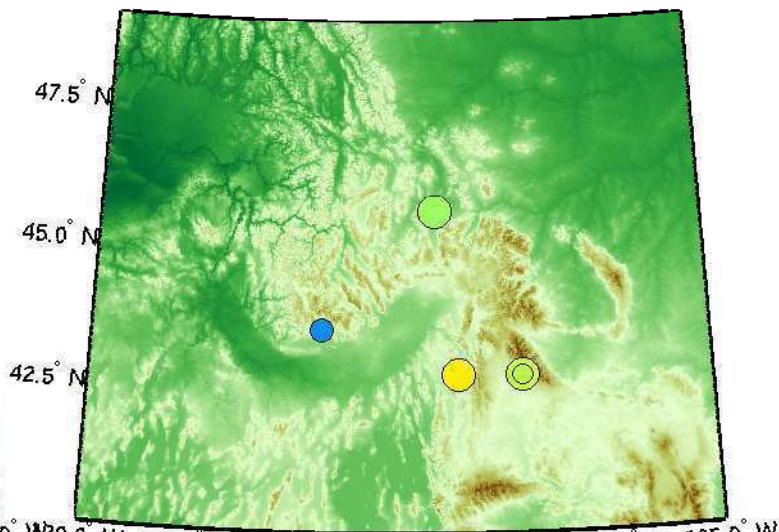
Baz = 102.9216  
Mean xcor value = 0.806  
Range of  $t^*$  values is 0.556  
Median  $t^*$  err is 0.14977



travel time residuals

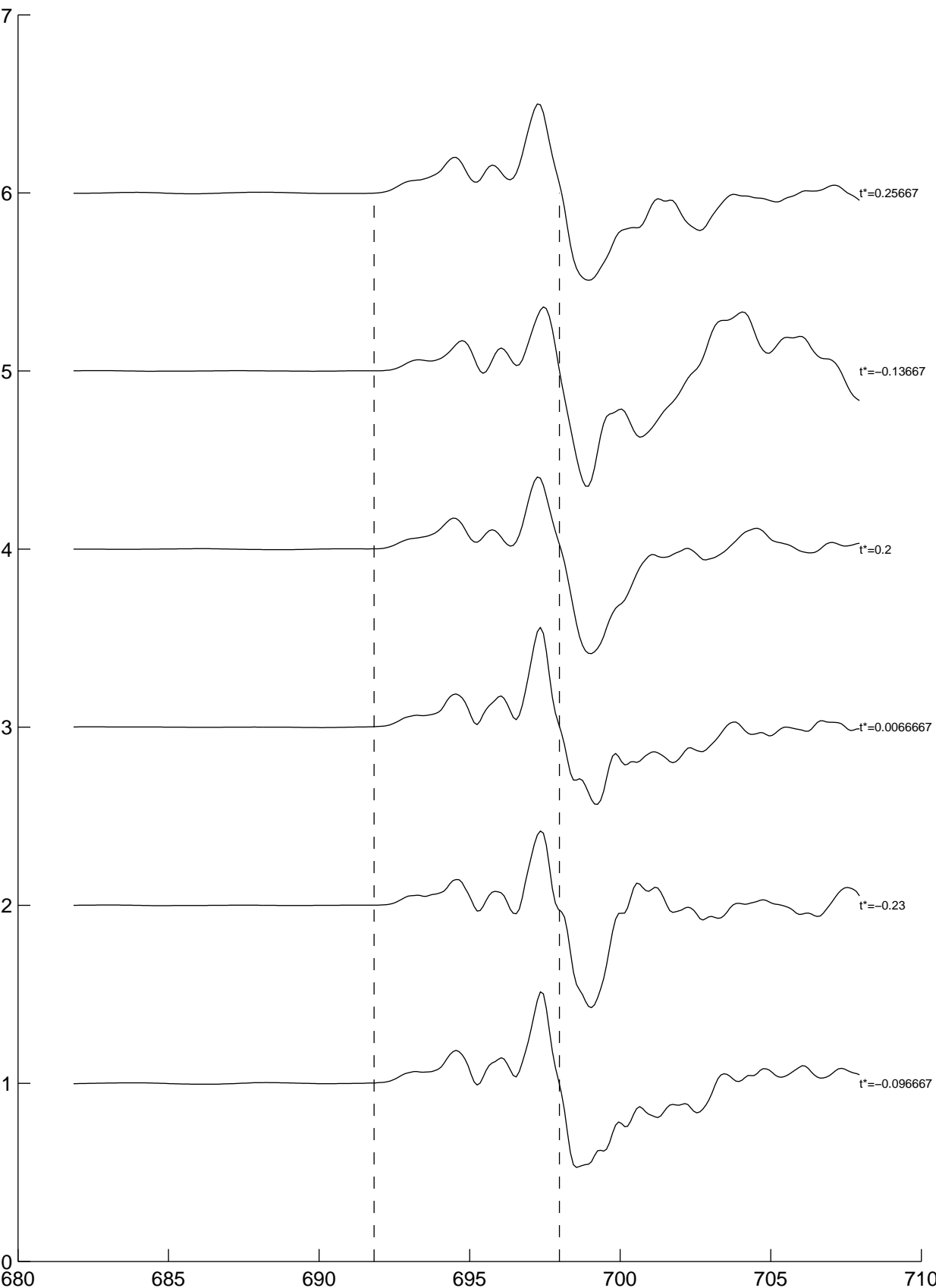


$t^*$  values

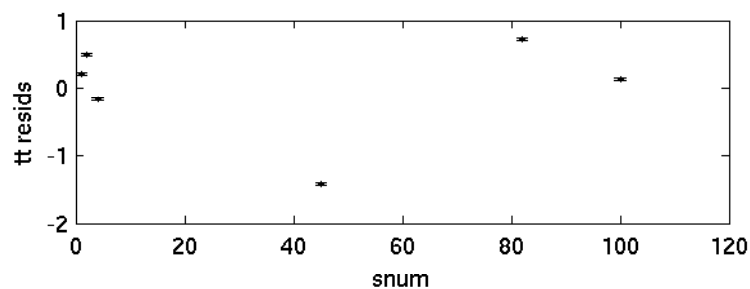
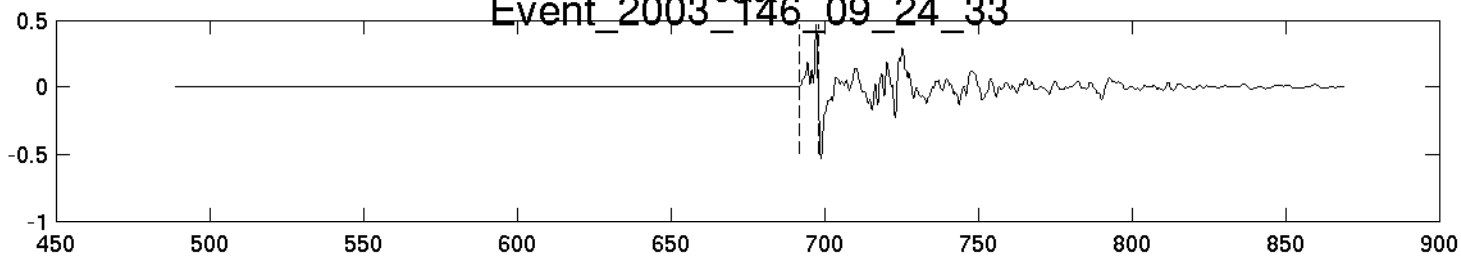




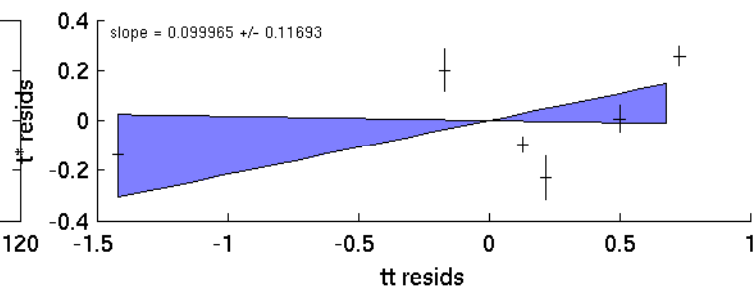
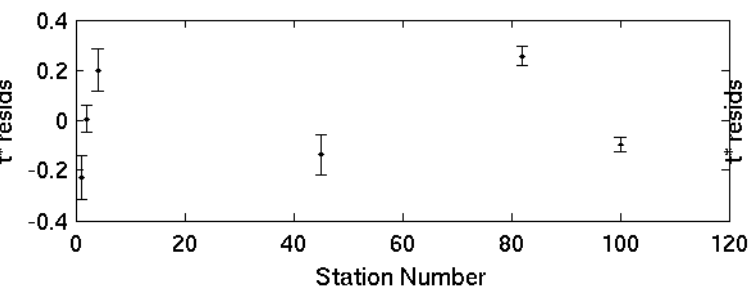
# Event\_2003\_146\_09\_24\_33



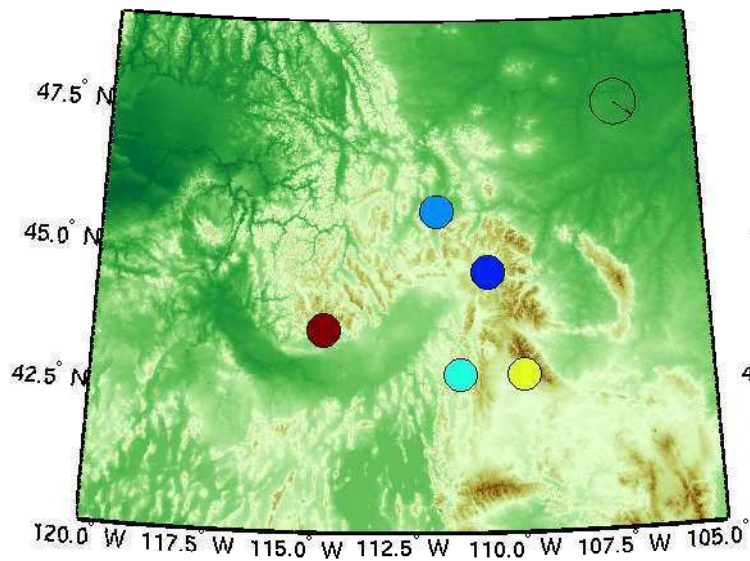
# Event\_2003\_Stack\_146\_09\_24\_33



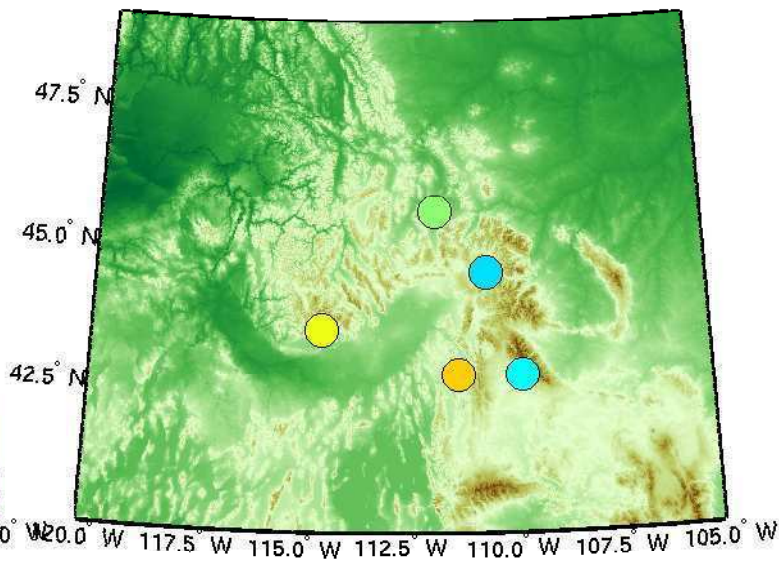
Baz = 309.1952  
Mean xcor value = 0.77167  
Range of  $t^*$  values is 0.48667  
Median  $t^*$  err is 0.066439



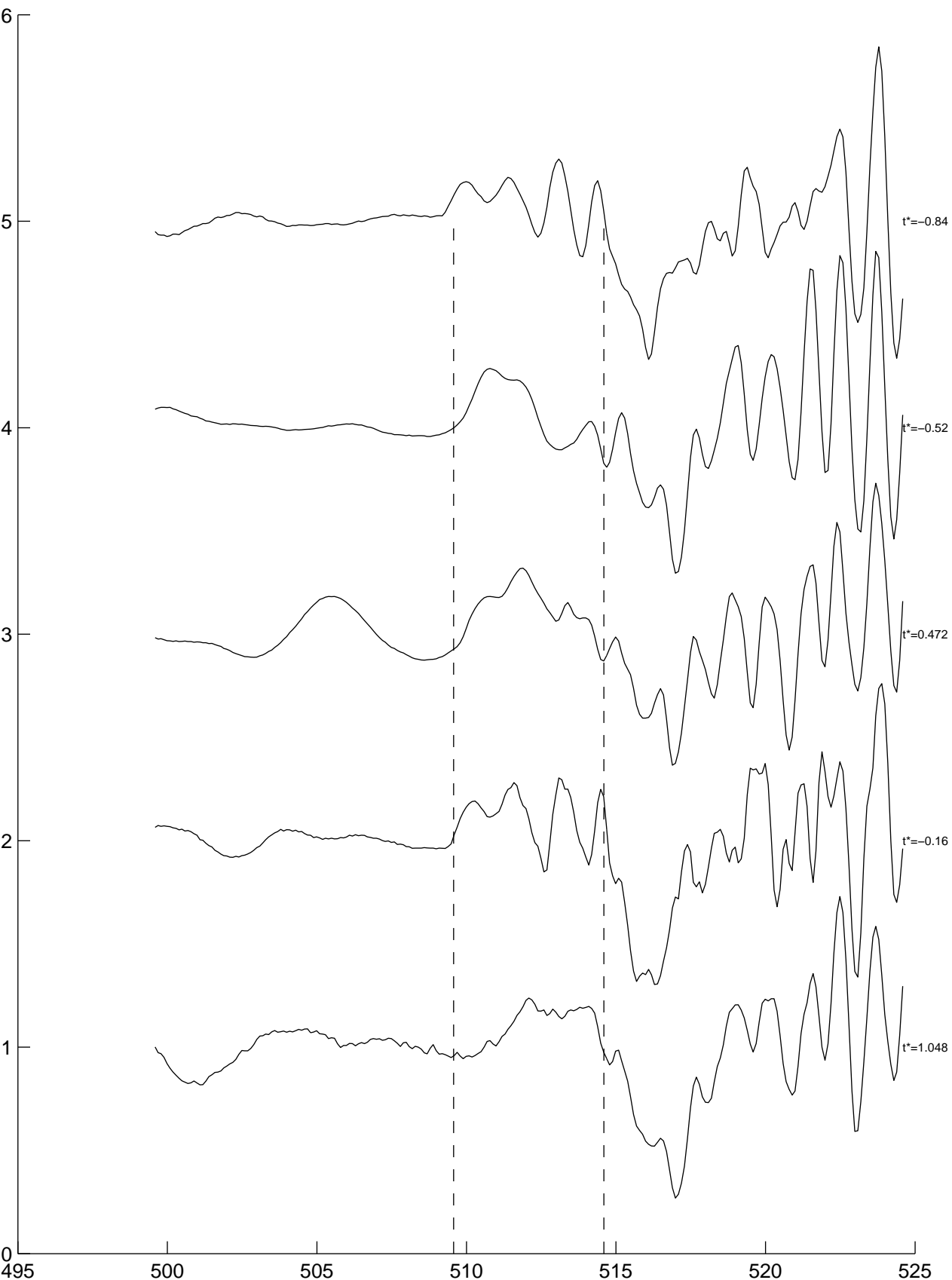
travel time residuals



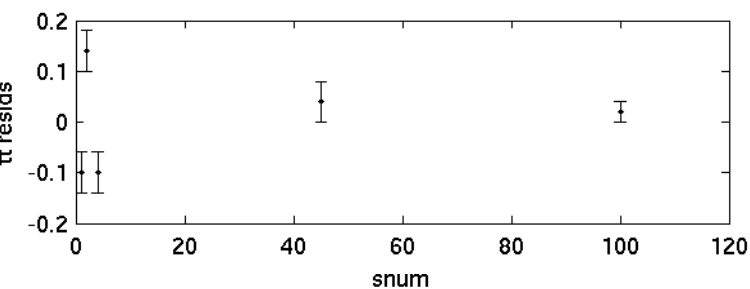
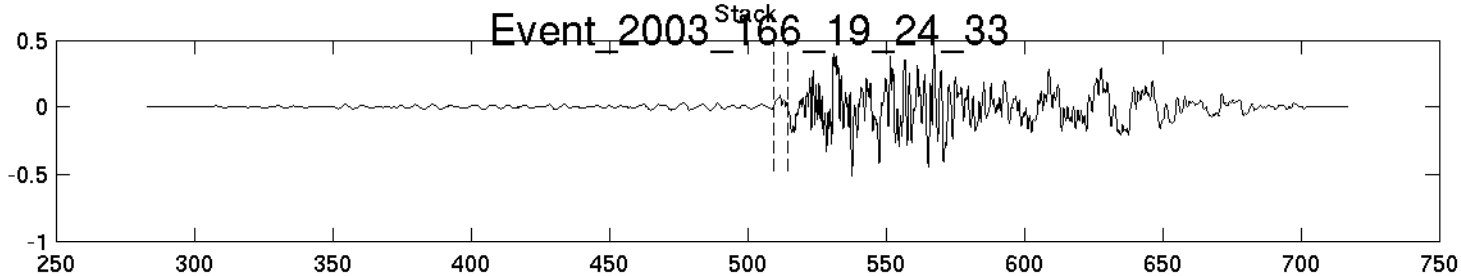
$t^*$  values



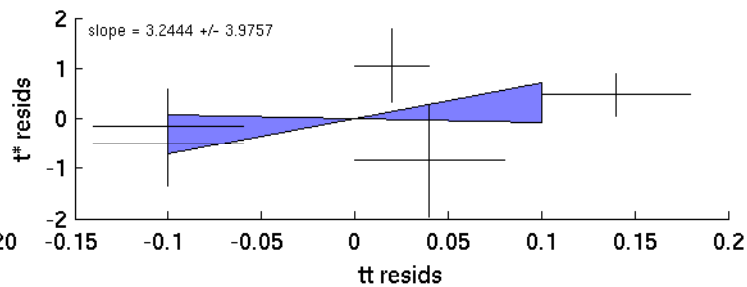
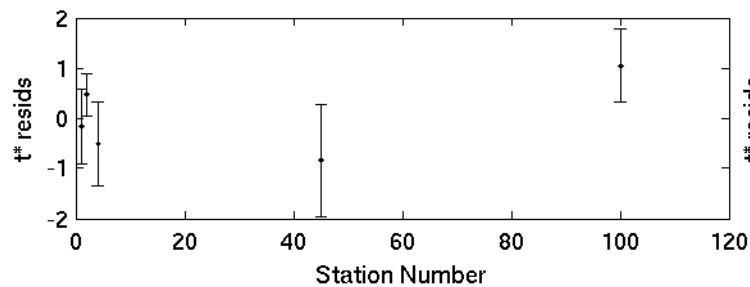
# Event\_2003\_166\_19\_24\_33



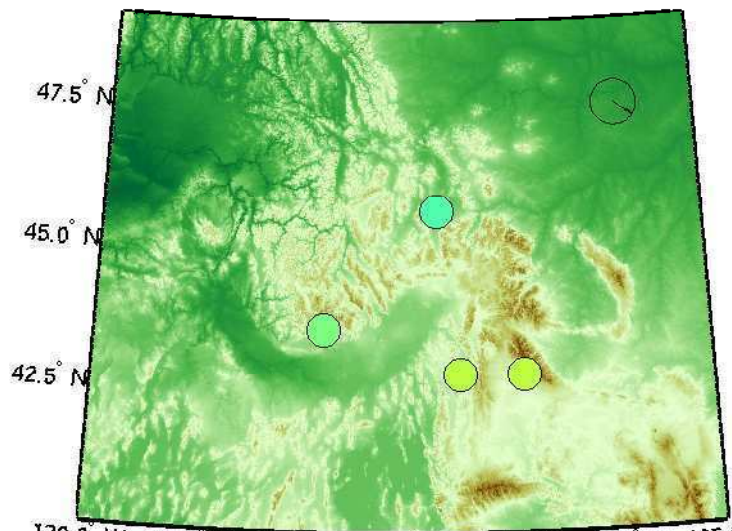
# Event\_2003\_166\_19\_24\_33



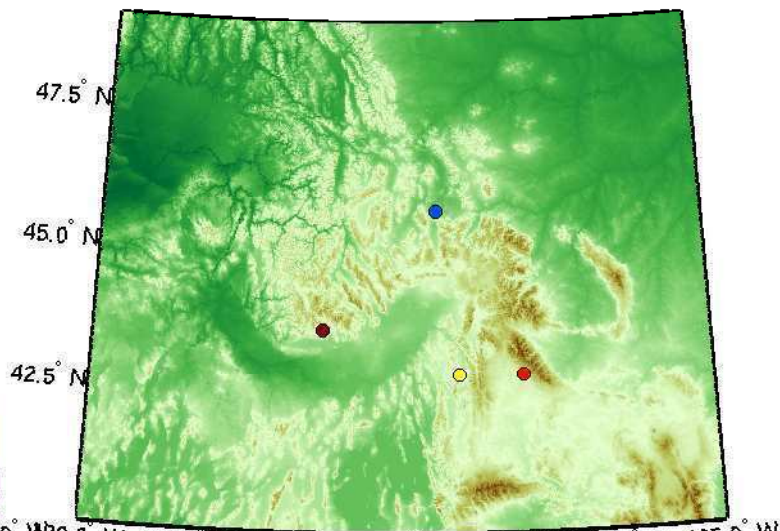
Baz = 305.7401  
Mean xcor value = 0.664  
Range of  $t^*$  values is 1.888  
Median  $t^*$  err is 0.75245



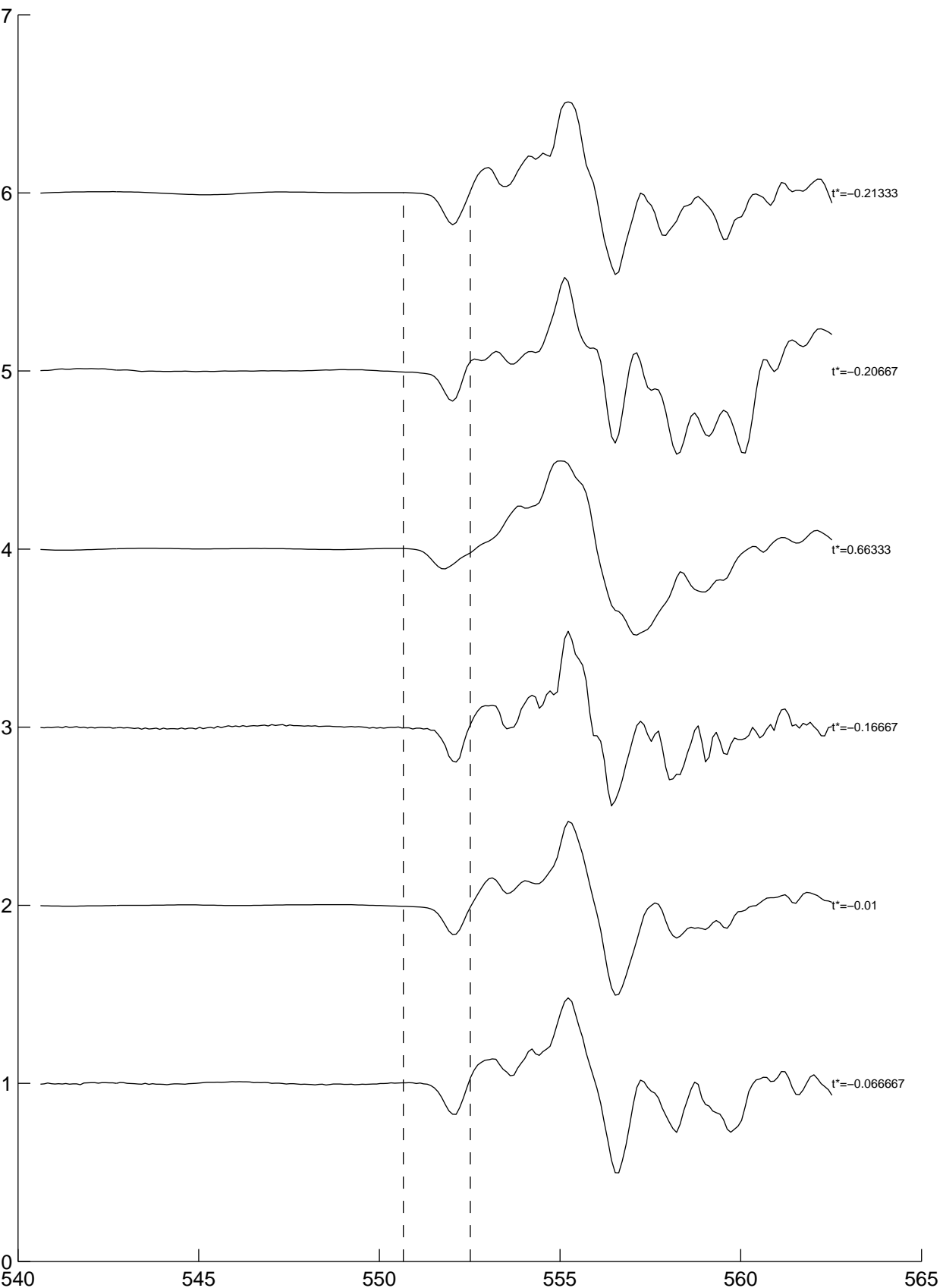
travel time residuals



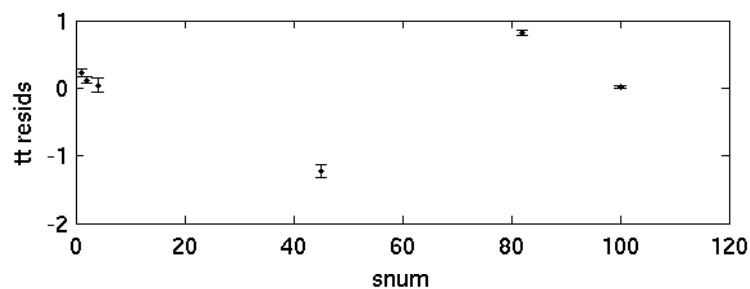
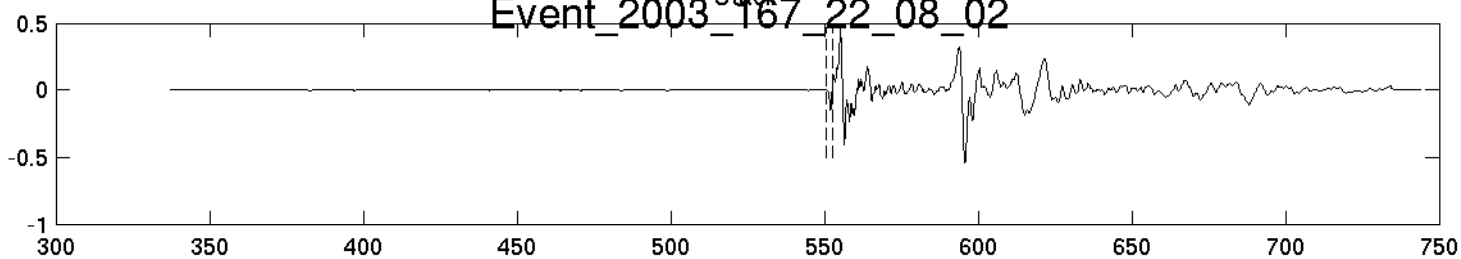
$t^*$  values



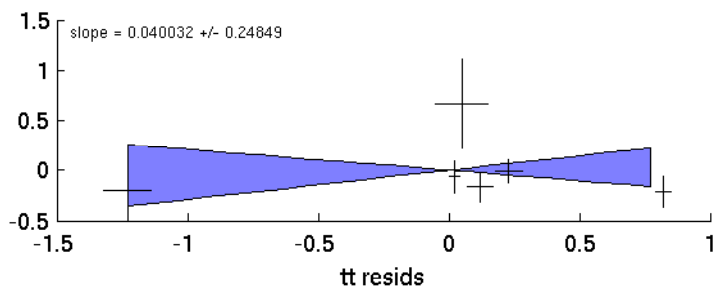
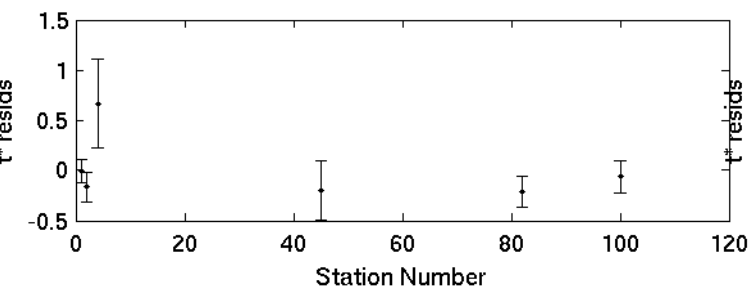
# Event\_2003\_167\_22\_08\_02



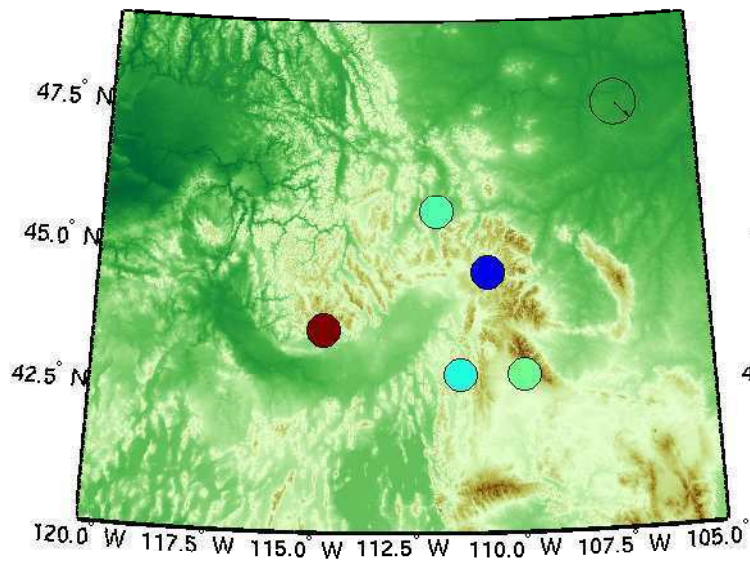
Event\_2003\_167\_22\_08\_02



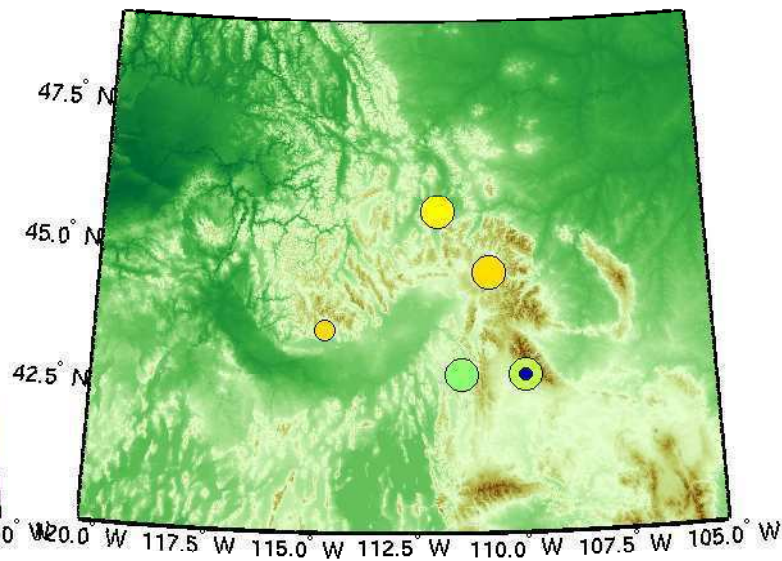
Baz = 315.7052  
Mean xcor value = 0.72333  
Range of  $t^*$  values is 0.87667  
Median  $t^*$  err is 0.15579



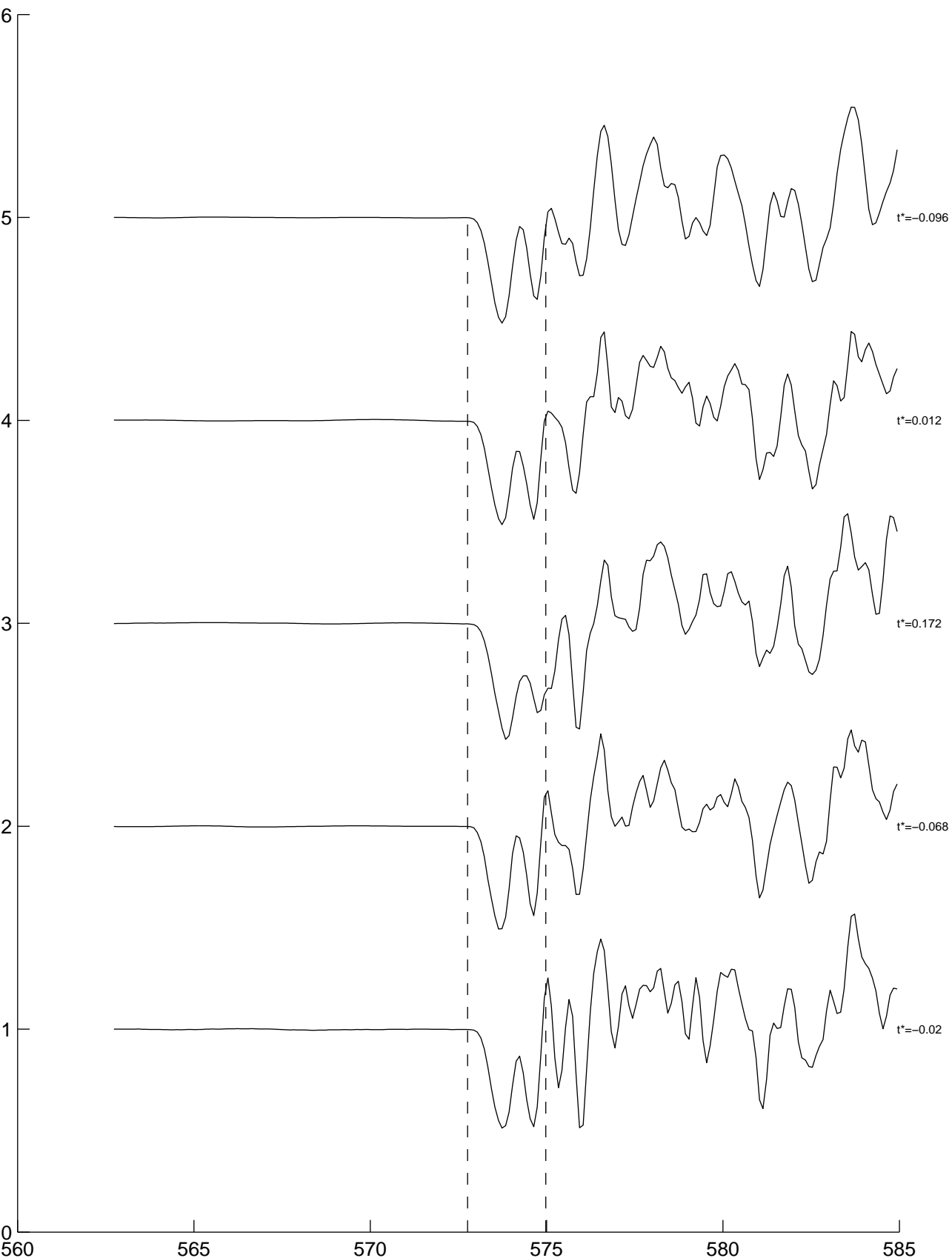
travel time residuals



$t^*$  values

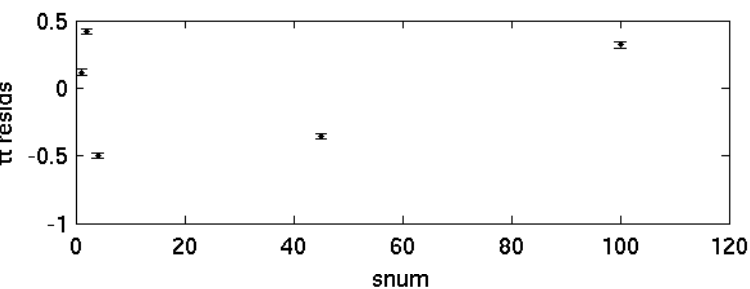
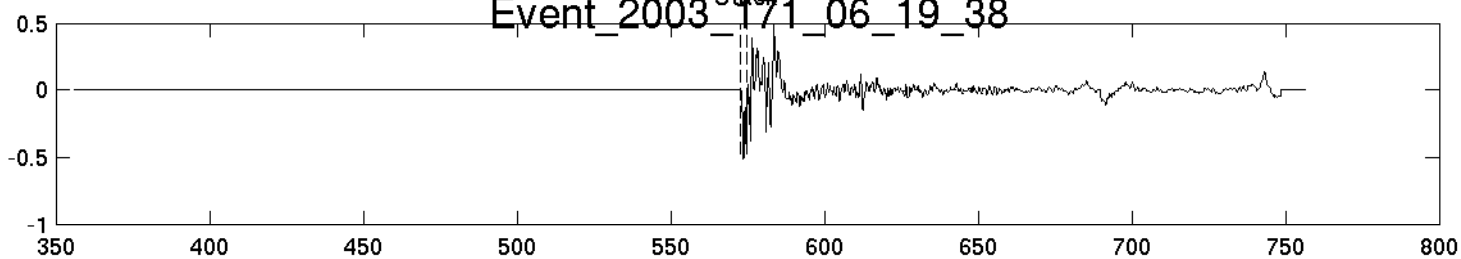


# Event\_2003\_171\_06\_19\_38

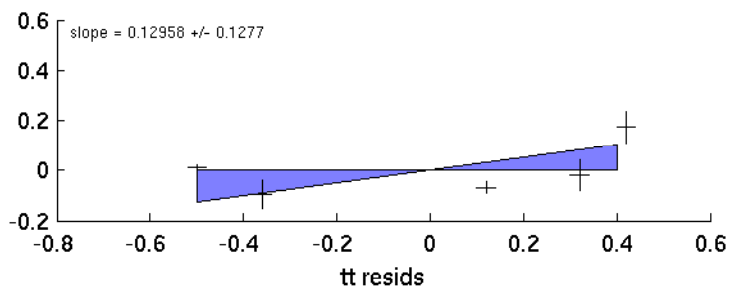
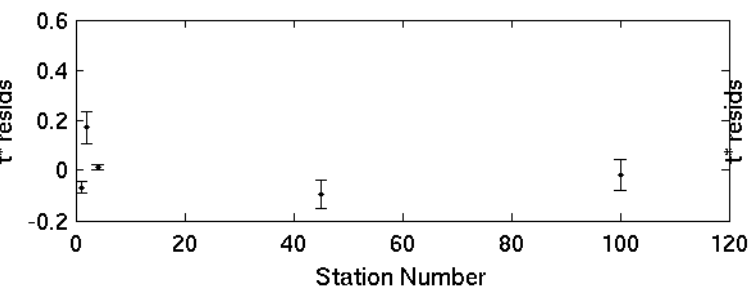




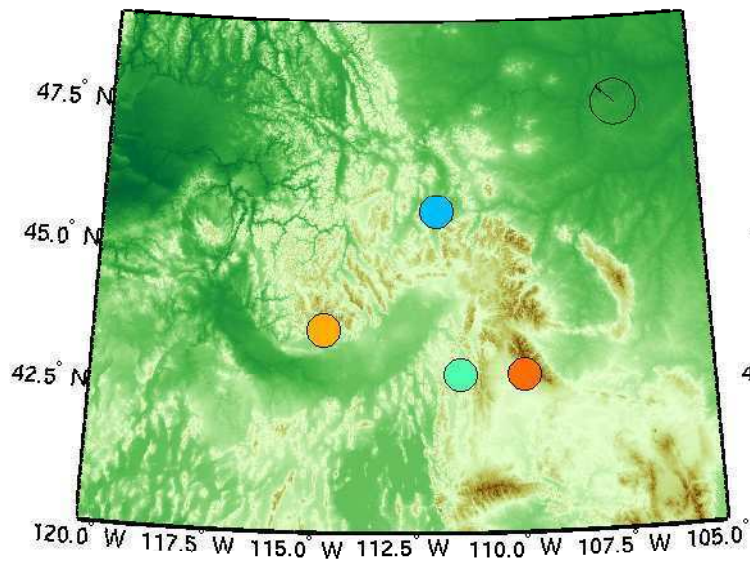
# Event\_2003\_171\_06\_19\_38



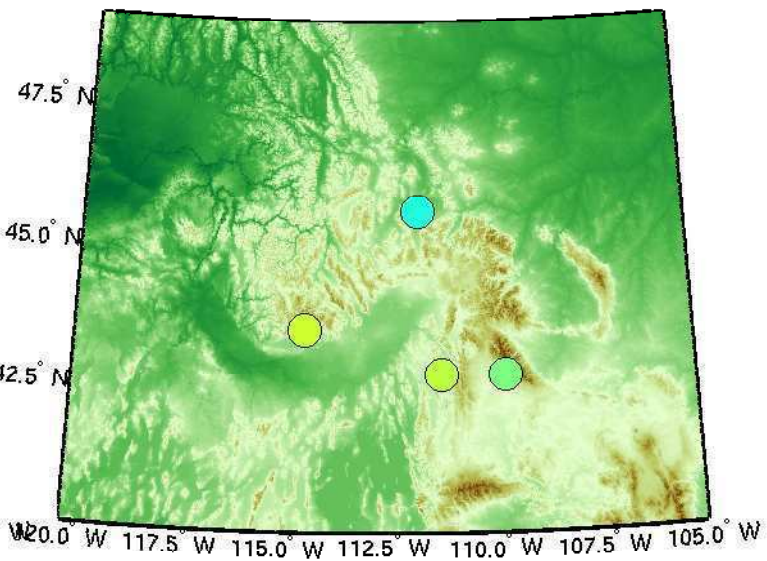
Baz = 134.5858  
Mean xcor value = 0.706  
Range of  $t^*$  values is 0.268  
Median  $t^*$  err is 0.054797



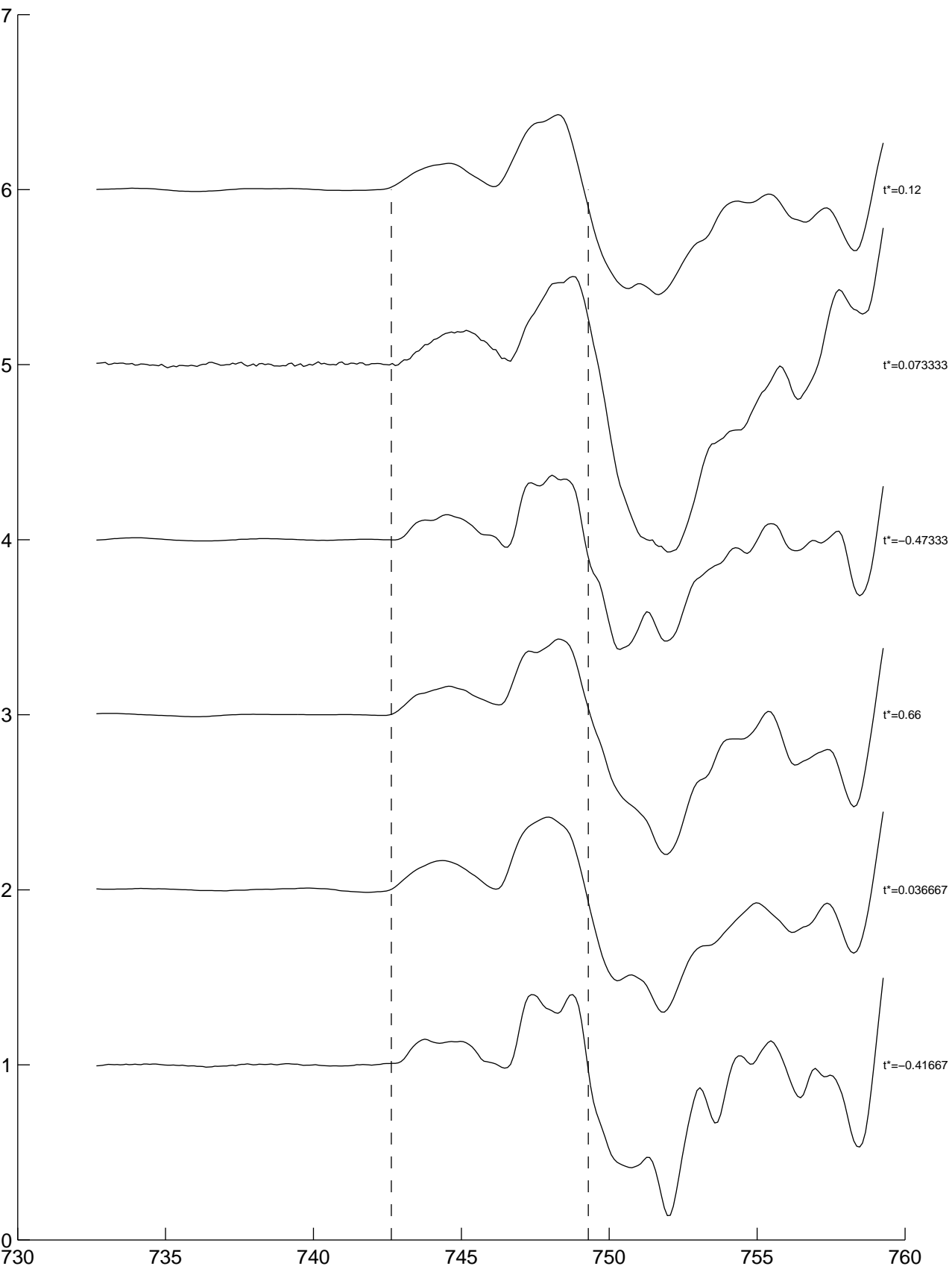
travel time residuals



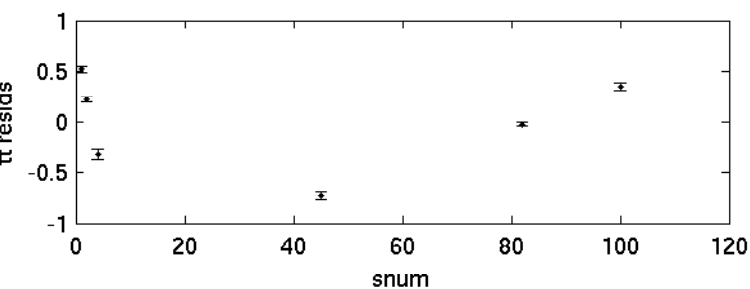
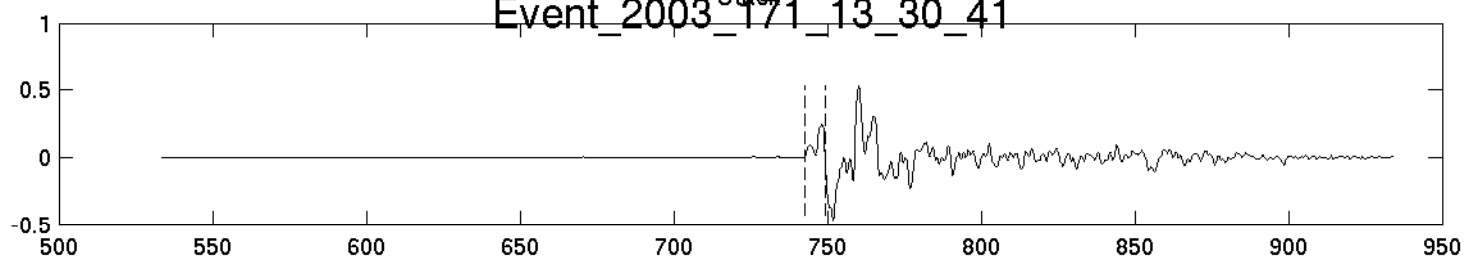
$t^*$  values



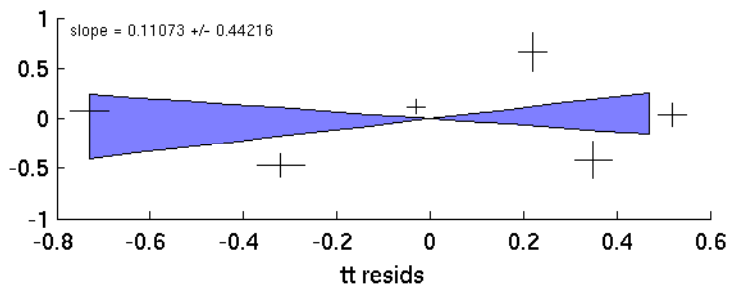
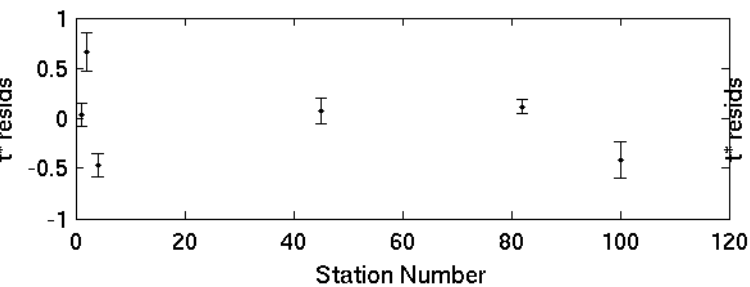
# Event\_2003\_171\_13\_30\_41



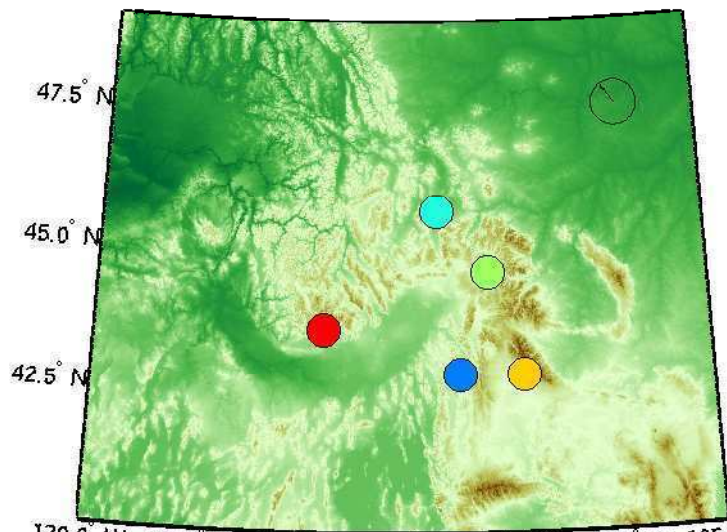
# Event\_2003\_171\_13\_30\_41



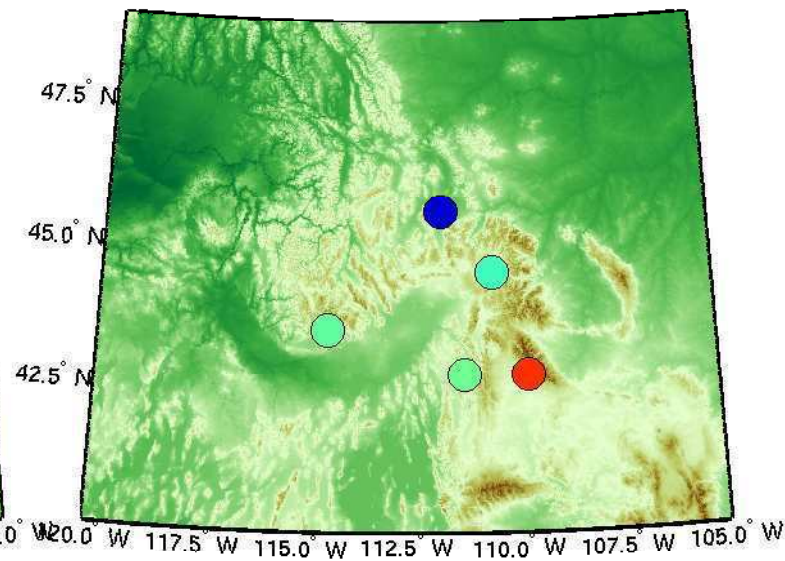
Baz = 146.2268  
 Mean xcor value = 0.83667  
 Range of  $t^*$  values is 1.1333  
 Median  $t^*$  err is 0.12085



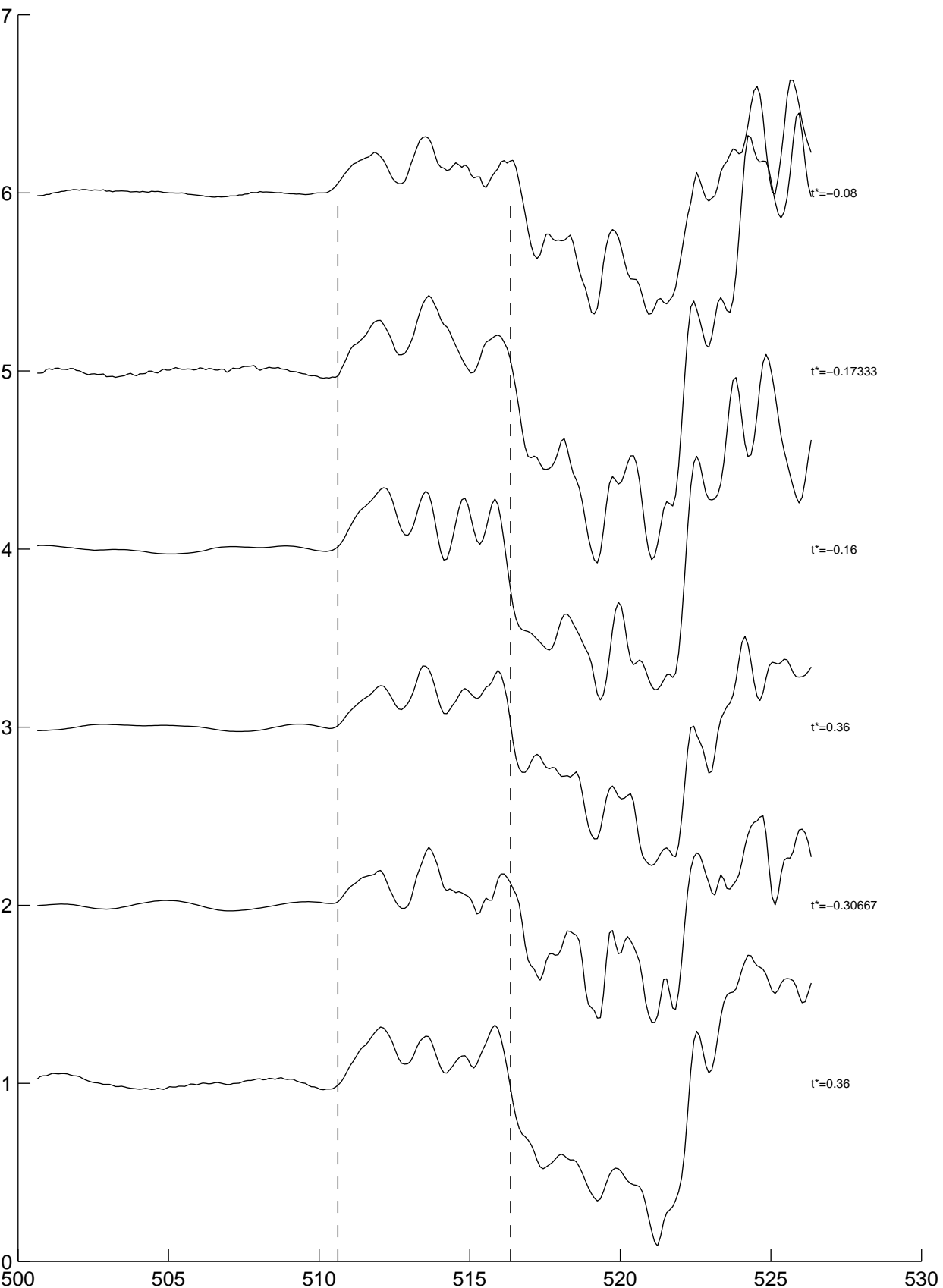
travel time residuals



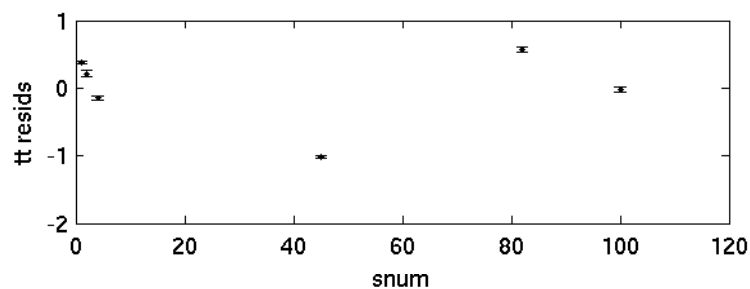
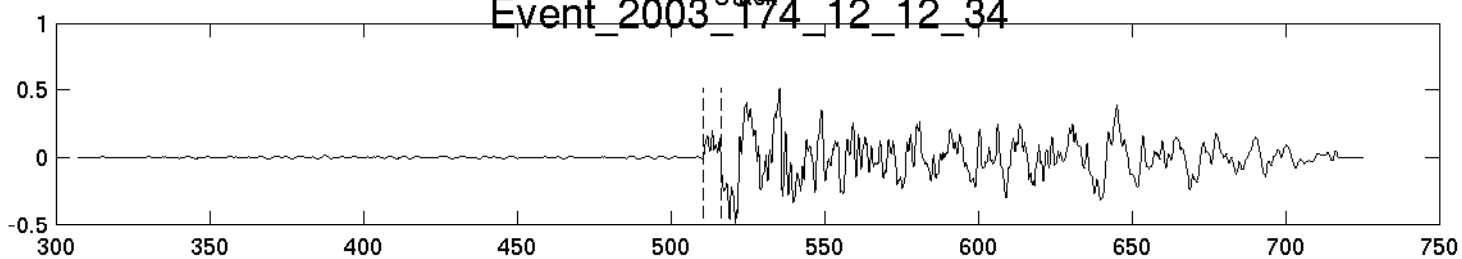
$t^*$  values



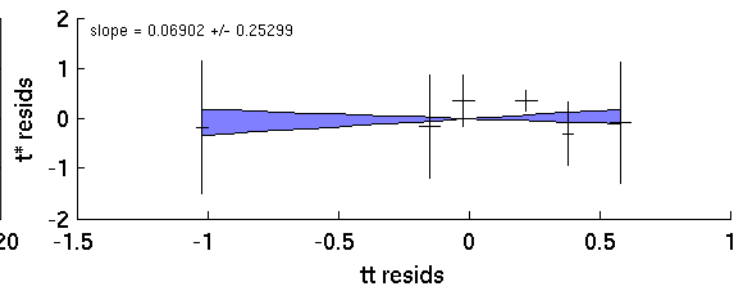
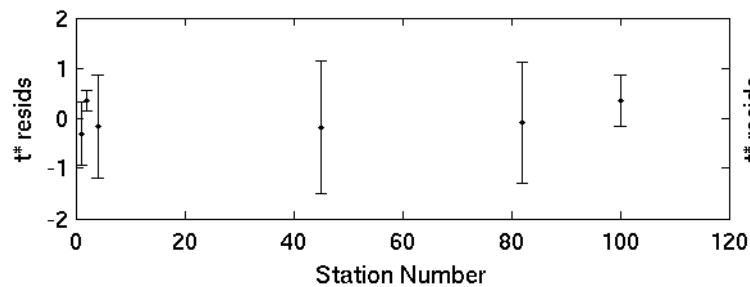
# Event\_2003\_174\_12\_12\_34



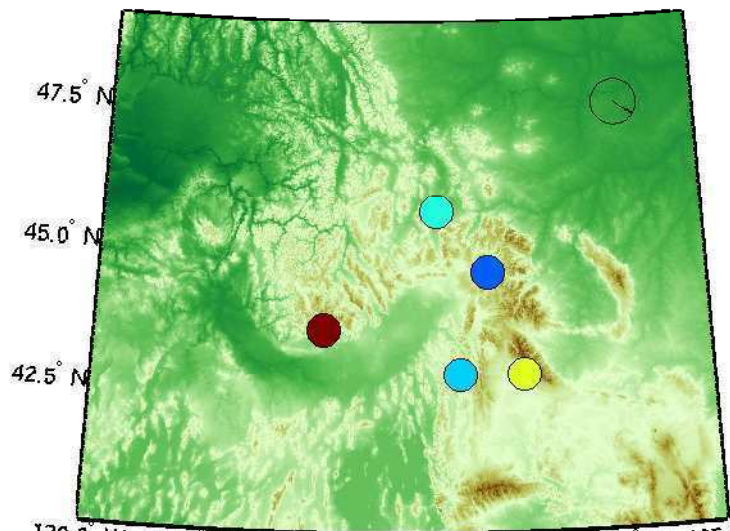
# Event\_2003\_174\_12\_12\_34



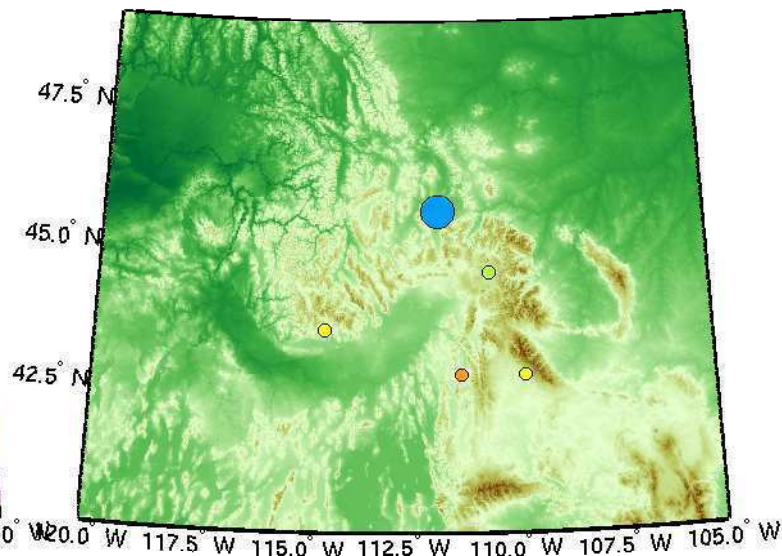
Baz = 305.6371  
 Mean xcor value = 0.785  
 Range of  $t^*$  values is 0.66667  
 Median  $t^*$  err is 0.83353



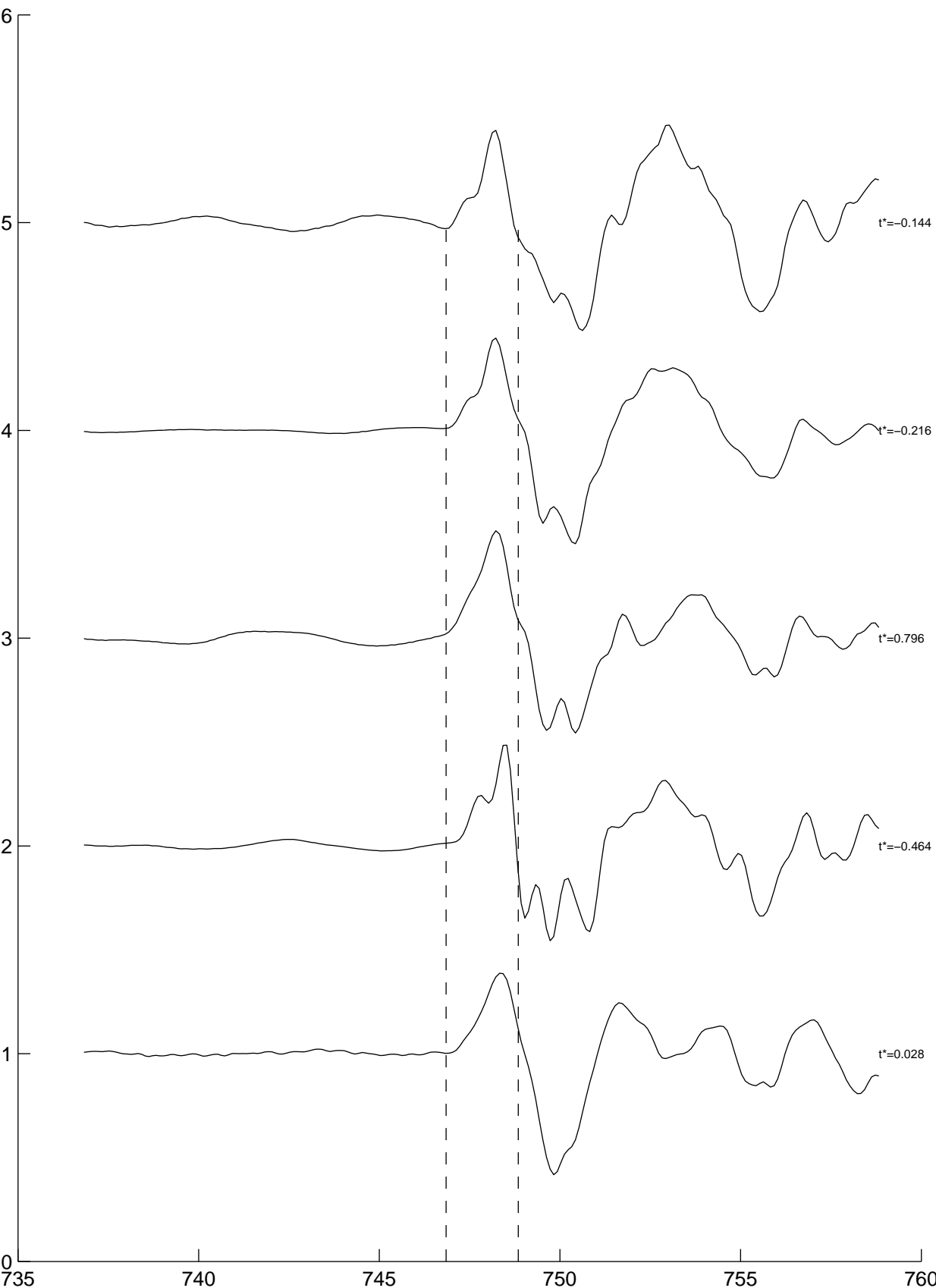
travel time residuals



$t^*$  values

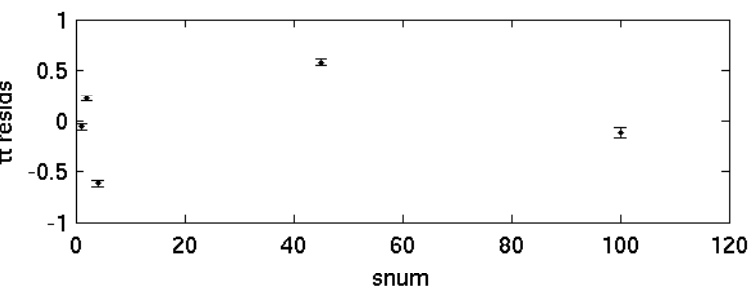
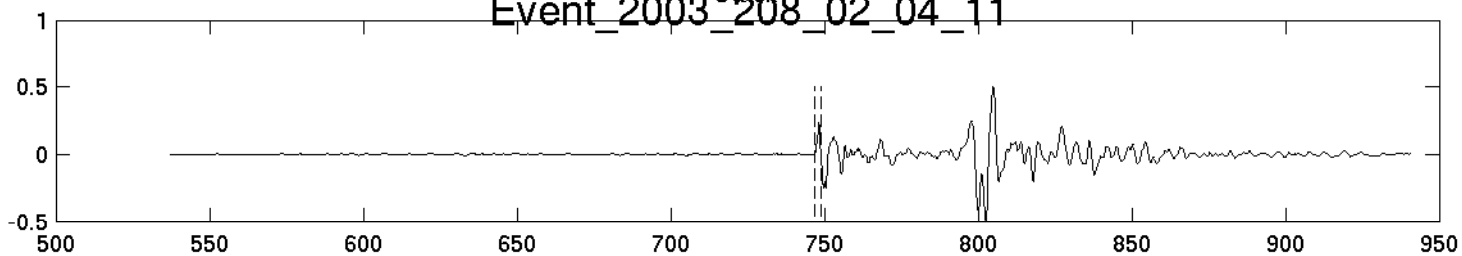


# Event\_2003\_208\_02\_04\_11

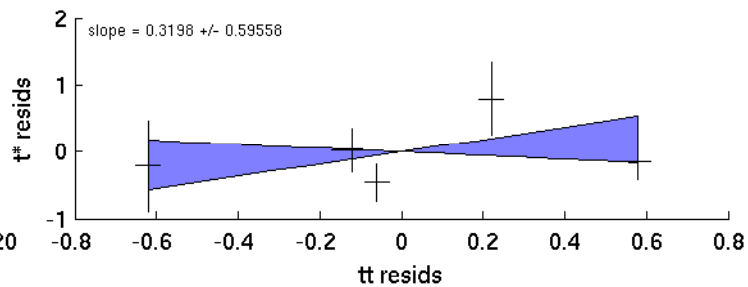
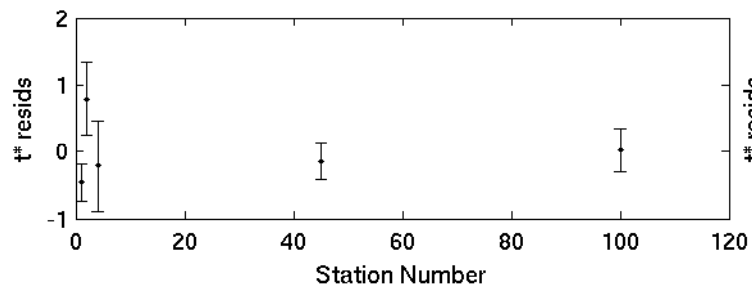




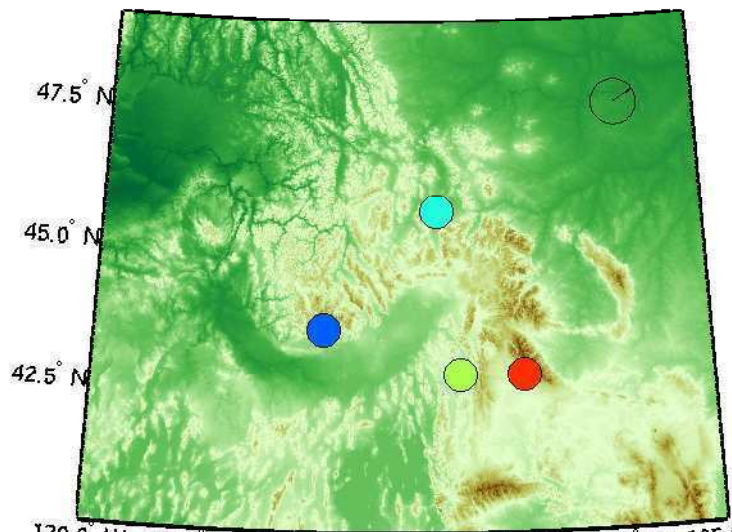
# Event\_2003\_208\_02\_04\_11



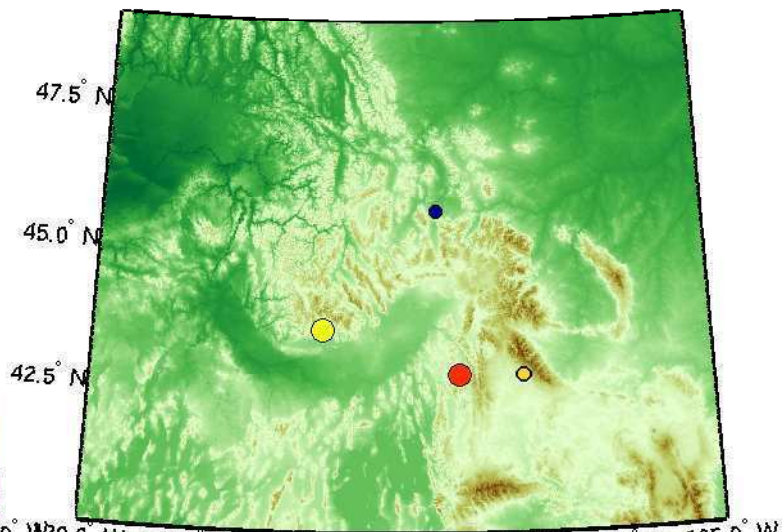
Baz = 237.8293  
 Mean xcor value = 0.706  
 Range of  $t^*$  values is 1.26  
 Median  $t^*$  err is 0.32338



travel time residuals

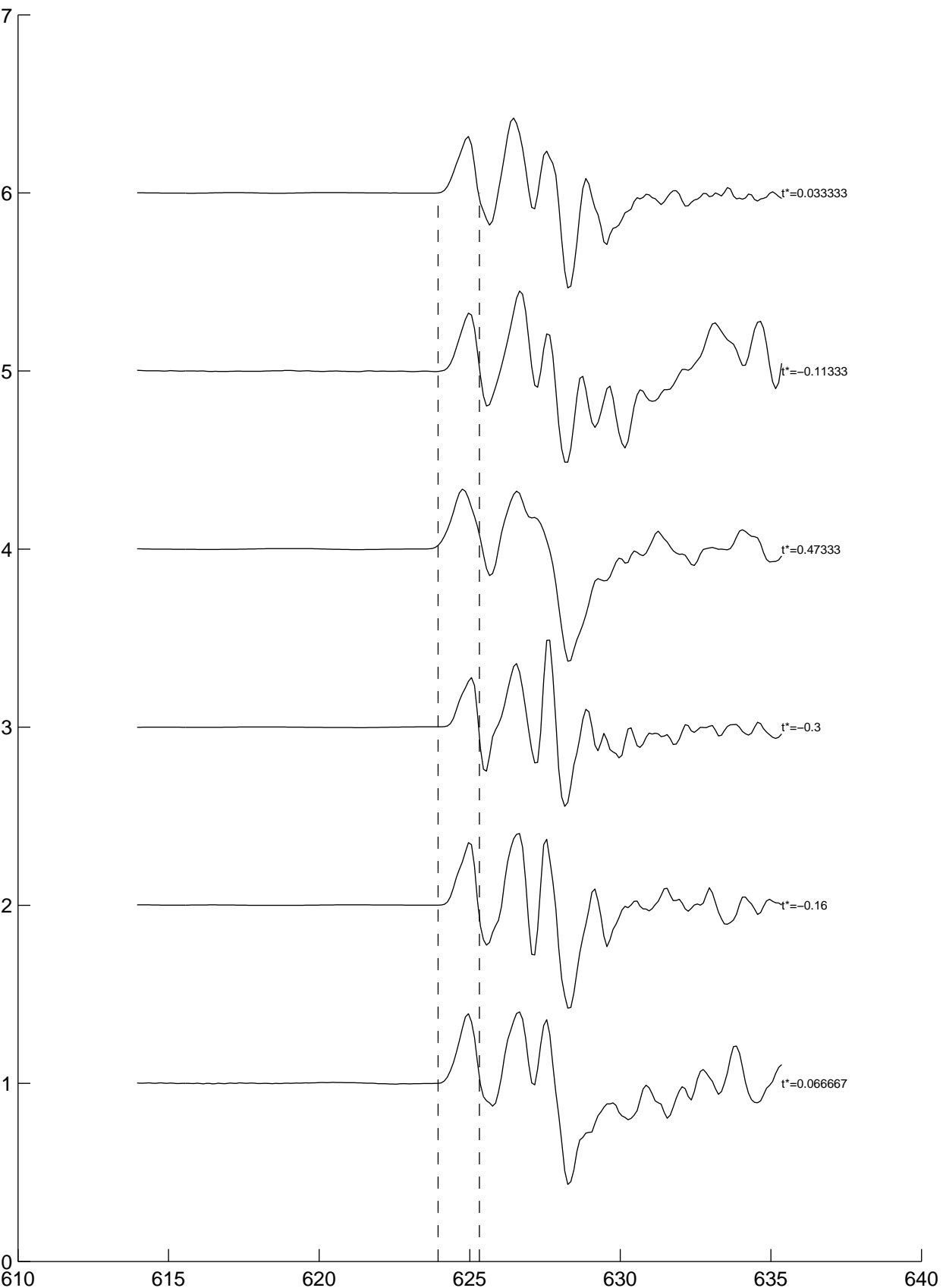


$t^*$  values

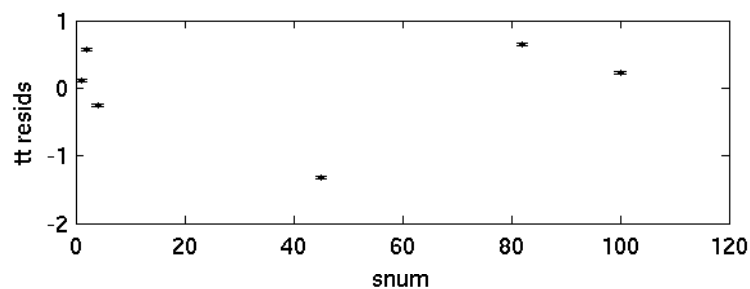
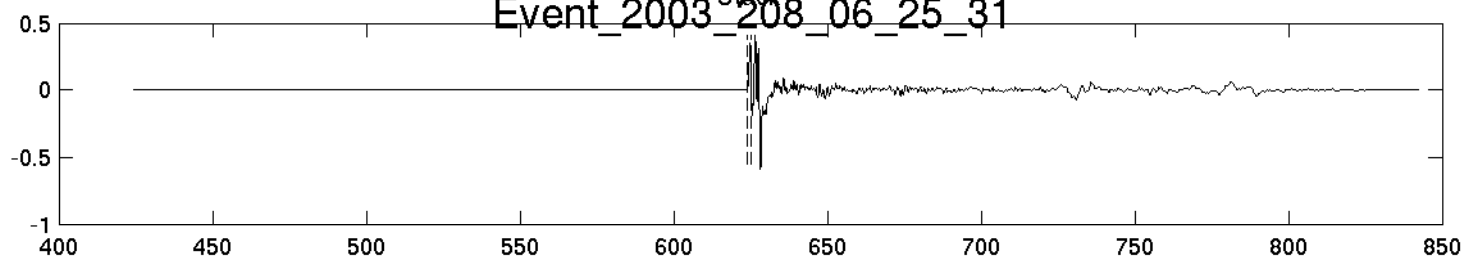




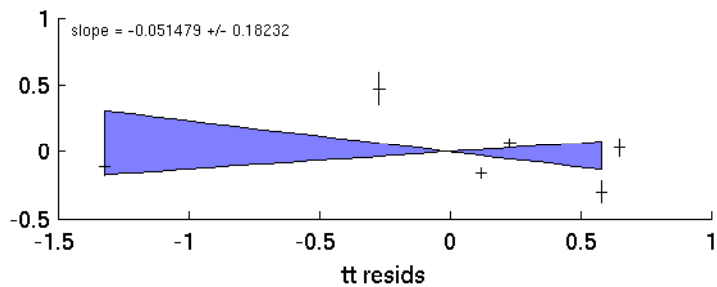
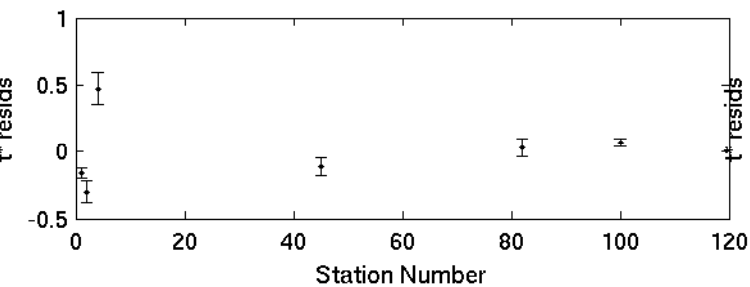
# Event\_2003\_208\_06\_25\_31



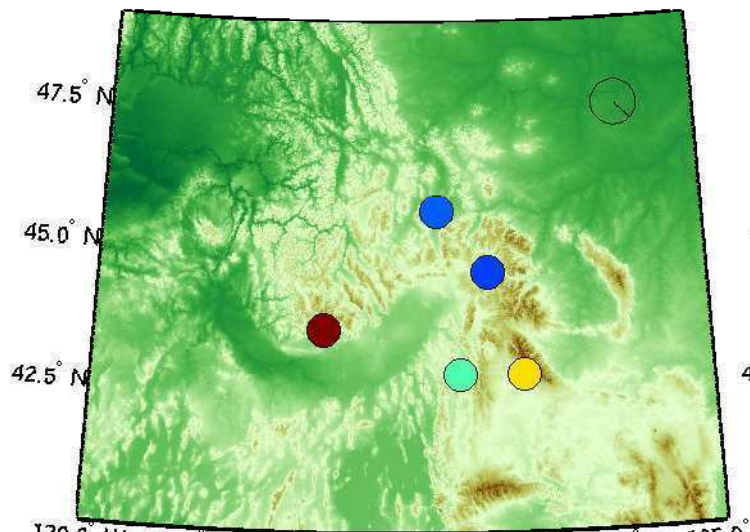
# Event\_2003\_208\_06\_25\_31



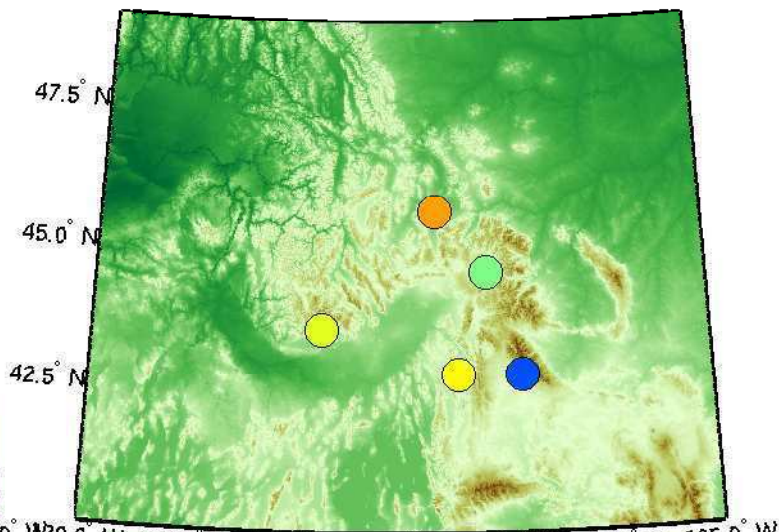
Baz = 316.7164  
 Mean xcor value = 0.69  
 Range of  $t^*$  values is 0.77333  
 Median  $t^*$  err is 0.066735



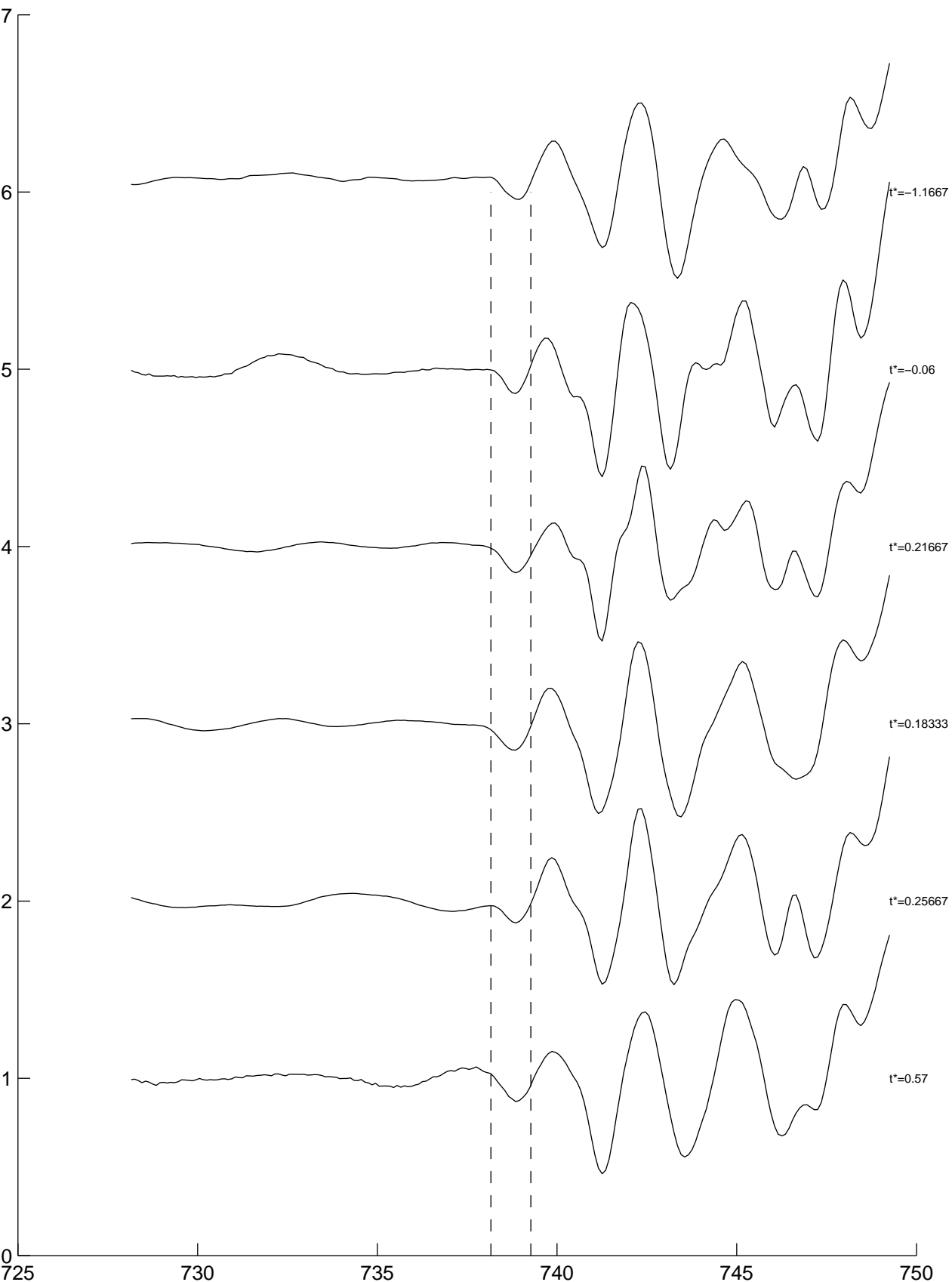
travel time residuals



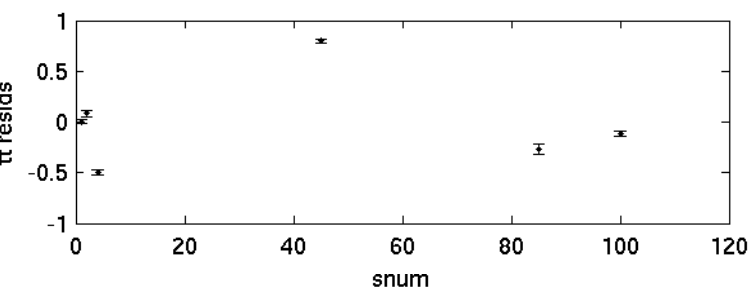
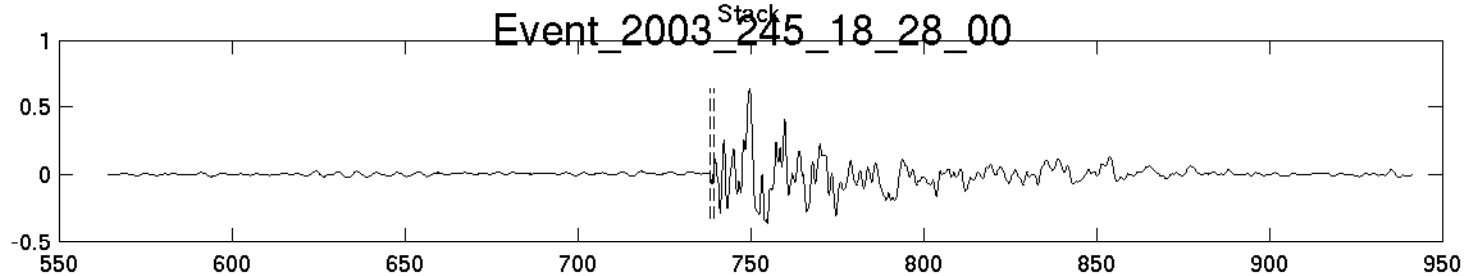
$t^*$  values



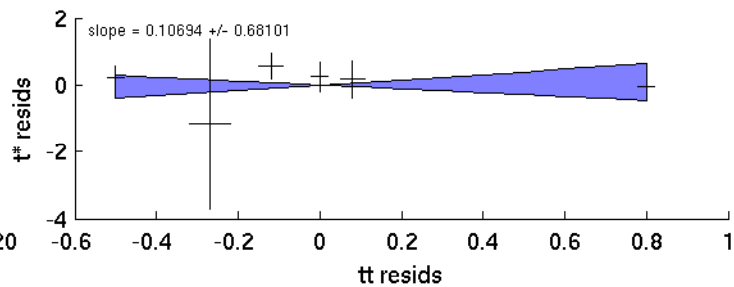
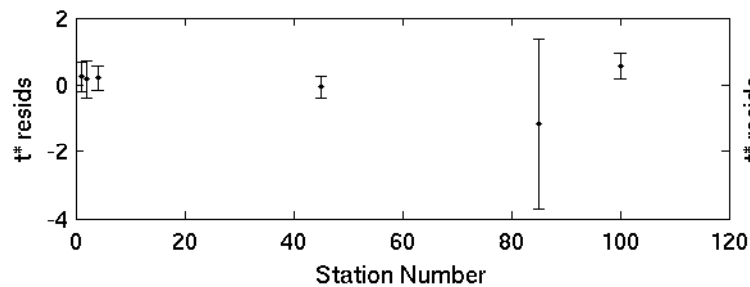
# Event\_2003\_245\_18\_28\_00



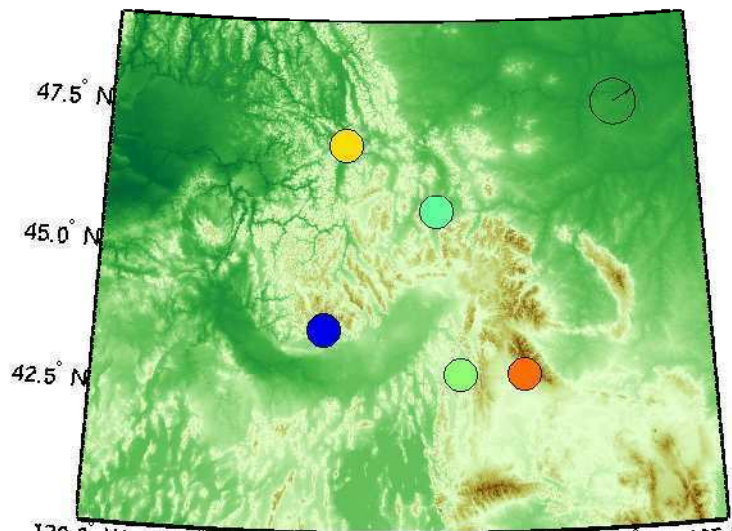
# Event\_2003\_245\_18\_28\_00



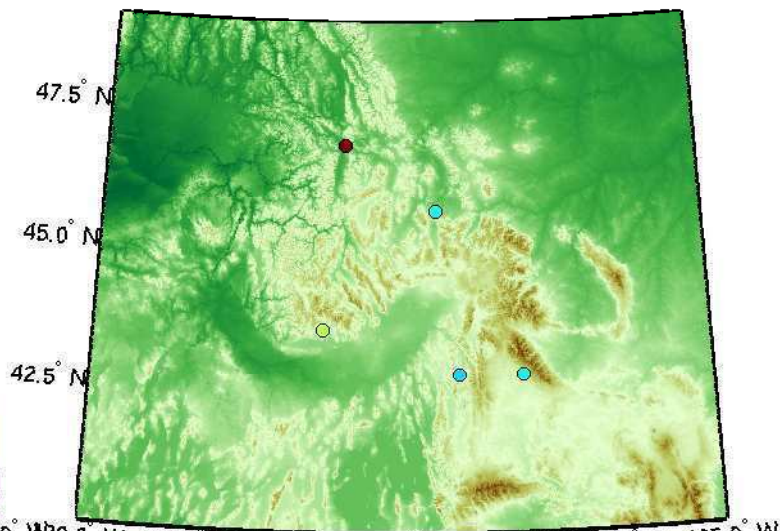
Baz = 239.1363  
 Mean xcor value = 0.86333  
 Range of  $t^*$  values is 1.7367  
 Median  $t^*$  err is 0.41084



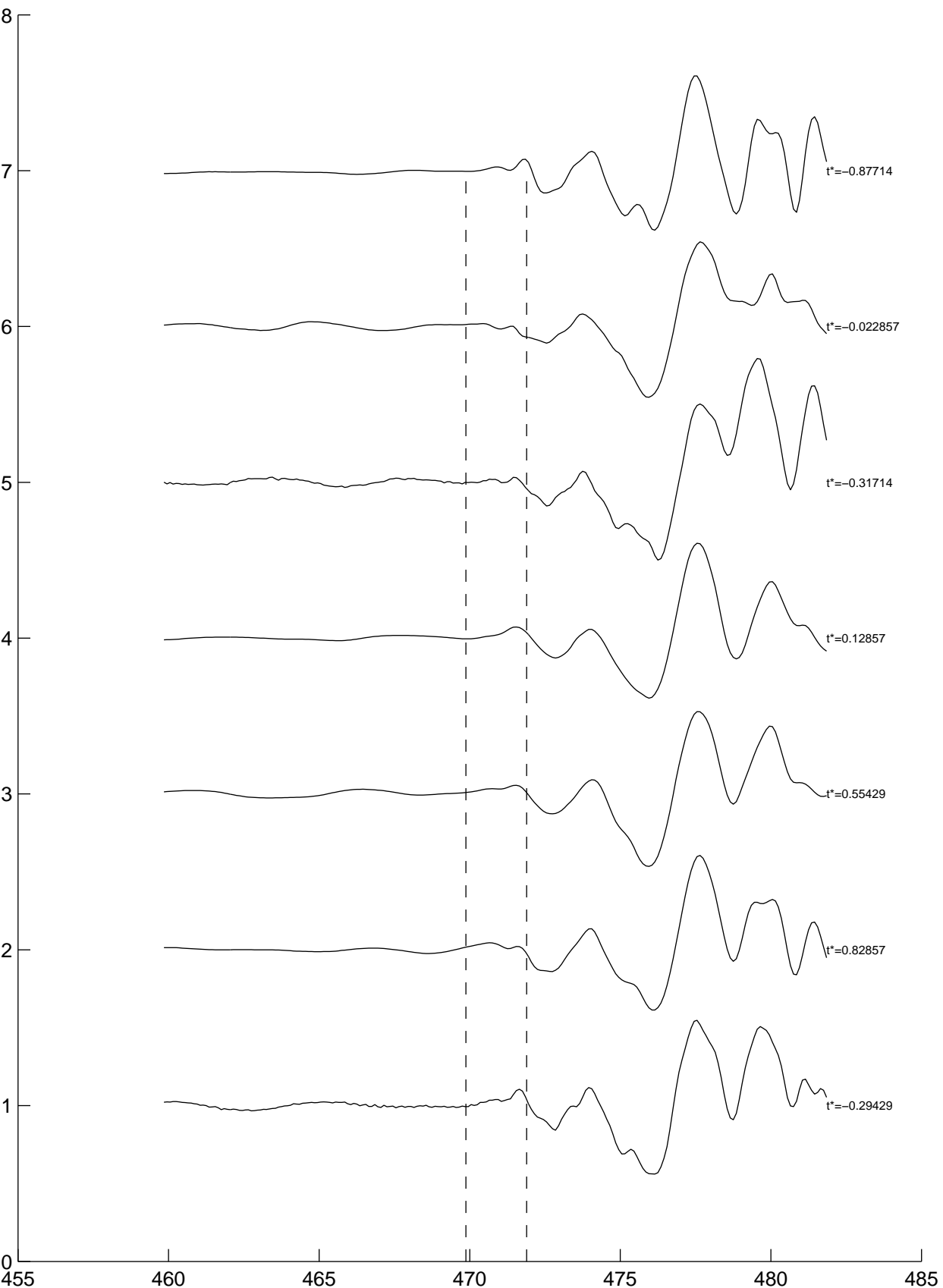
travel time residuals



$t^*$  values

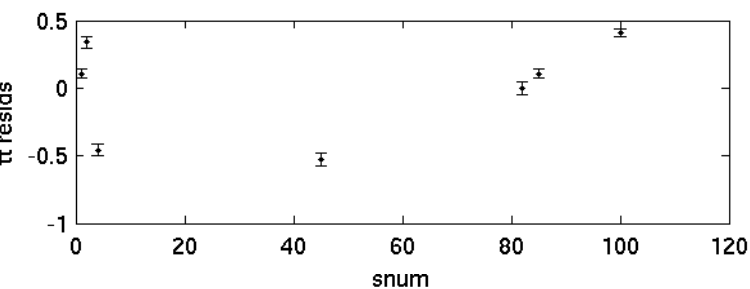
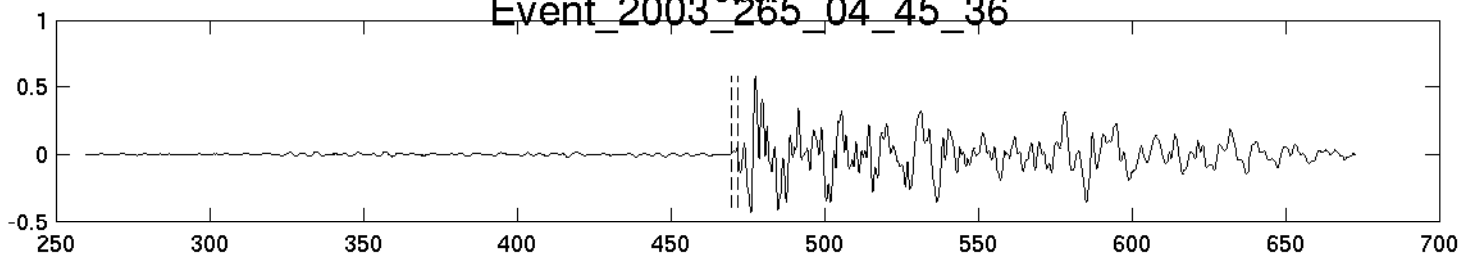


# Event\_2003\_265\_04\_45\_36

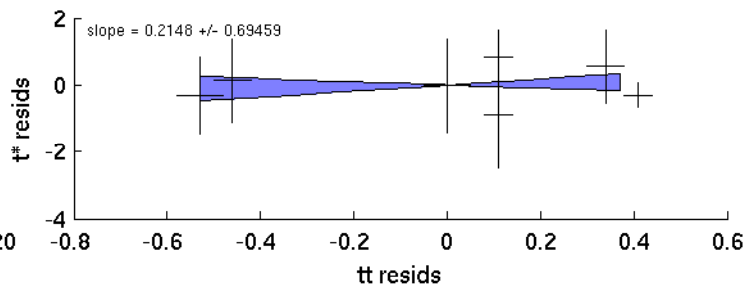
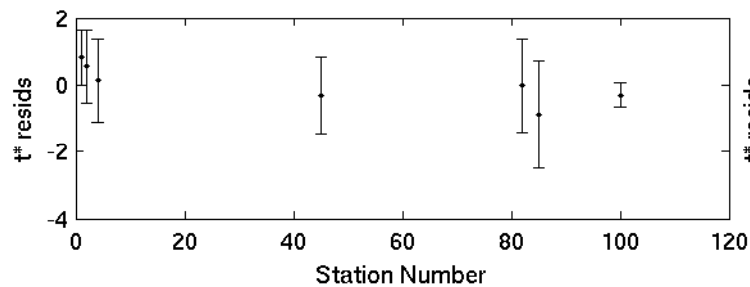


# Event\_2003\_265\_04\_45\_36

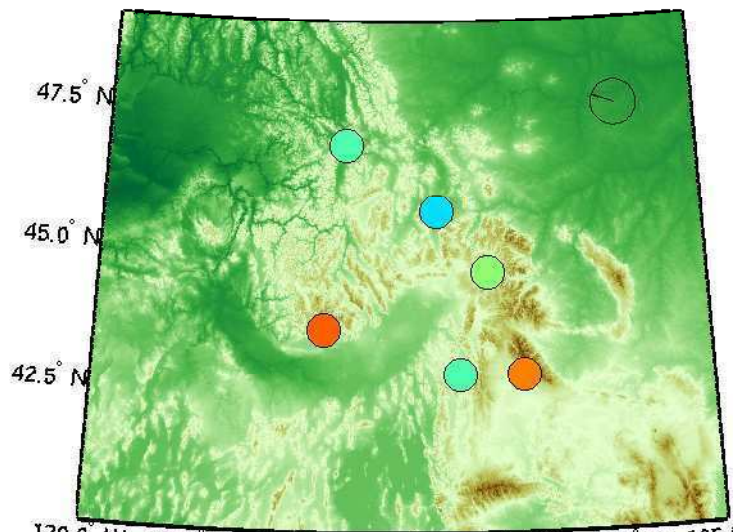
Stack



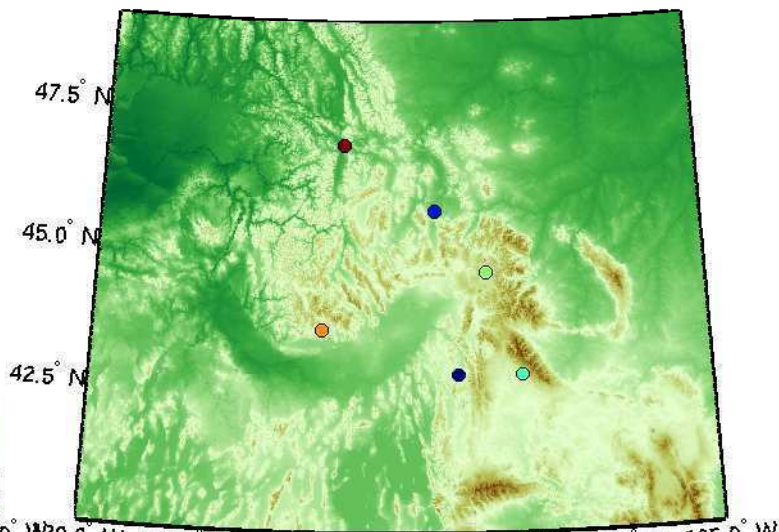
Baz = 112.3026  
Mean xcor value = 0.78143  
Range of  $t^*$  values is 1.7057  
Median  $t^*$  err is 1.1557



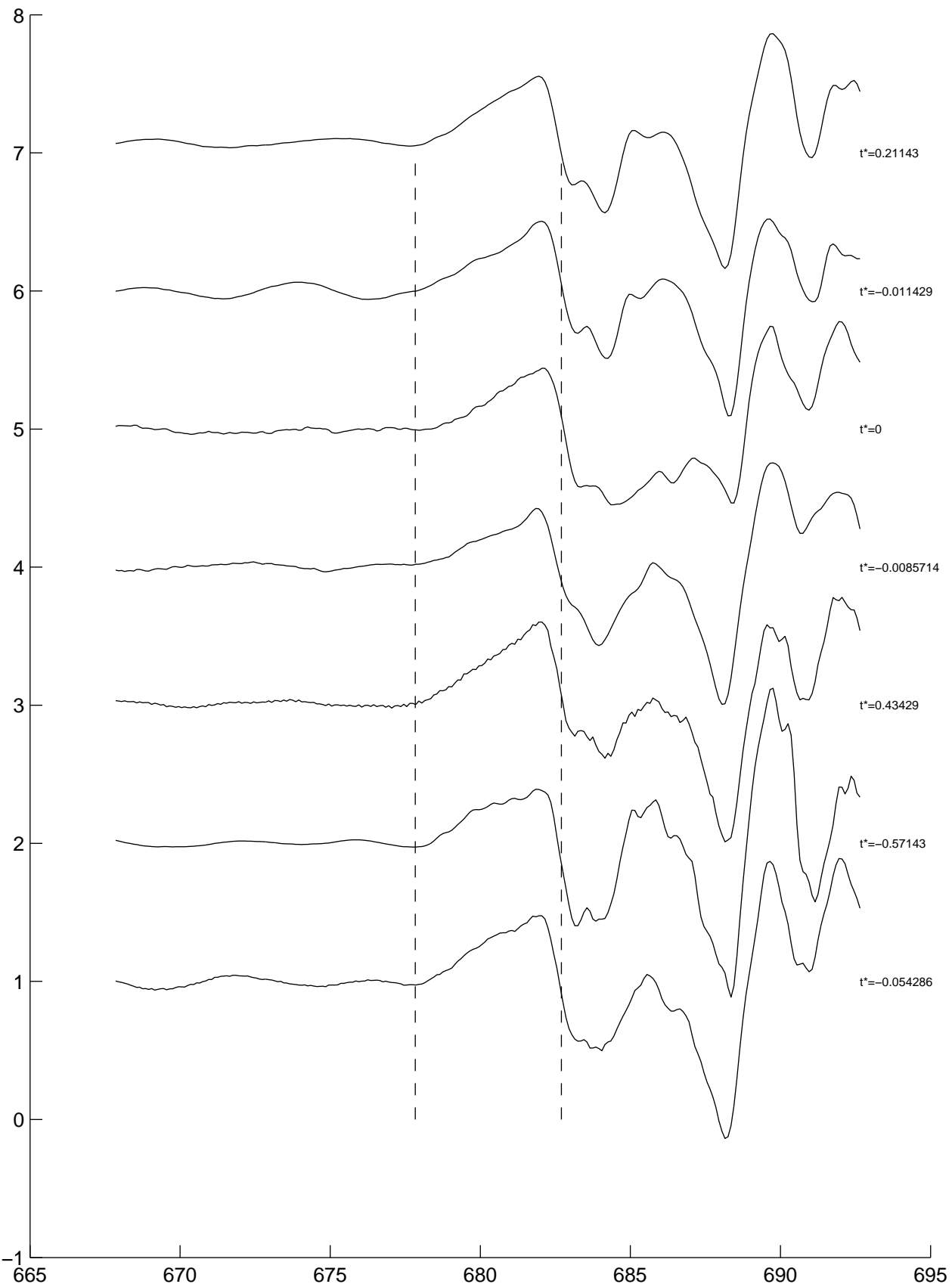
travel time residuals



$t^*$  values



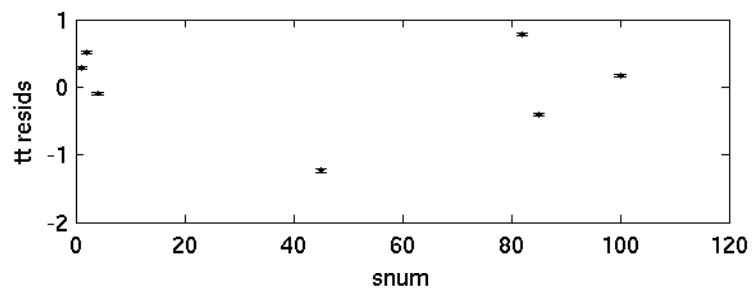
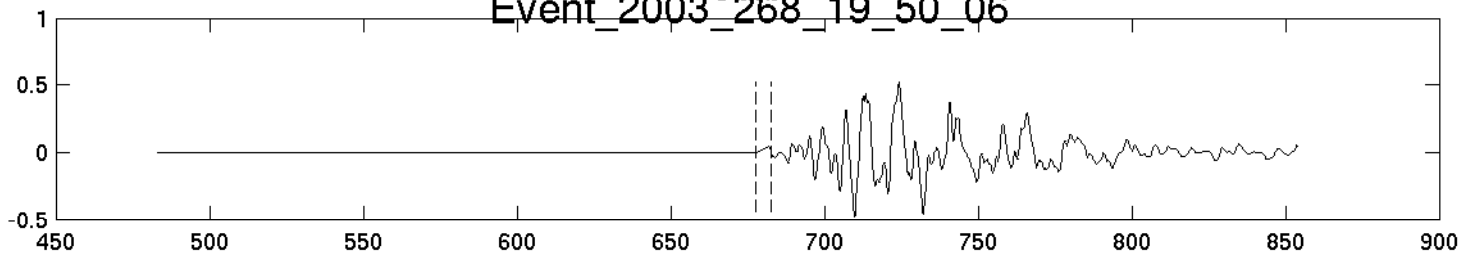
# Event\_2003\_268\_19\_50\_06



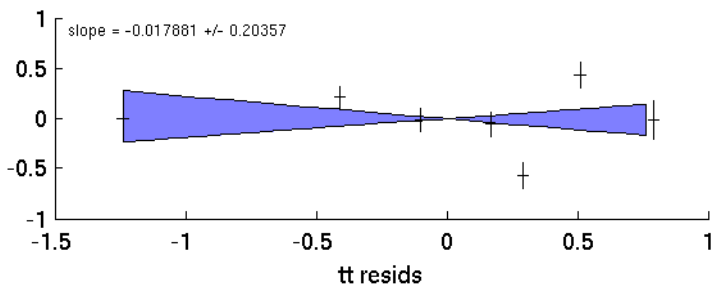
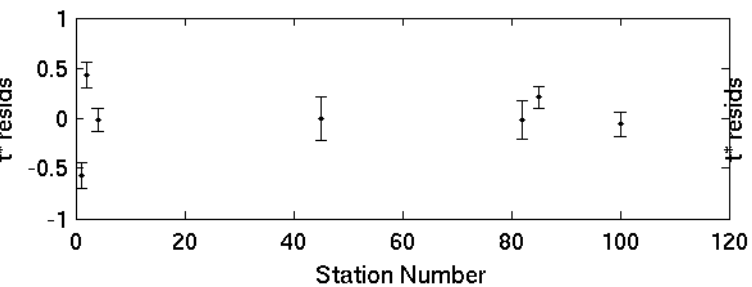


# Event\_2003\_268\_19\_50\_06

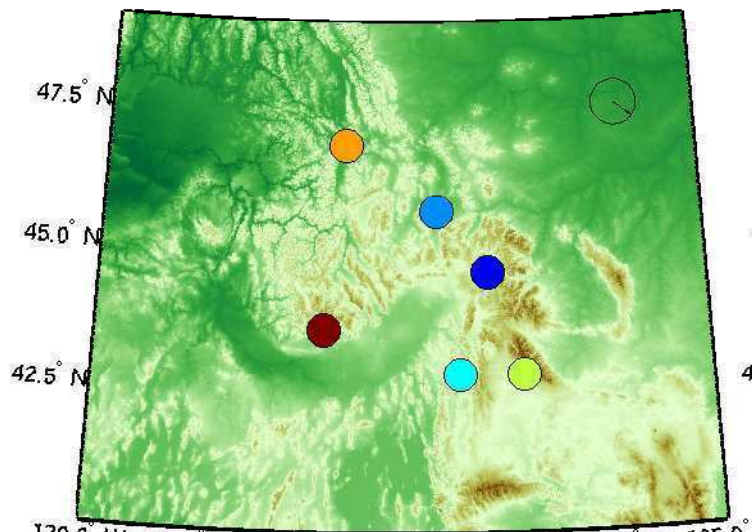
Stack



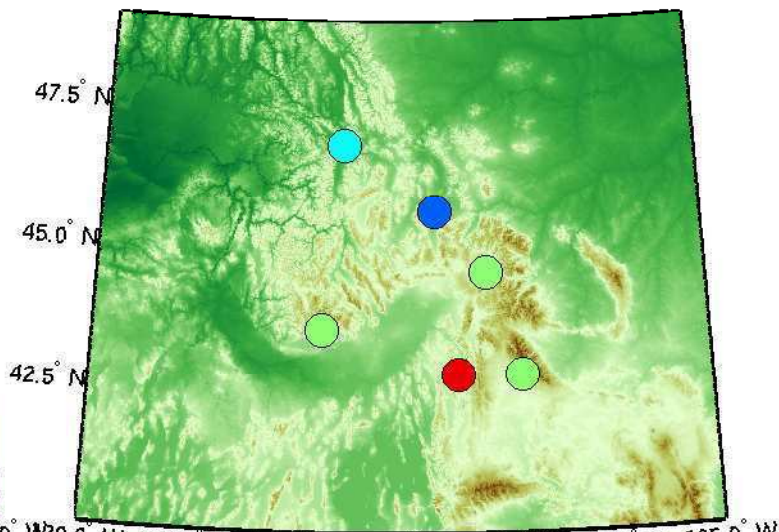
Baz = 310.2306  
Mean xcor value = 0.79429  
Range of  $t^*$  values is 1.0057  
Median  $t^*$  err is 0.12339



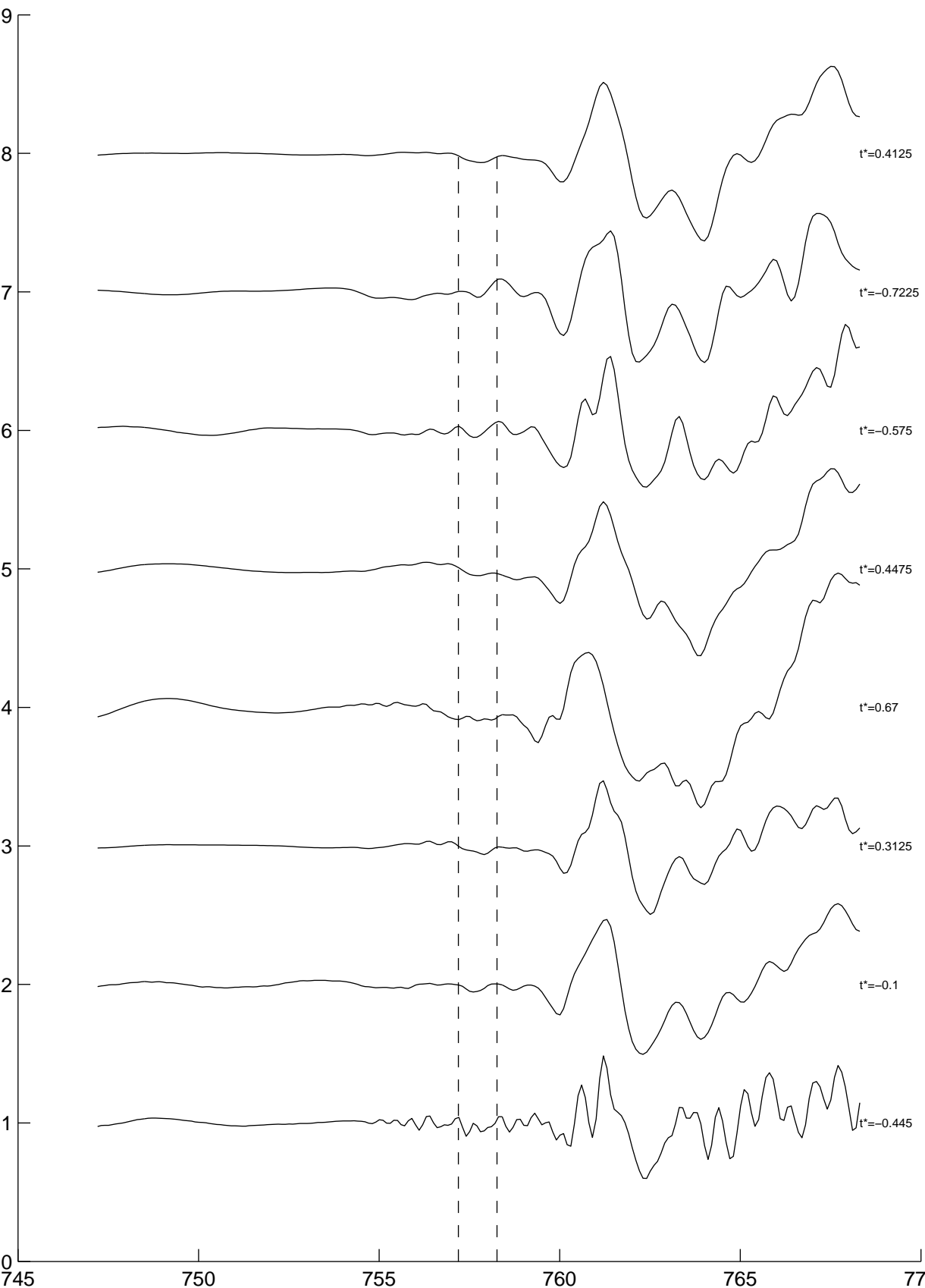
travel time residuals



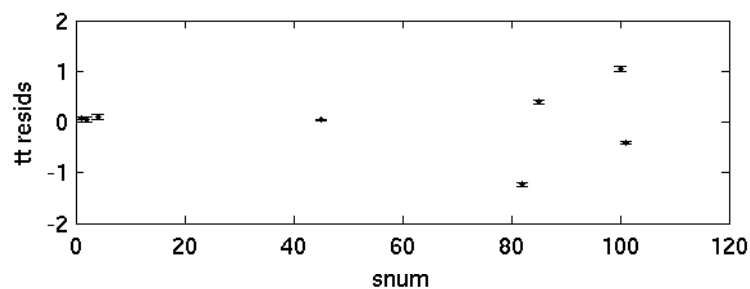
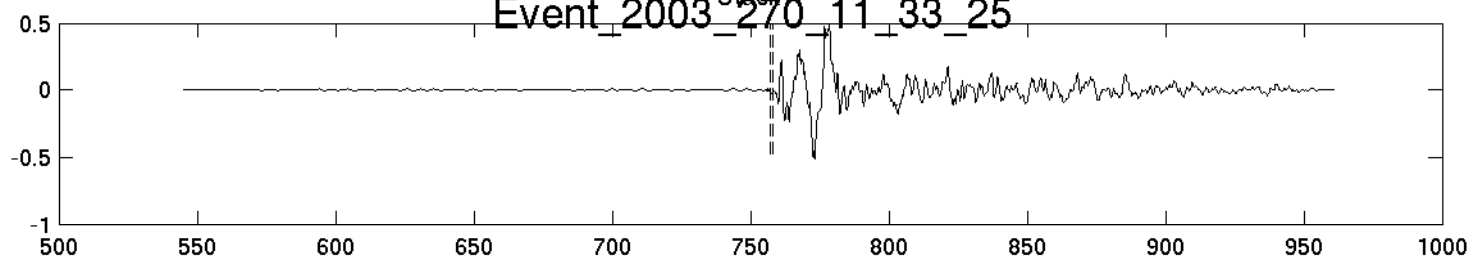
$t^*$  values



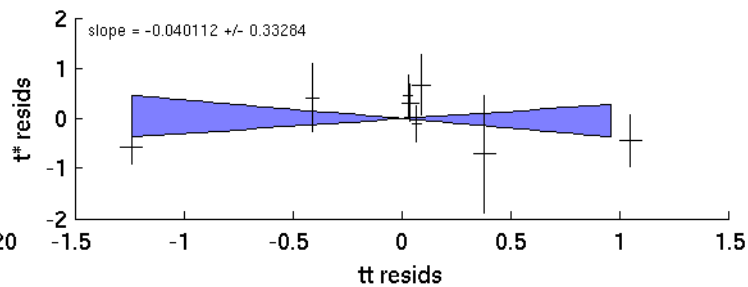
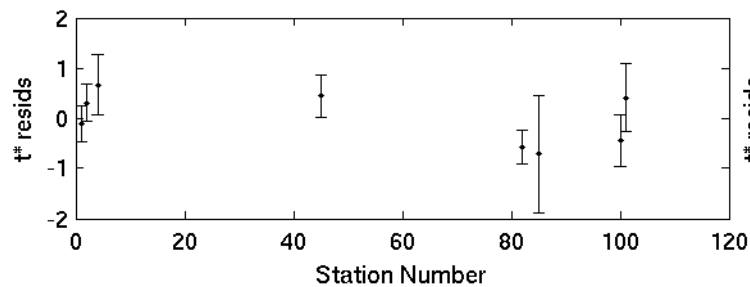
# Event\_2003\_270\_11\_33\_25



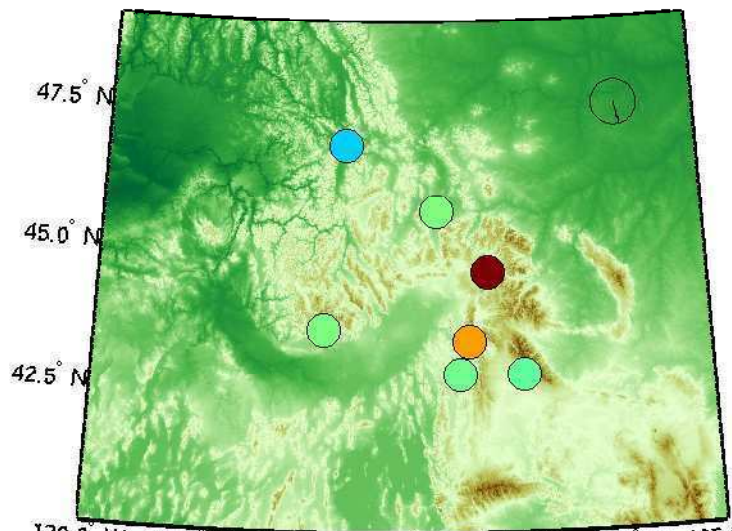
# Event\_2003\_270\_11\_33\_25



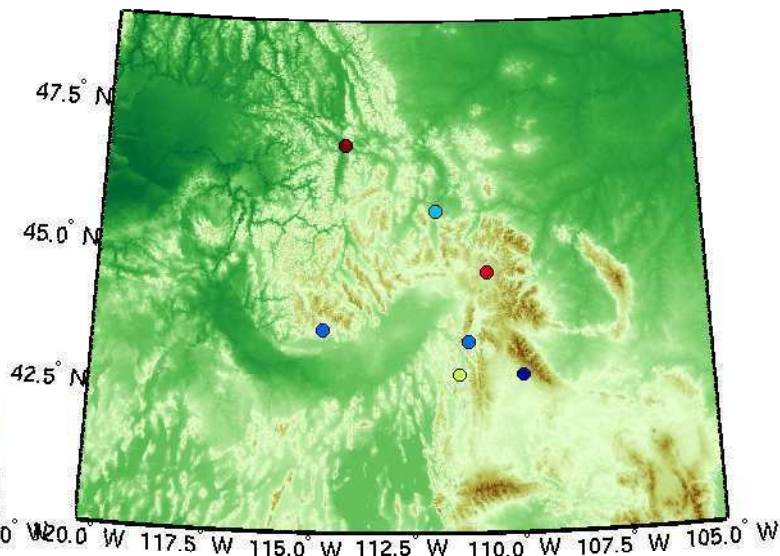
Baz = 347.7161  
Mean xcor value = 0.76  
Range of  $t^*$  values is 1.3925  
Median  $t^*$  err is 0.47604



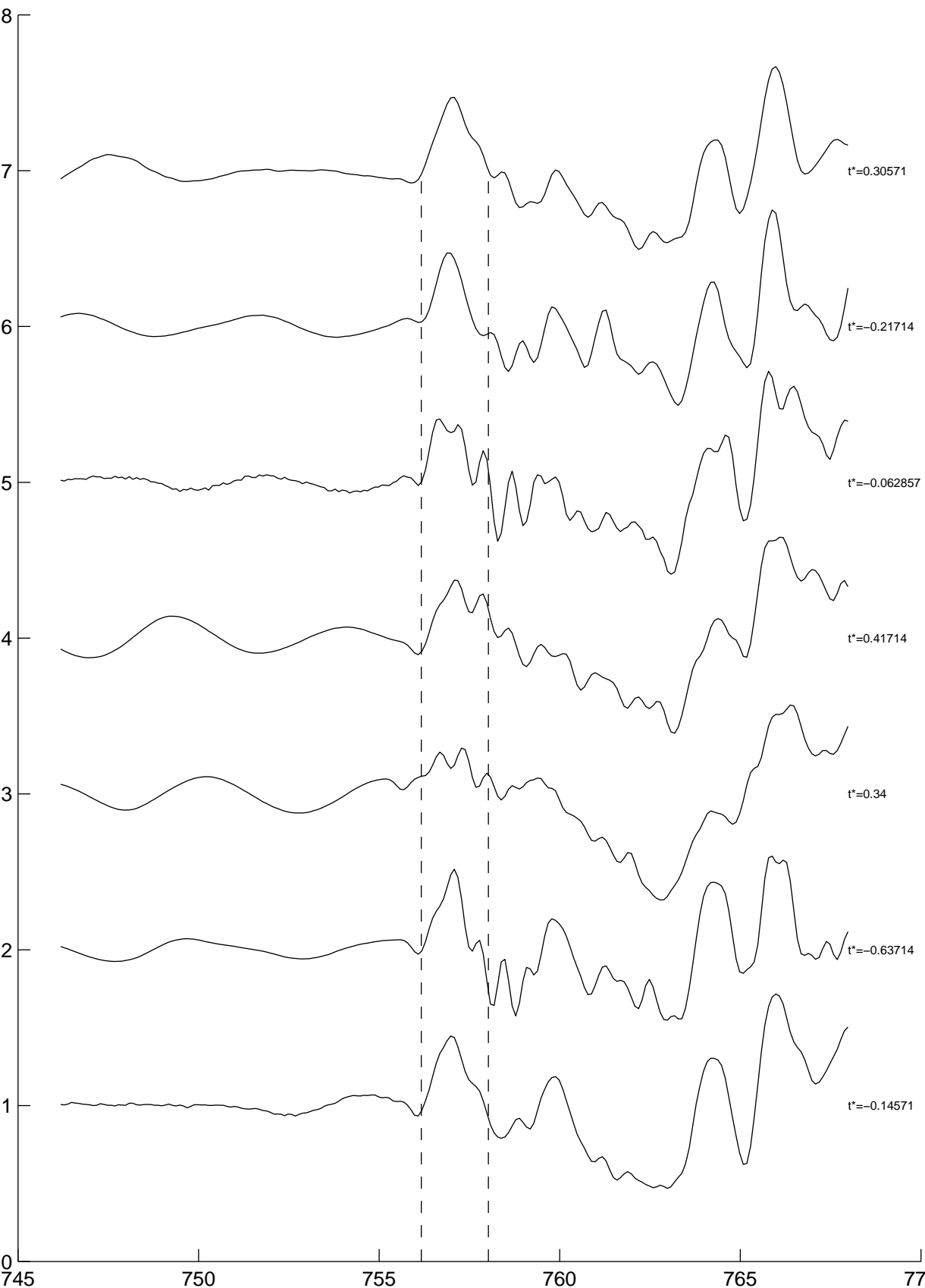
travel time residuals



$t^*$  values

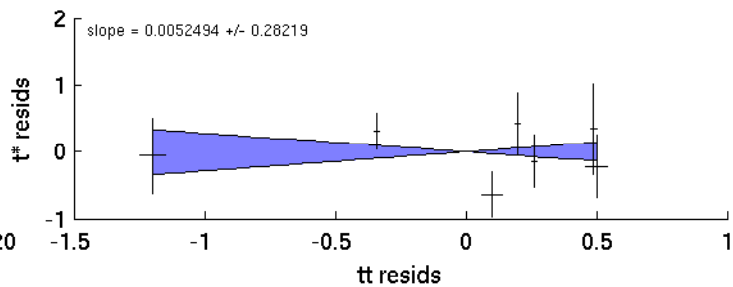
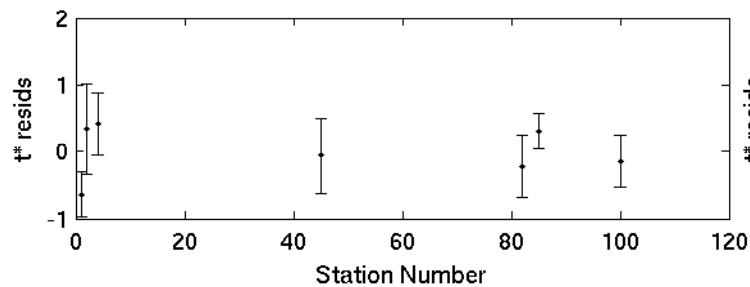
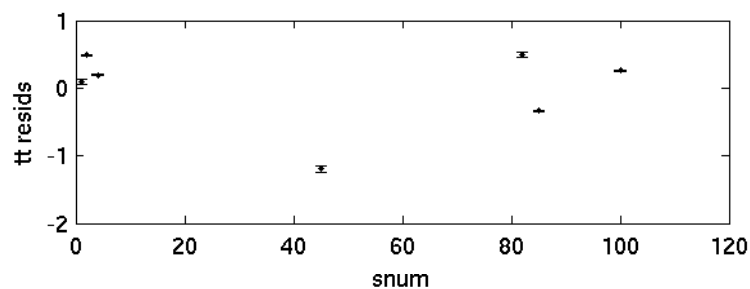
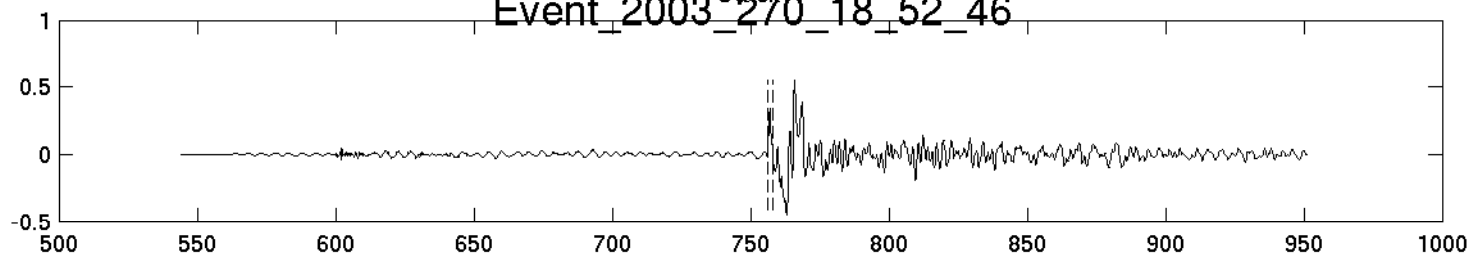


# Event\_2003\_270\_18\_52\_46

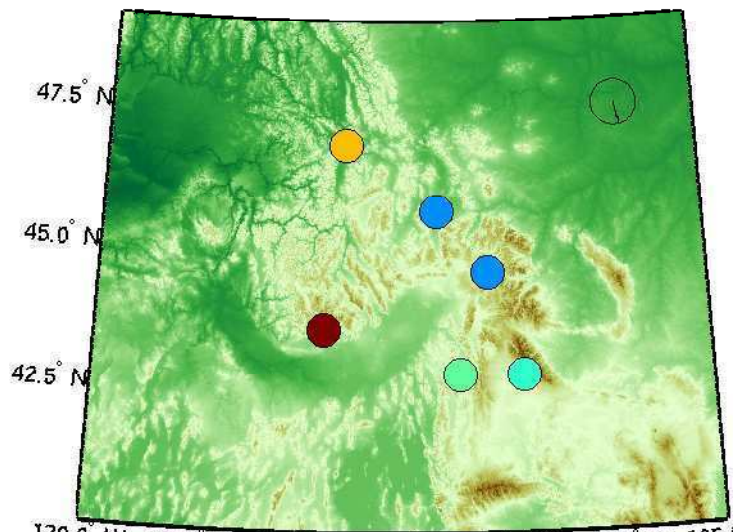


# Event\_2003\_270\_18\_52\_46

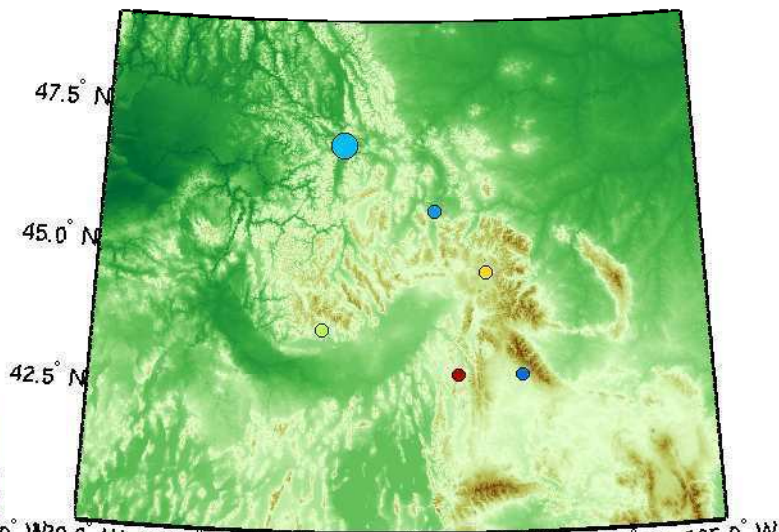
Stack



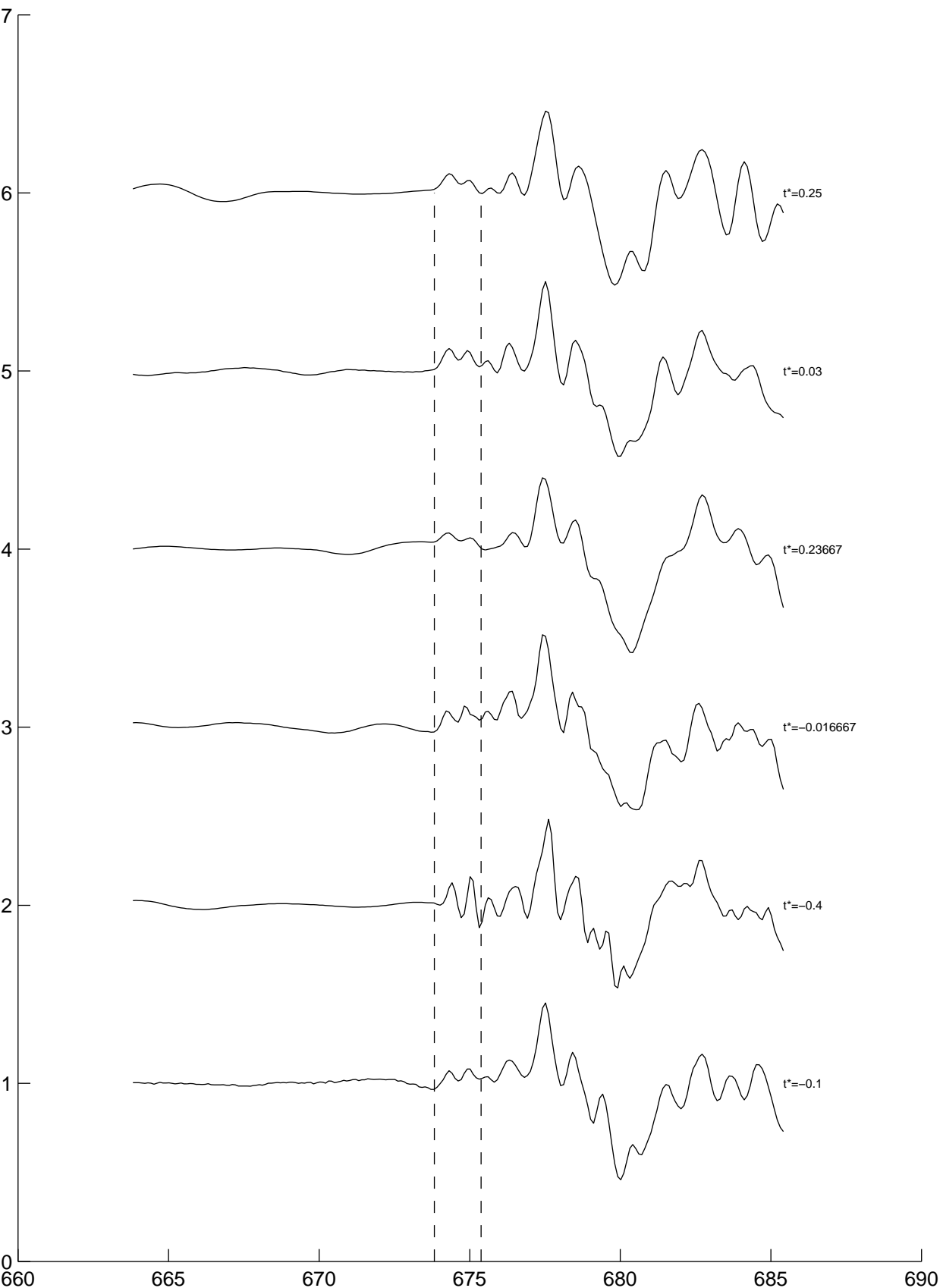
travel time residuals



$t^*$  values

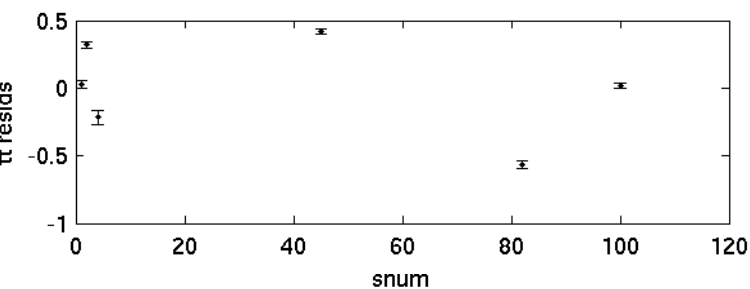
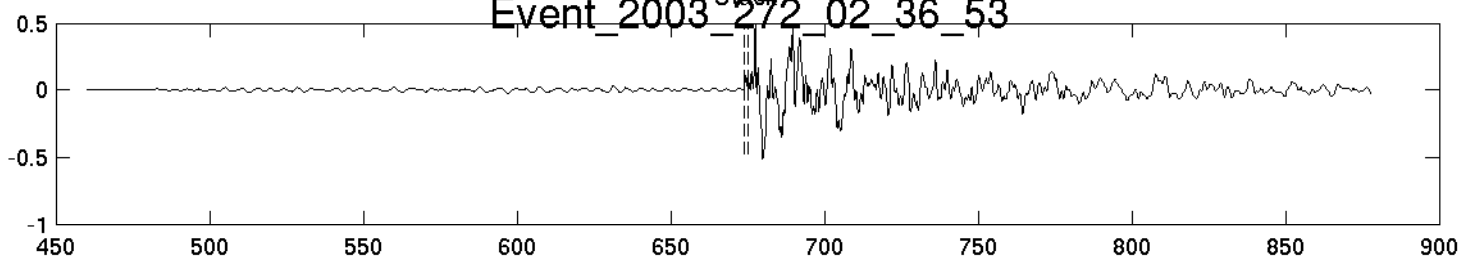


# Event\_2003\_272\_02\_36\_53

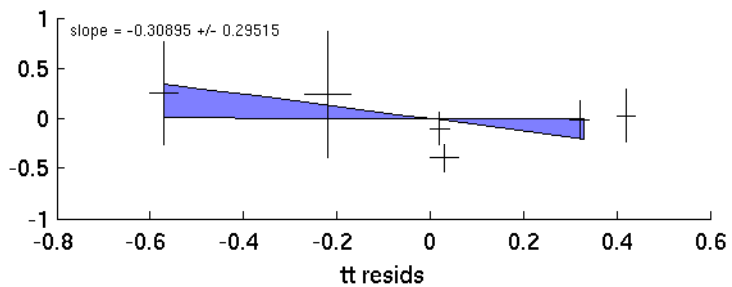
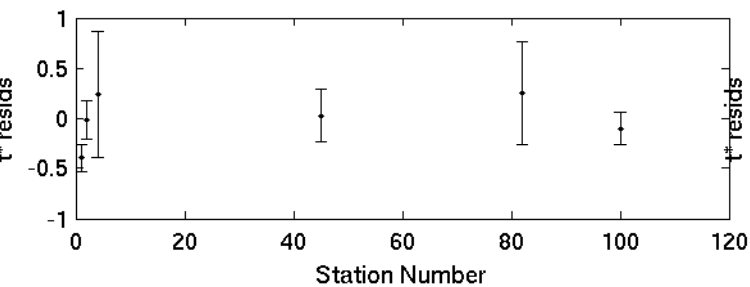




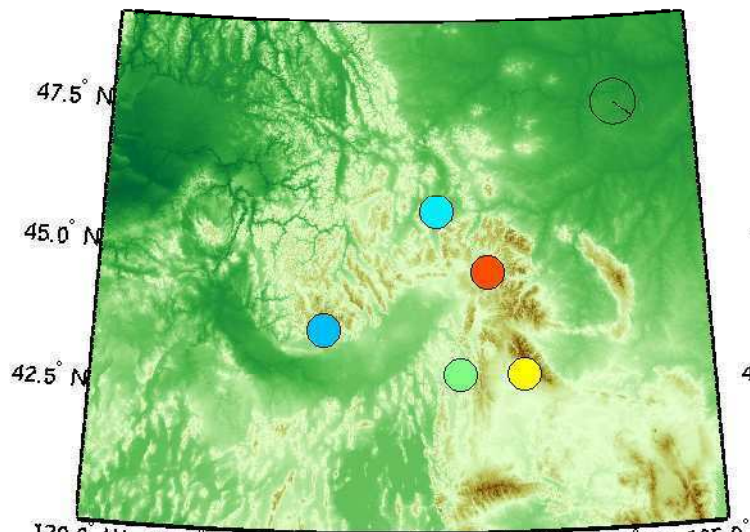
Event\_2003\_272\_02\_36\_53



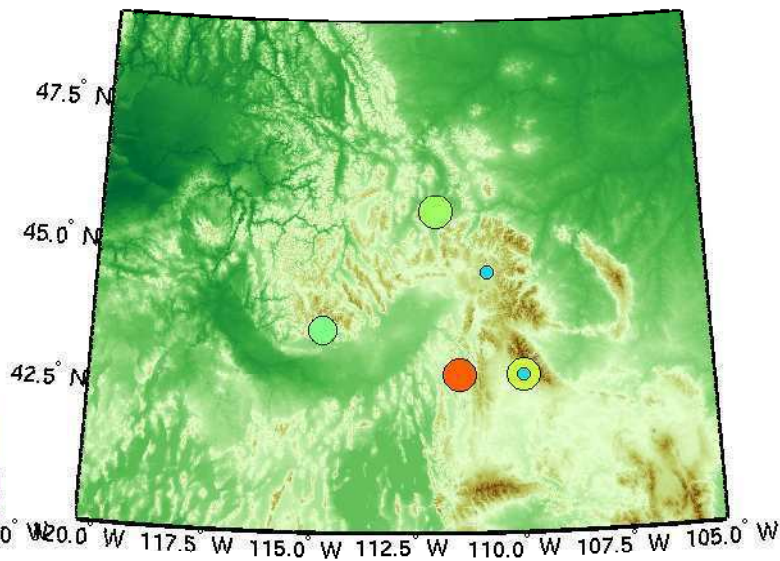
Baz = 310.4786  
Mean xcor value = 0.76167  
Range of  $t^*$  values is 0.65  
Median  $t^*$  err is 0.22344



travel time residuals

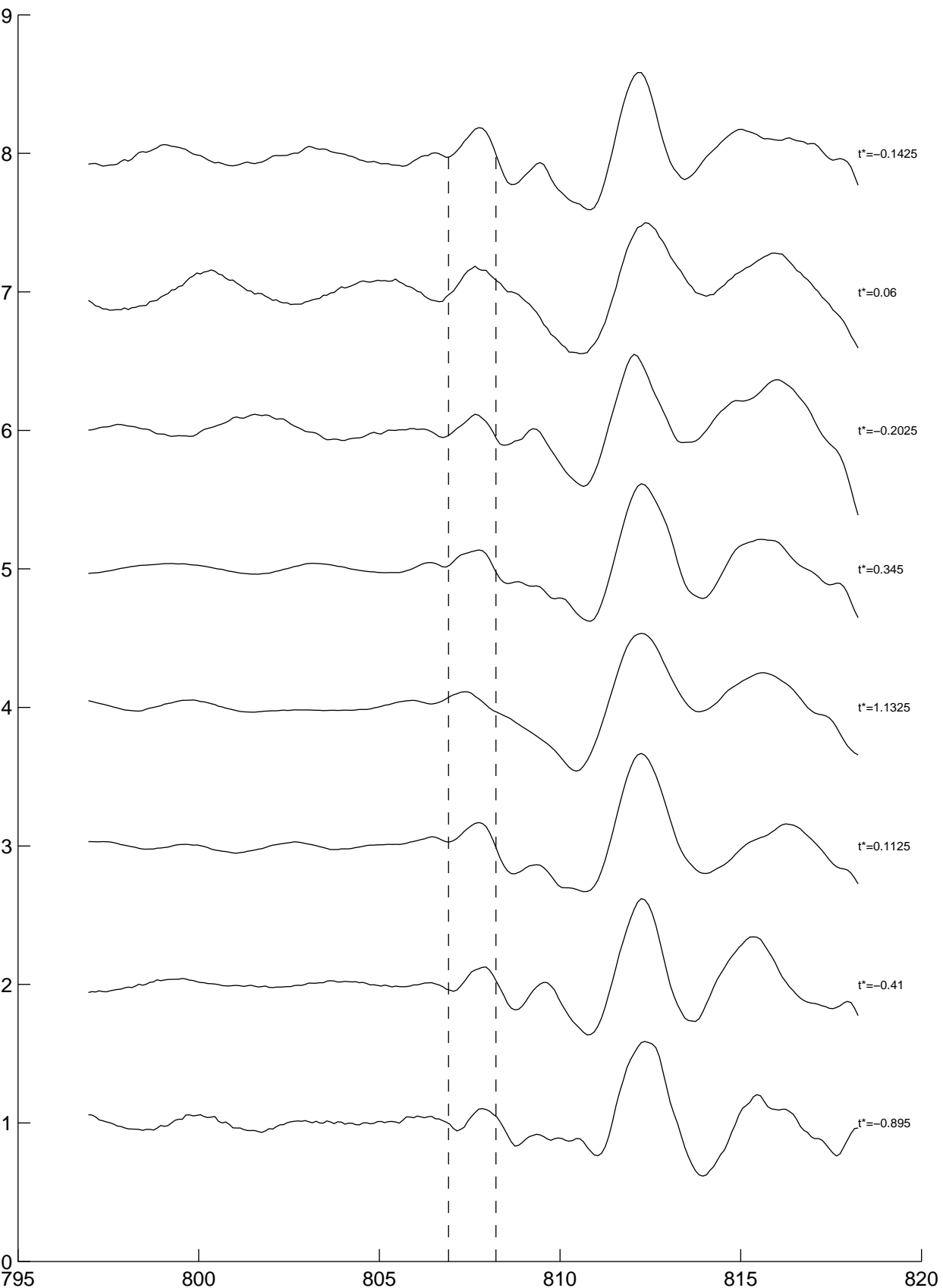


$t^*$  values

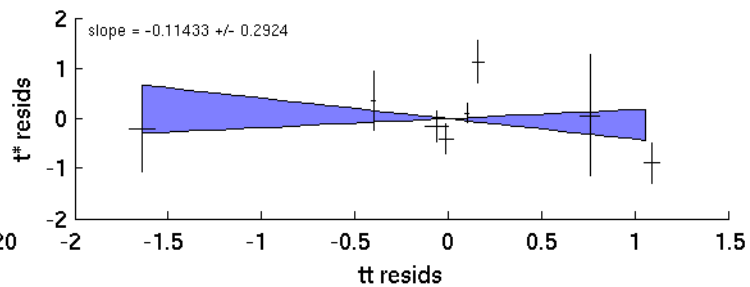
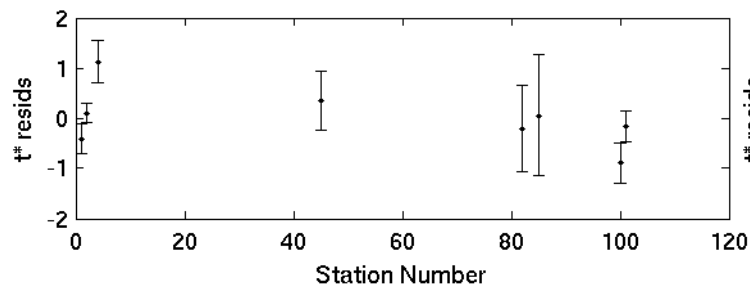
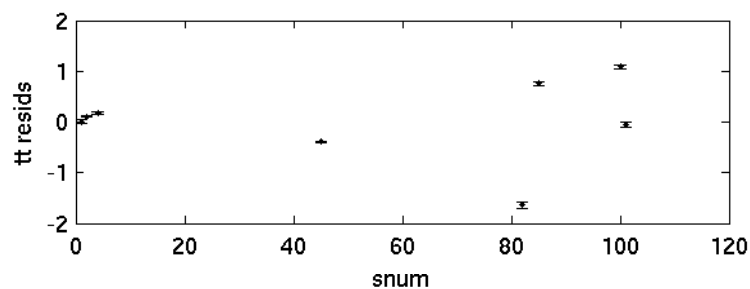
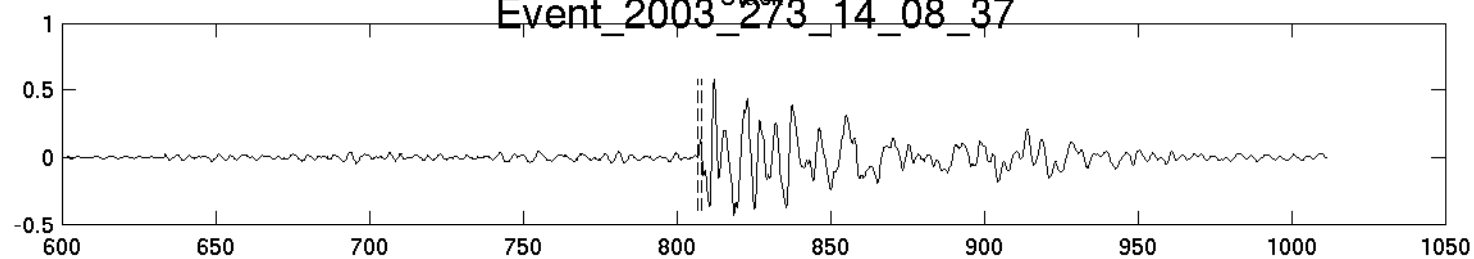




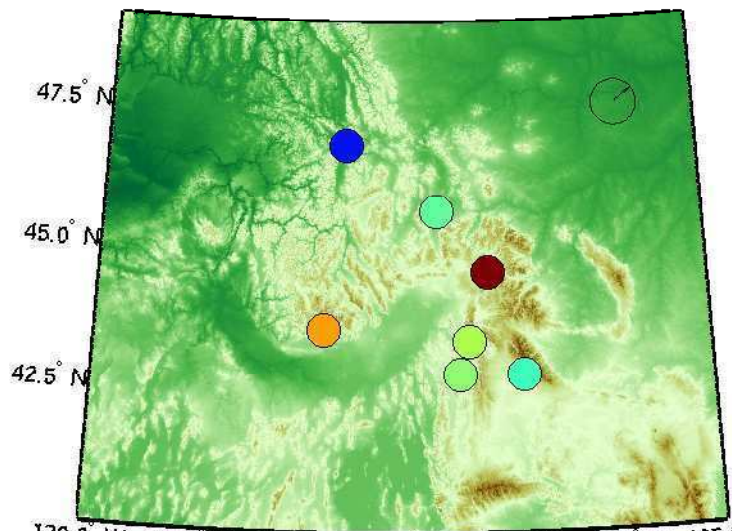
# Event\_2003\_273\_14\_08\_37



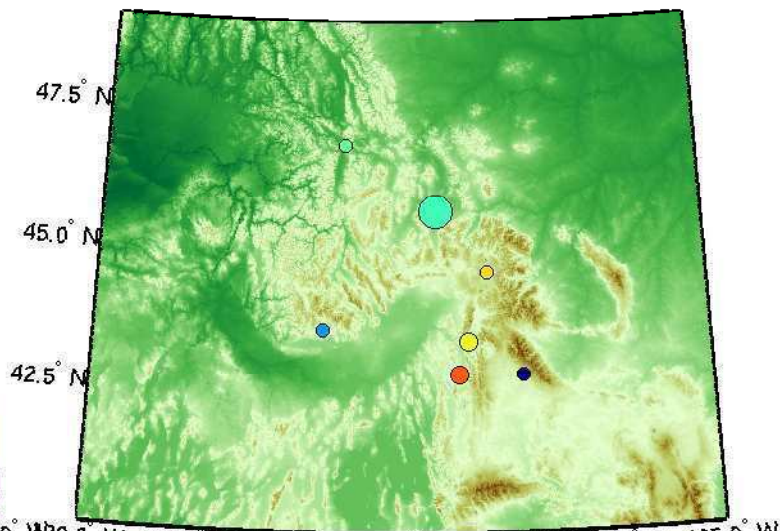
# Event\_2003\_273\_14\_08\_37



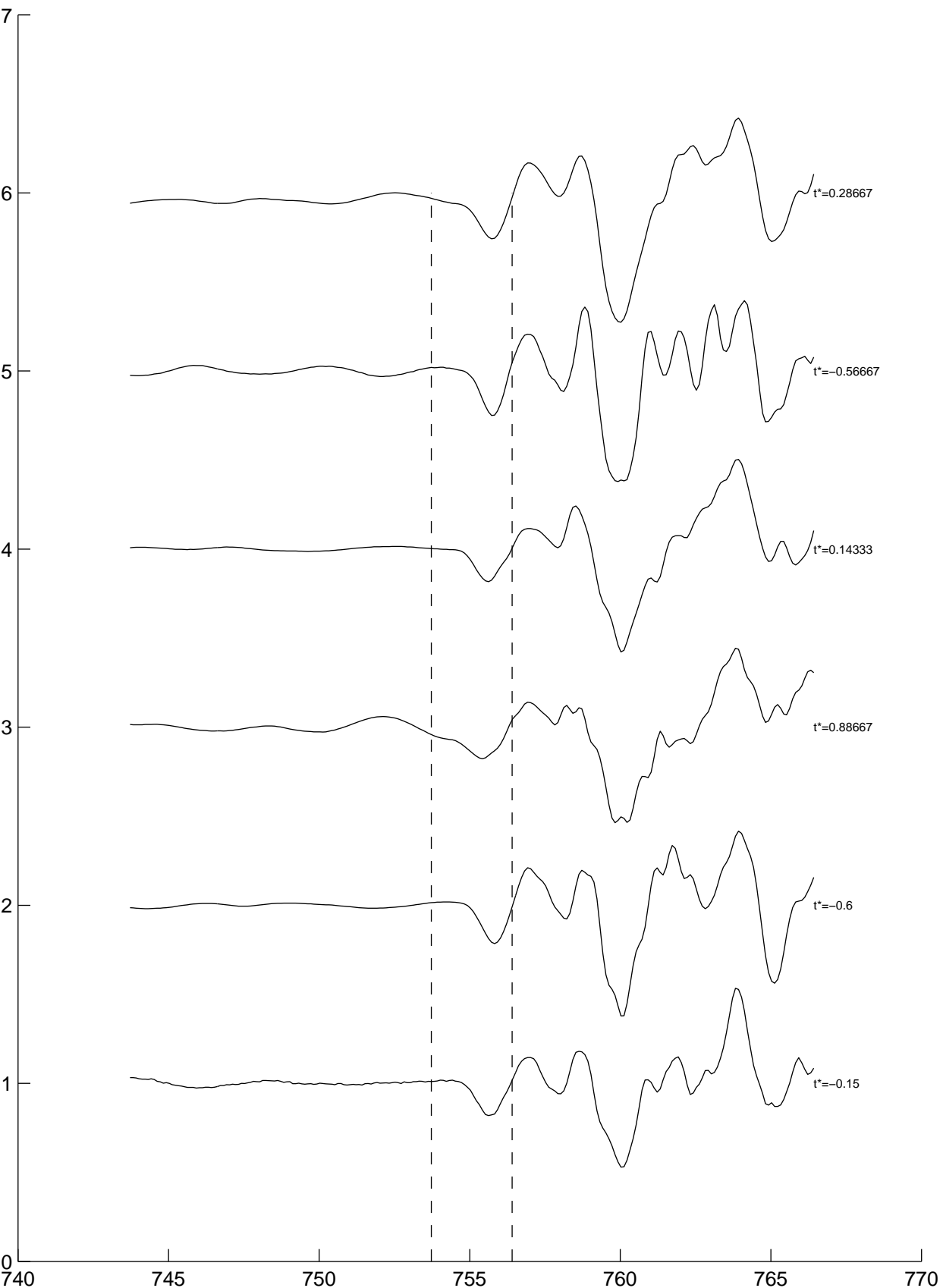
travel time residuals



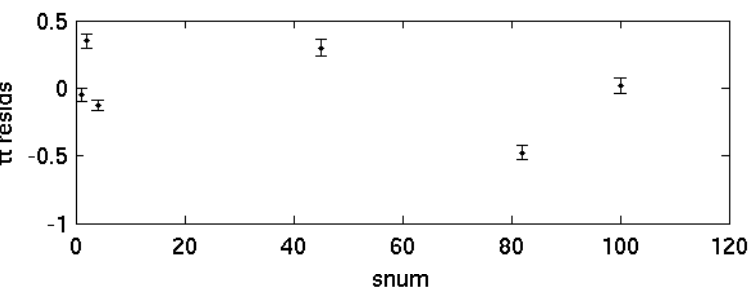
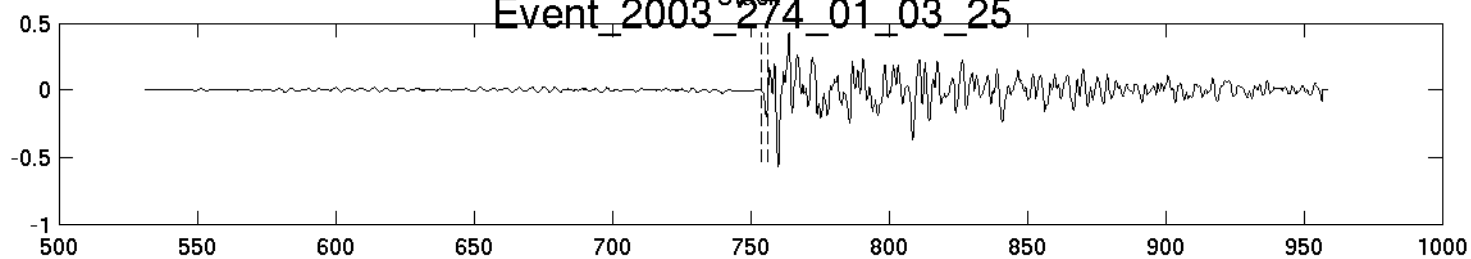
t\* values



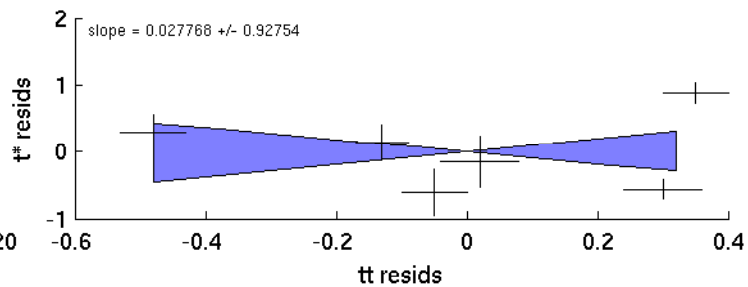
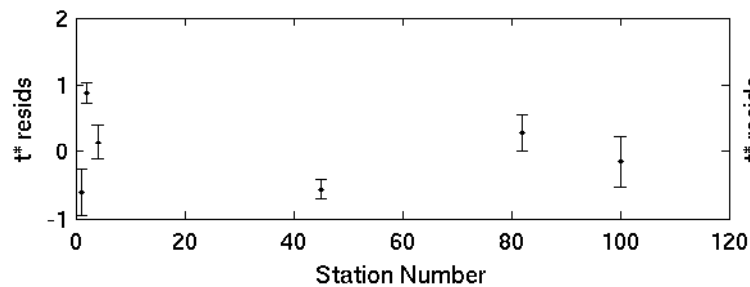
# Event\_2003\_274\_01\_03\_25



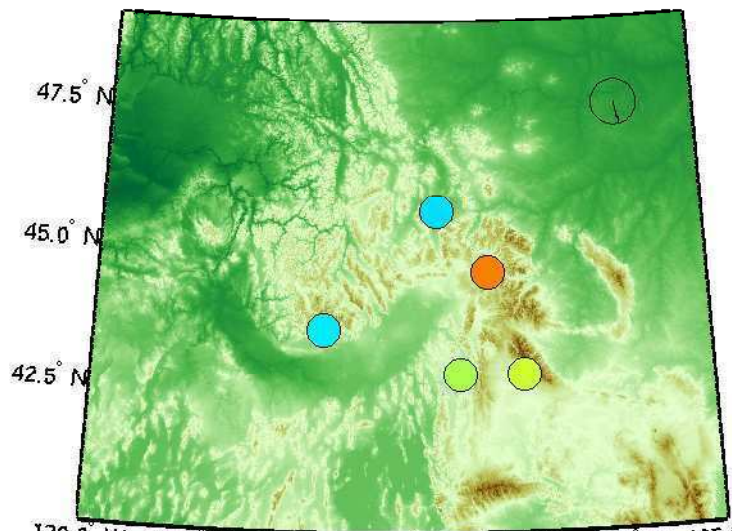
# Event\_2003\_274\_01\_03\_25



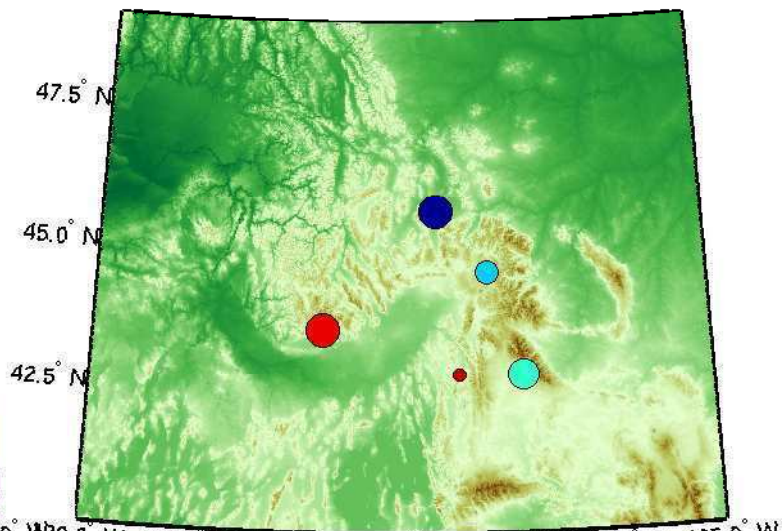
Baz = 347.815  
Mean xcor value = 0.745  
Range of  $t^*$  values is 1.4867  
Median  $t^*$  err is 0.26545



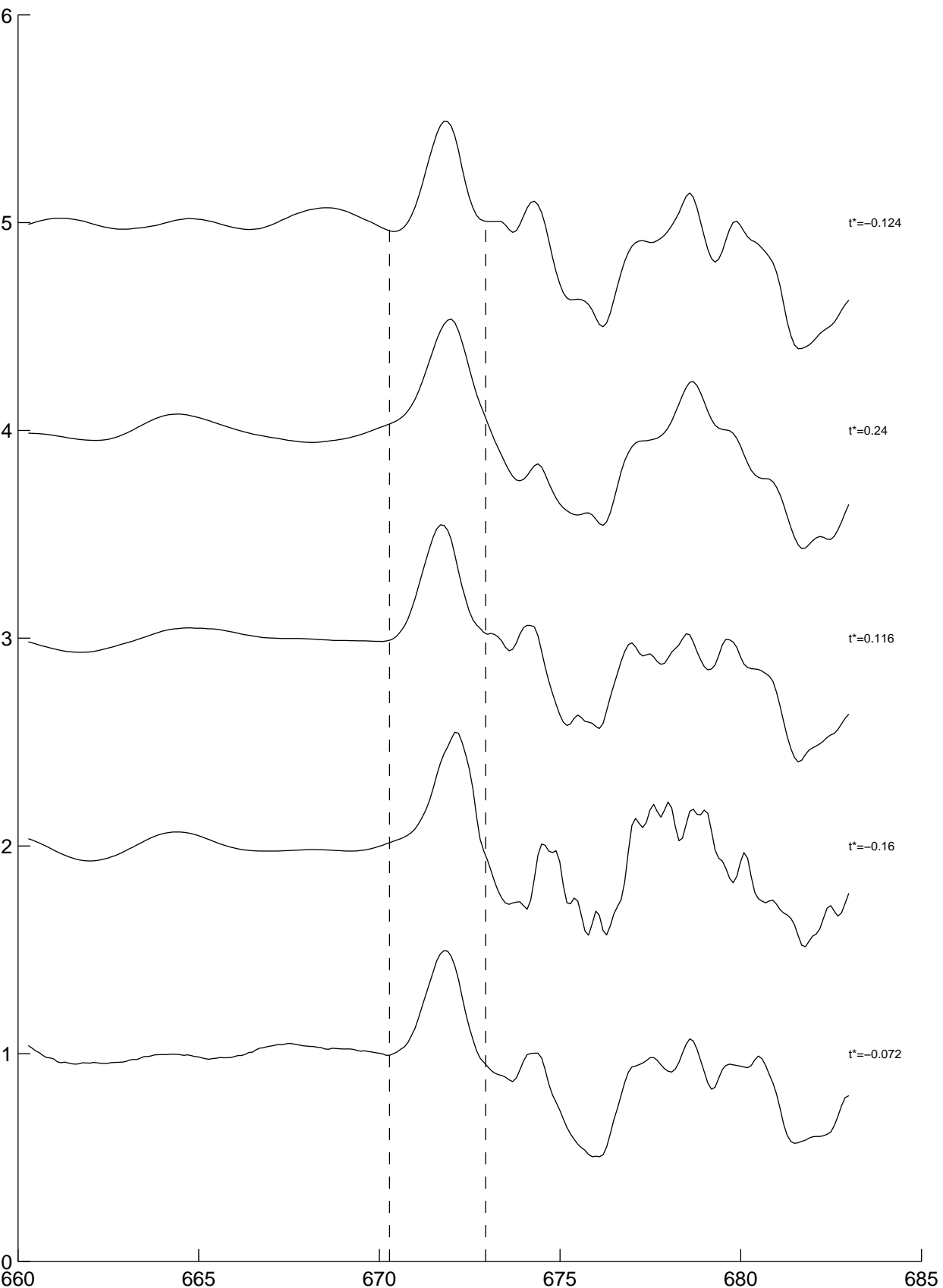
travel time residuals



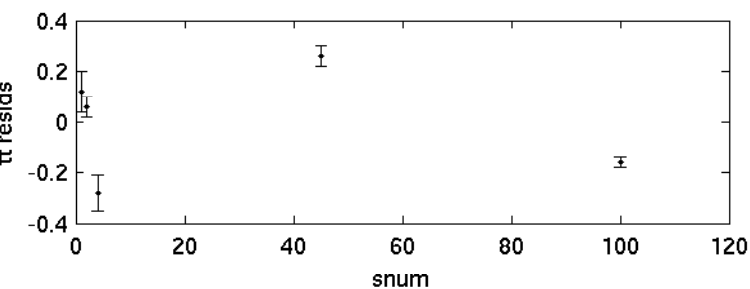
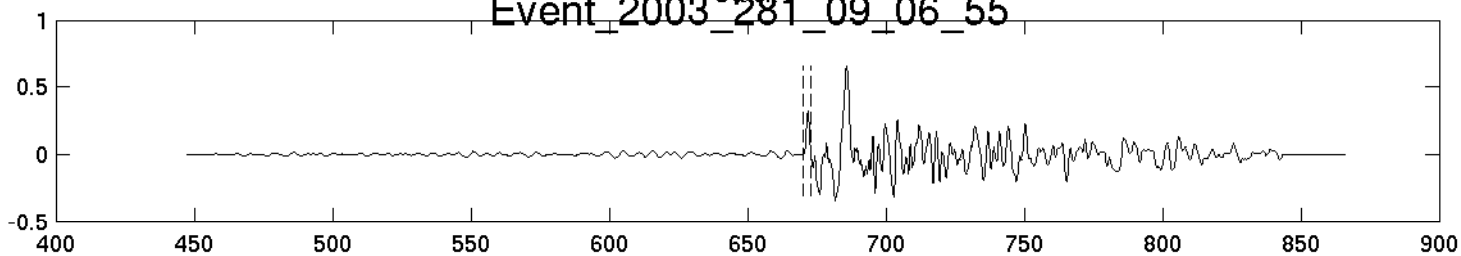
$t^*$  values



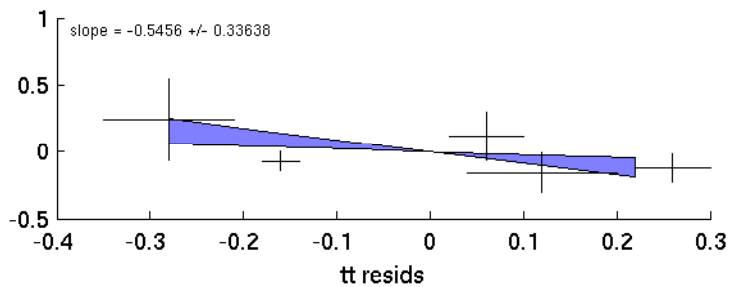
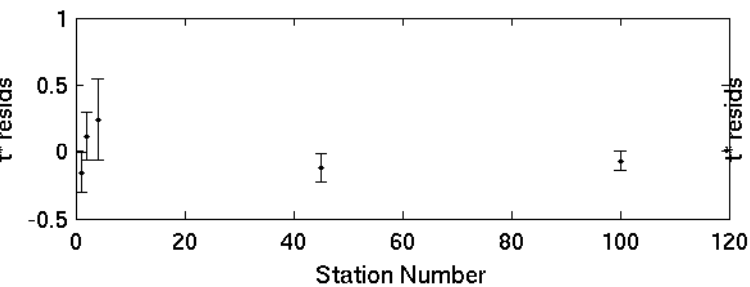
# Event\_2003\_281\_09\_06\_55



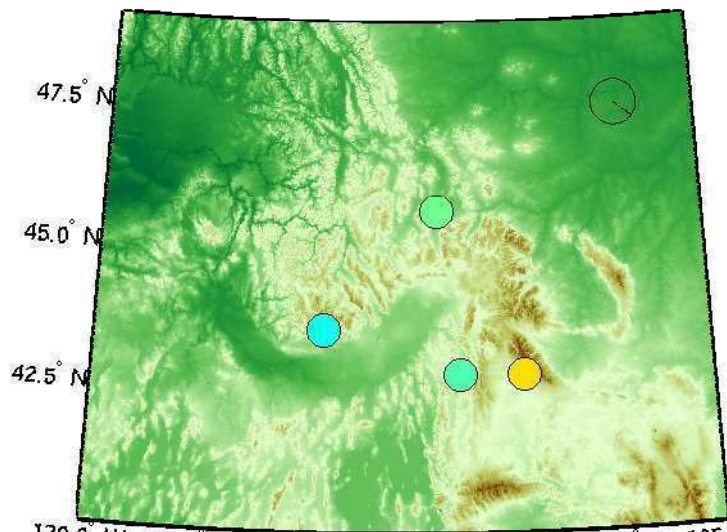
# Event\_2003\_281\_09\_06\_55



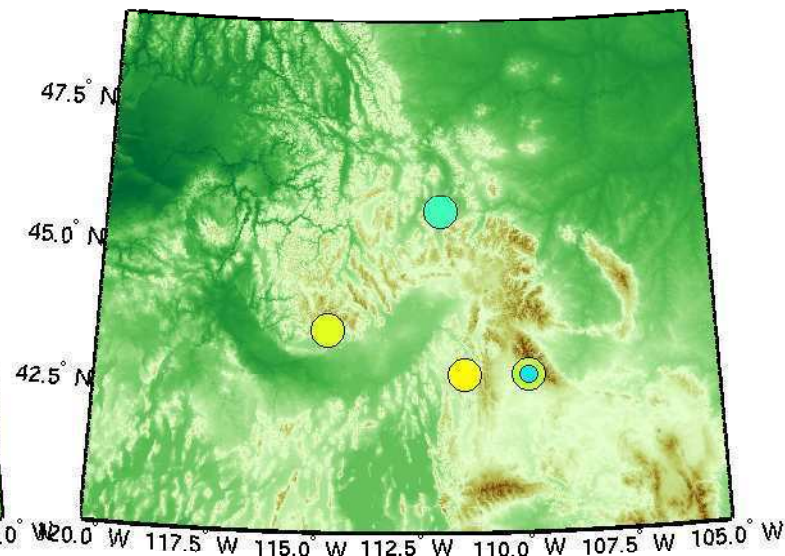
Baz = 310.3807  
 Mean xcor value = 0.84  
 Range of  $t^*$  values is 0.4  
 Median  $t^*$  err is 0.1487



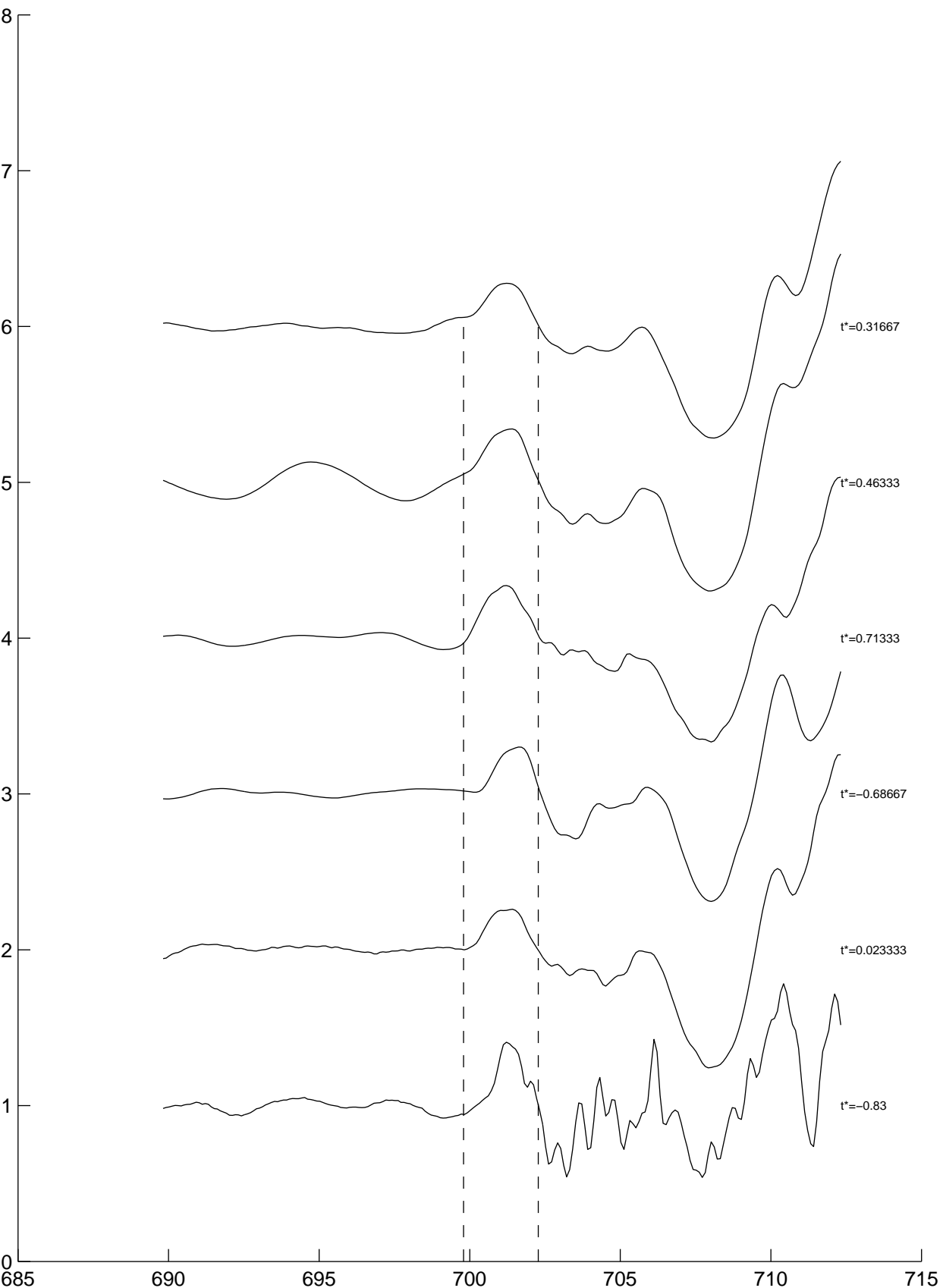
travel time residuals



$t^*$  values



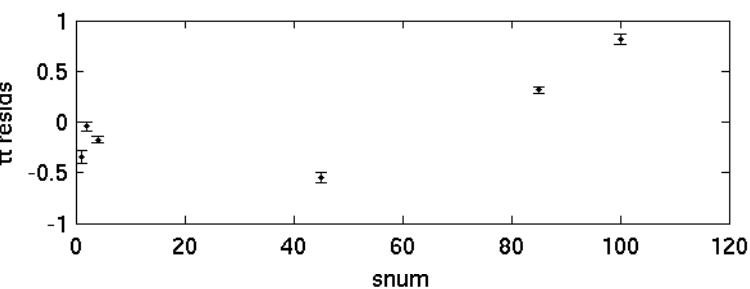
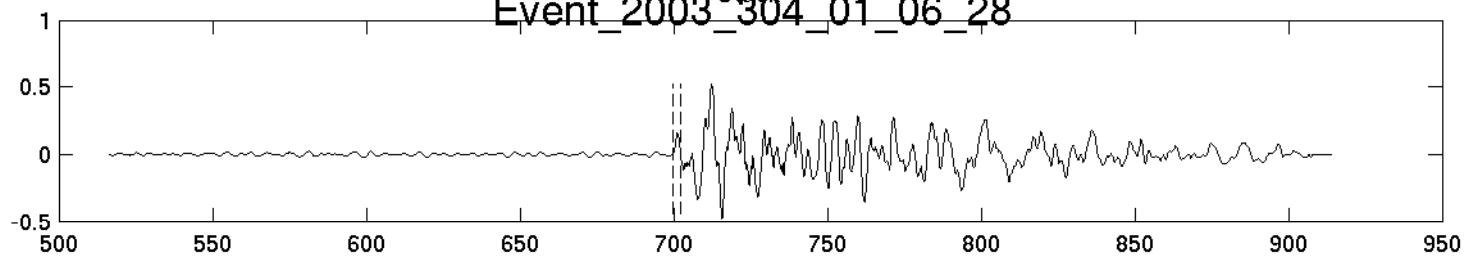
# Event\_2003\_304\_01\_06\_28



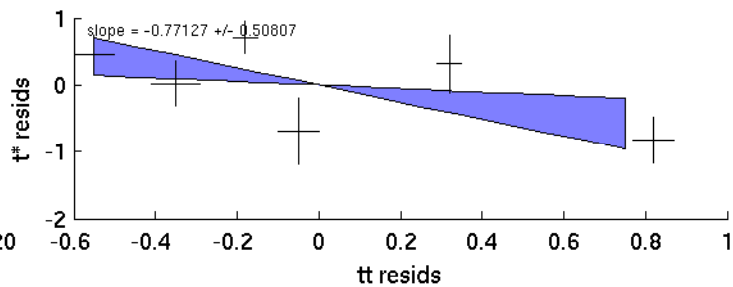
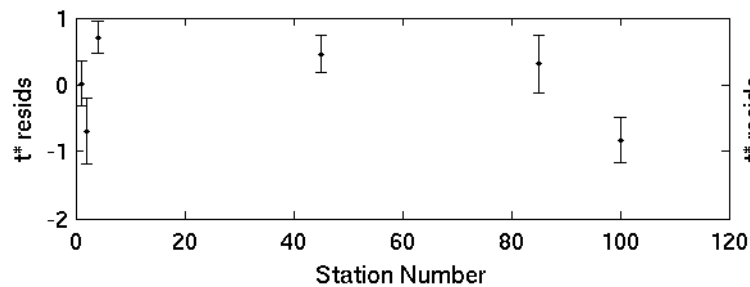


# Event\_2003\_304\_01\_06\_28

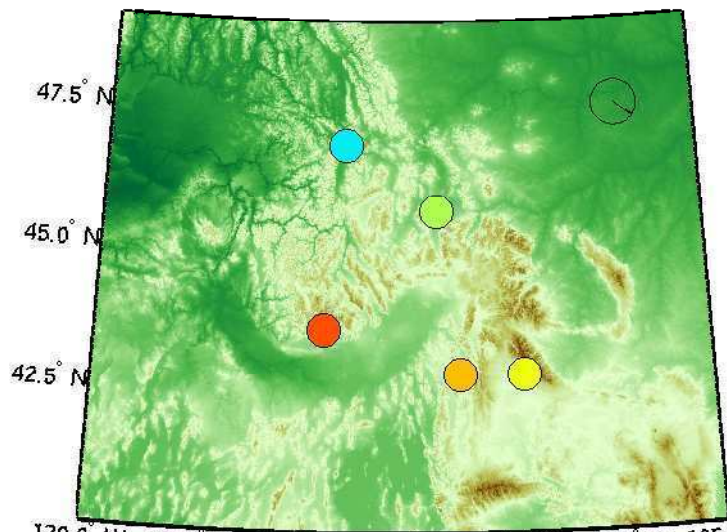
Stack



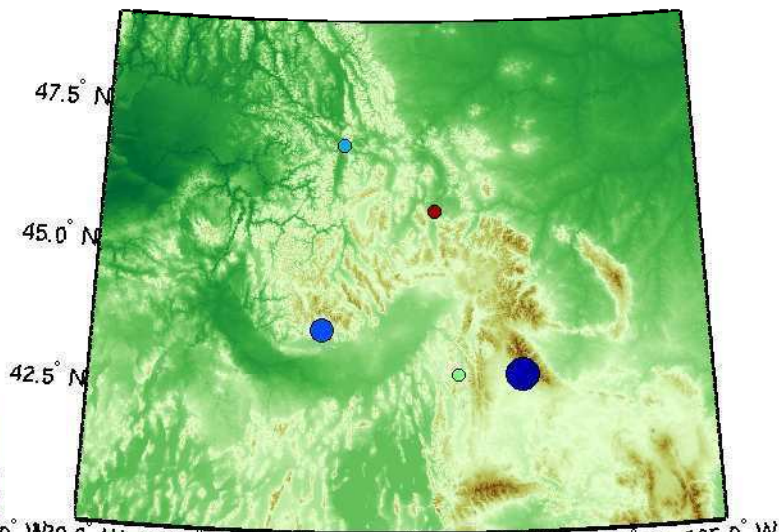
Baz = 307.7303  
Mean xcor value = 0.80833  
Range of  $t^*$  values is 1.5433  
Median  $t^*$  err is 0.33682



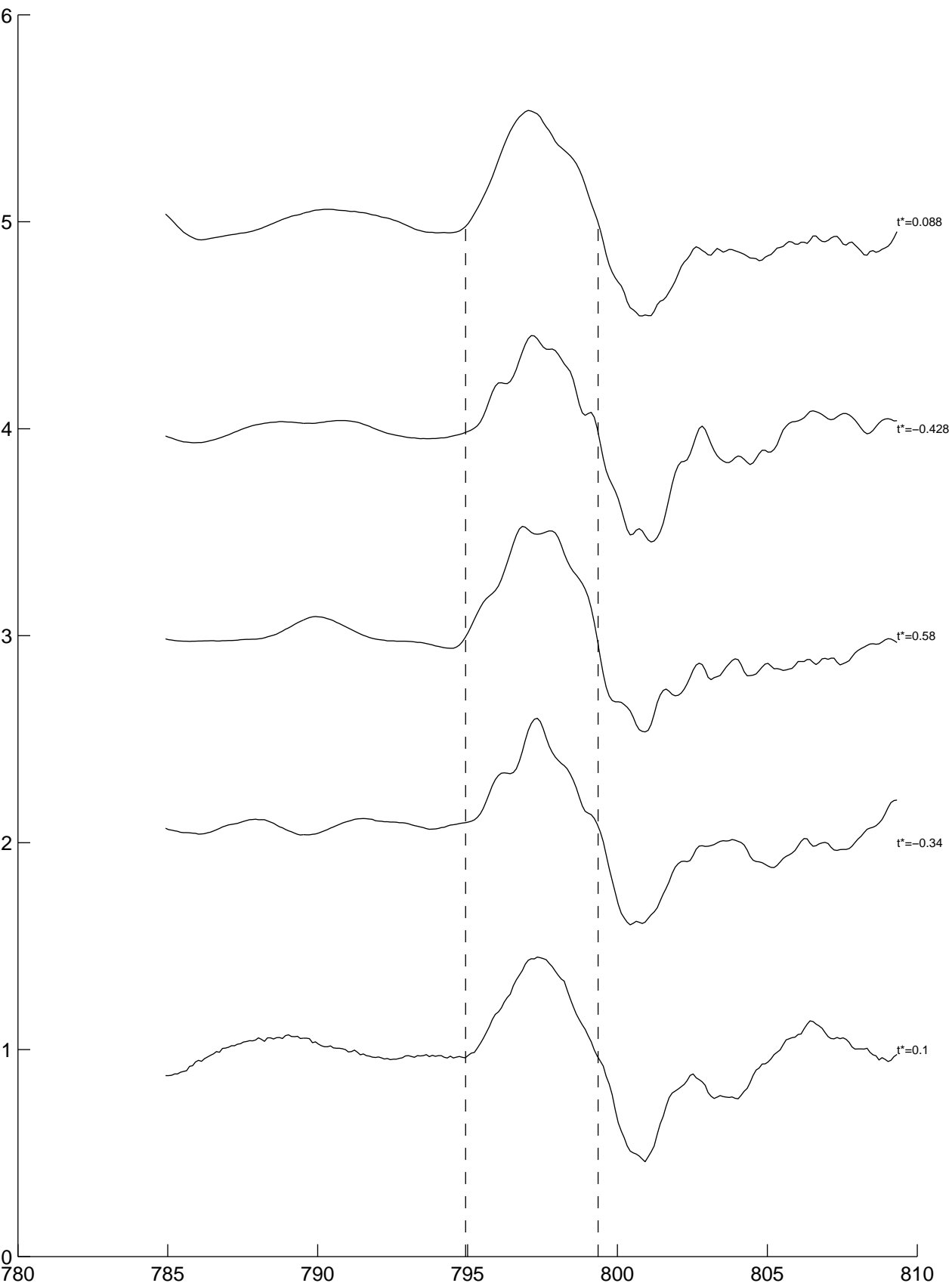
travel time residuals



$t^*$  values

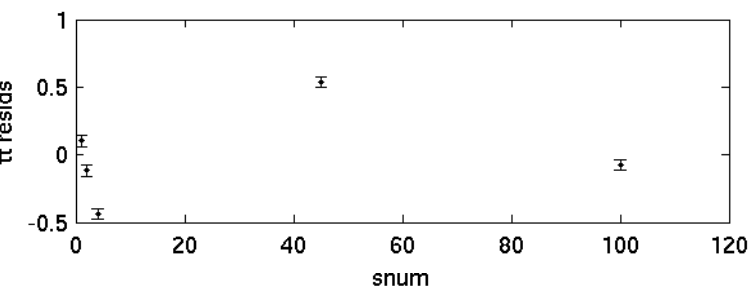
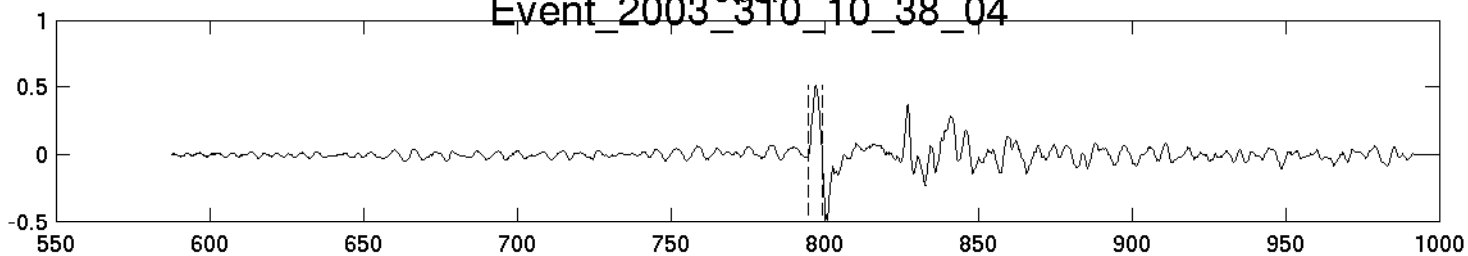


# Event\_2003\_310\_10\_38\_04

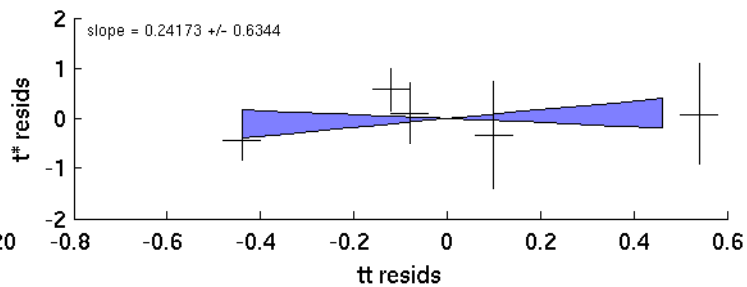
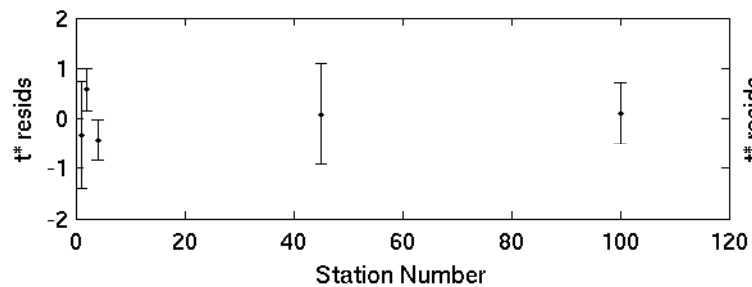


# Event\_2003\_310\_10\_38\_04

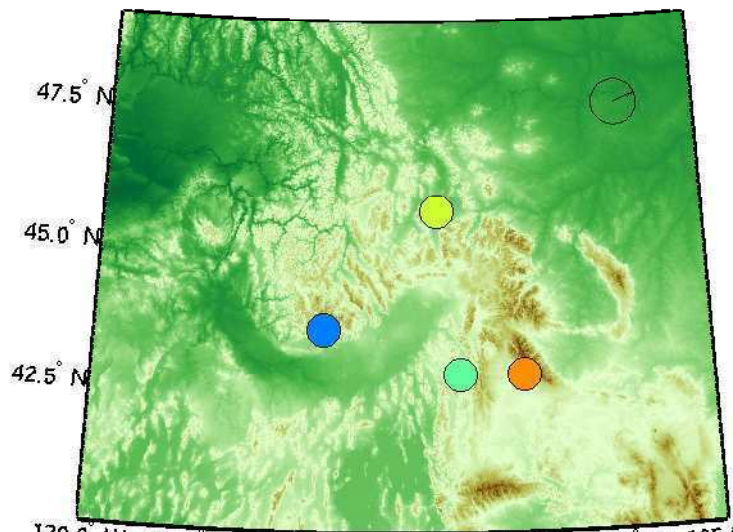
Stack



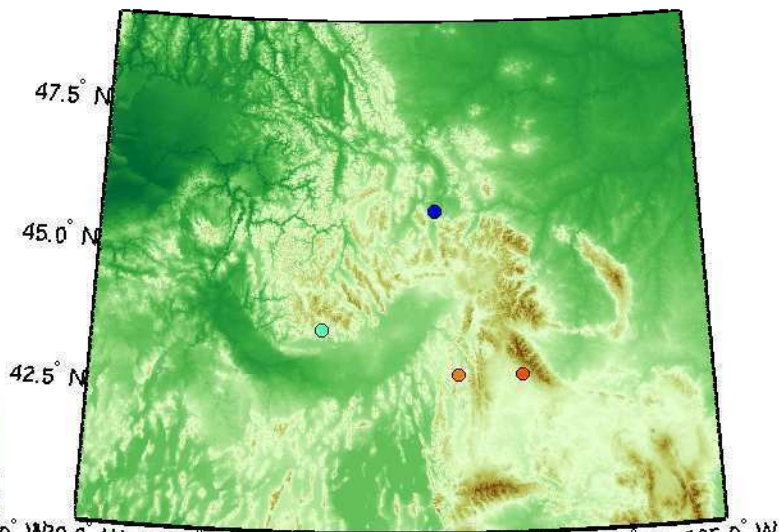
Baz = 248.8997  
Mean xcor value = 0.824  
Range of  $t^*$  values is 1.008  
Median  $t^*$  err is 0.61253



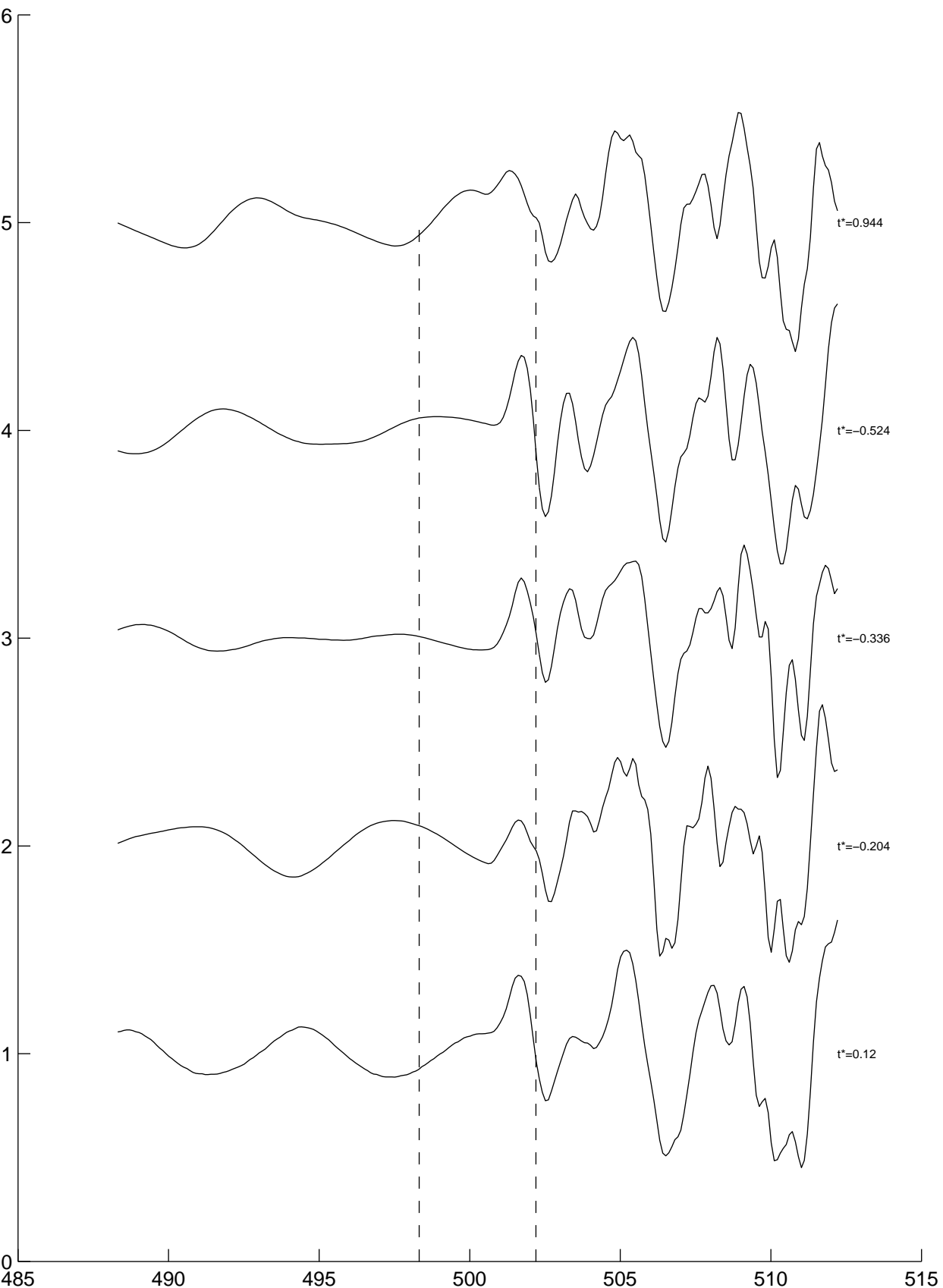
travel time residuals



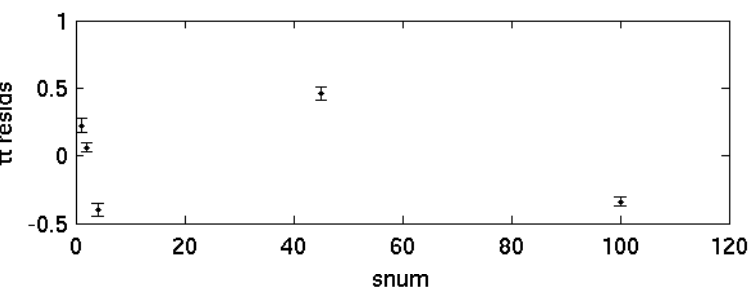
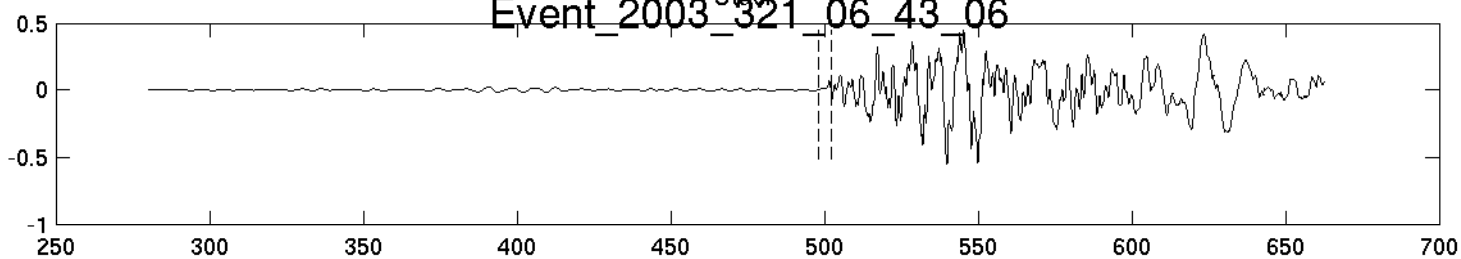
$t^*$  values



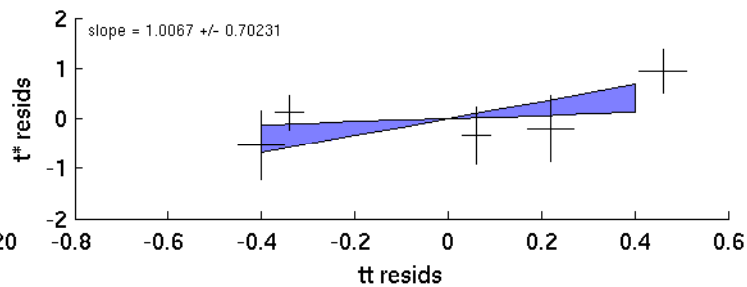
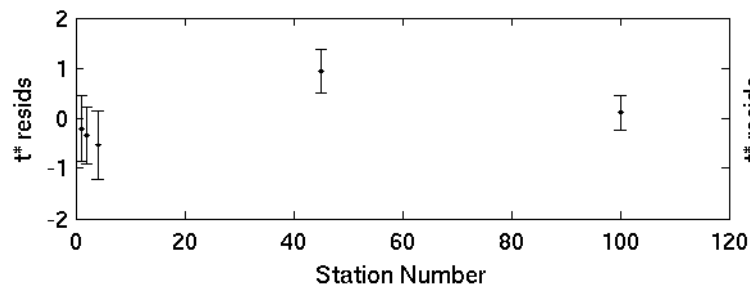
# Event\_2003\_321\_06\_43\_06



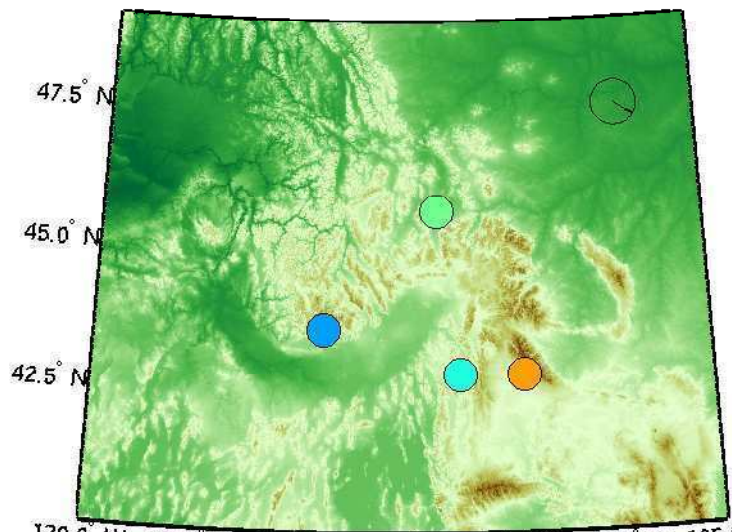
# Event\_2003\_321\_06\_43\_06



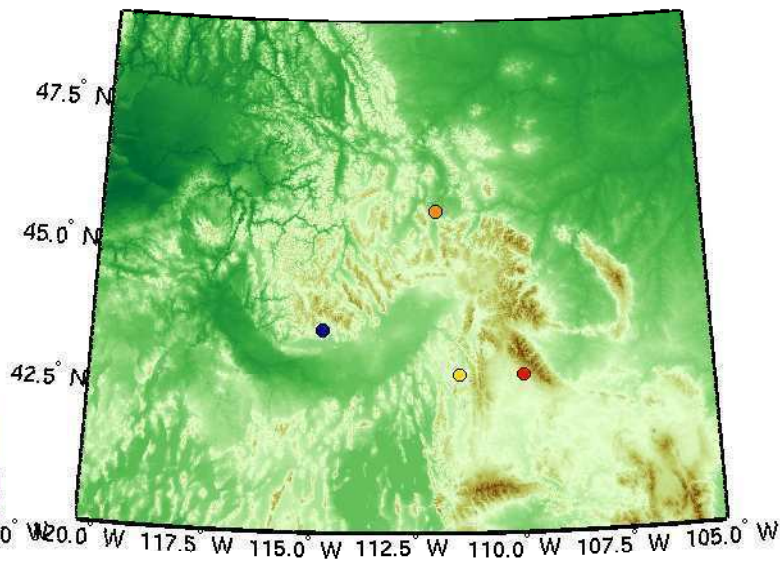
Baz = 304.687  
 Mean xcor value = 0.76  
 Range of  $t^*$  values is 1.468  
 Median  $t^*$  err is 0.57035



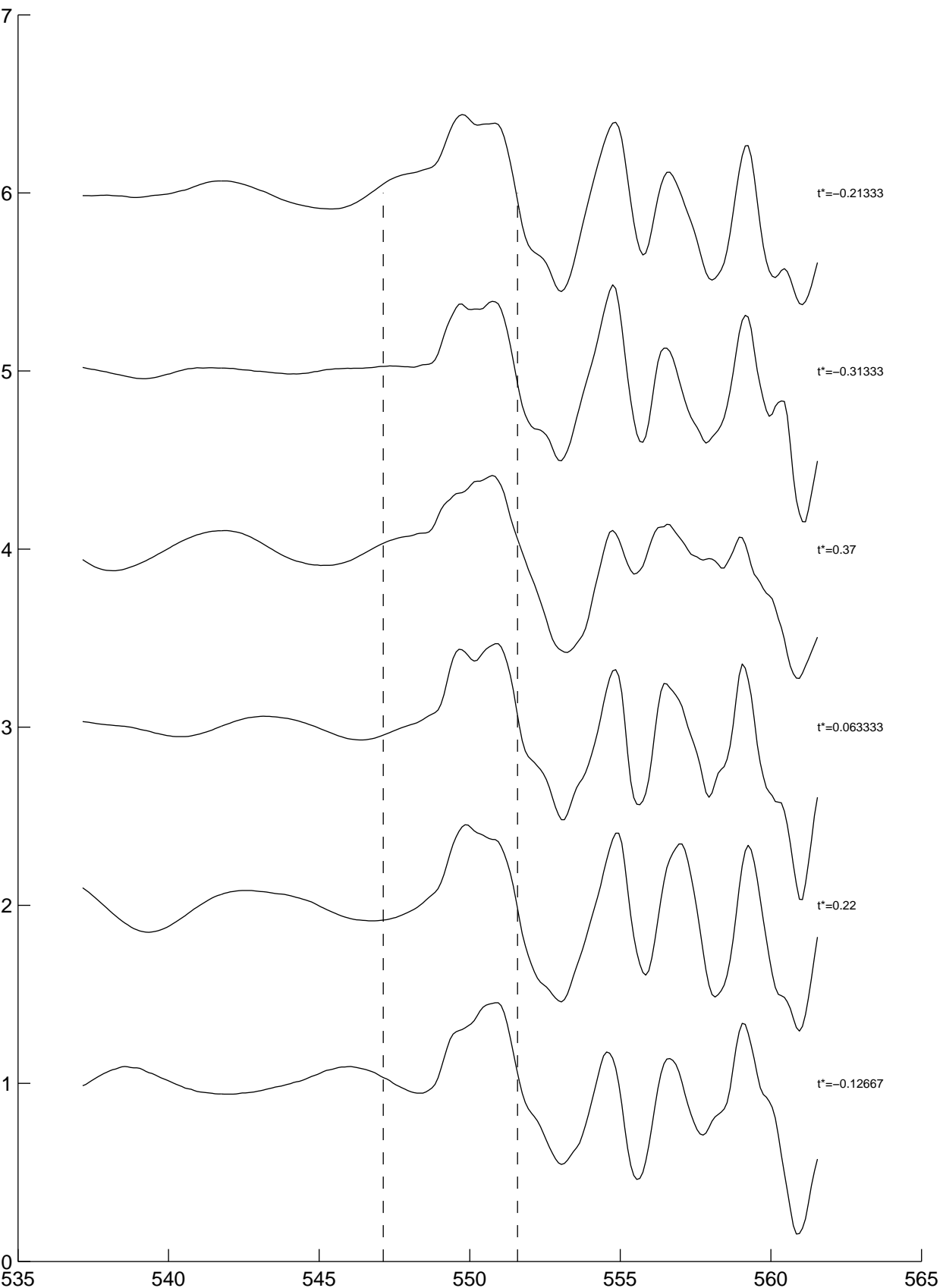
travel time residuals



$t^*$  values

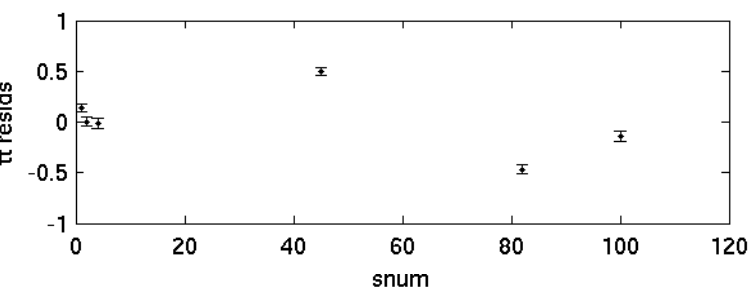
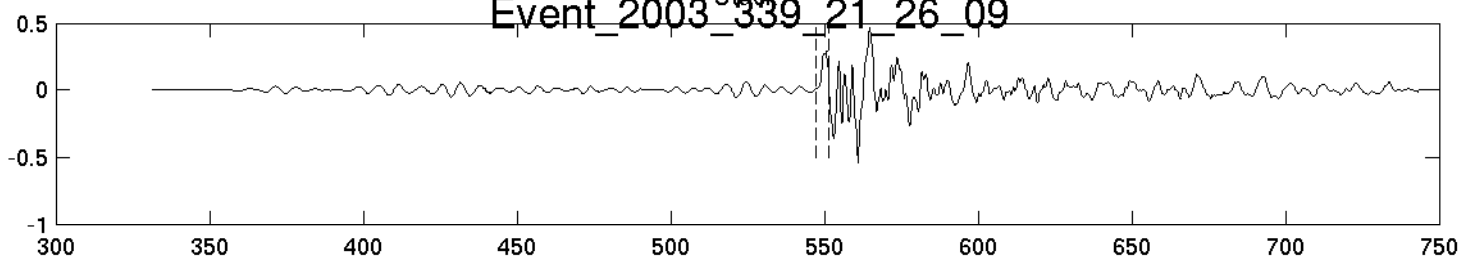


# Event\_2003\_339\_21\_26\_09

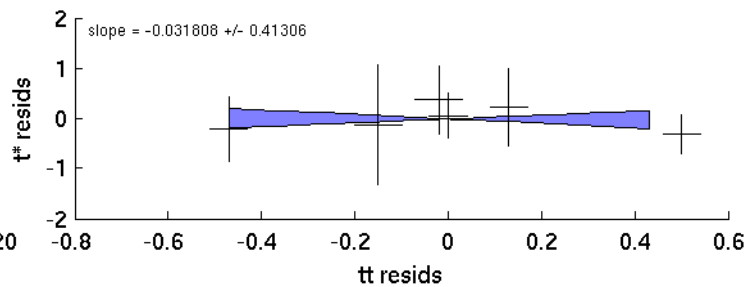
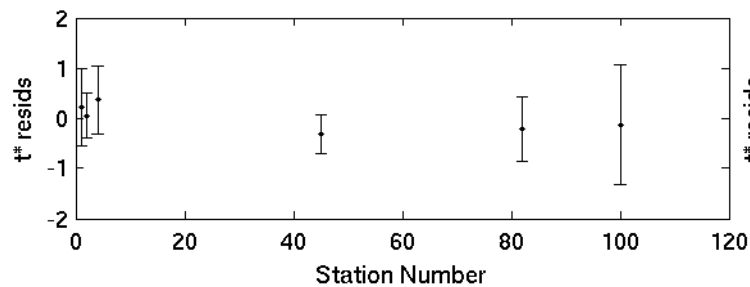




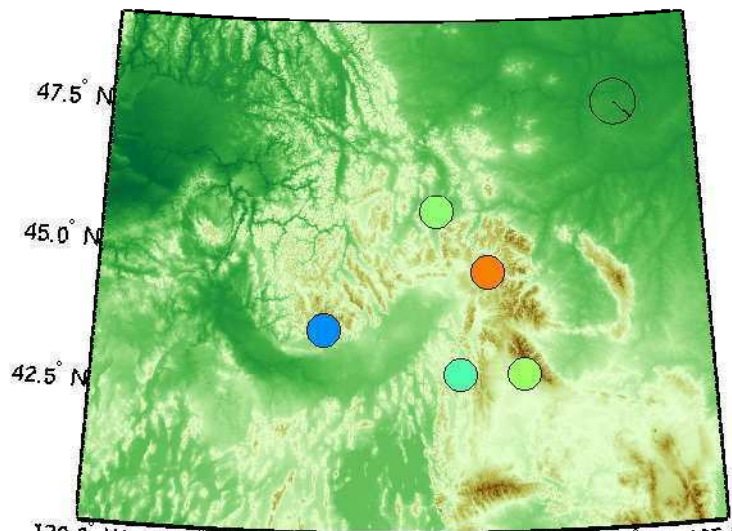
# Event\_2003\_339\_21\_26\_09



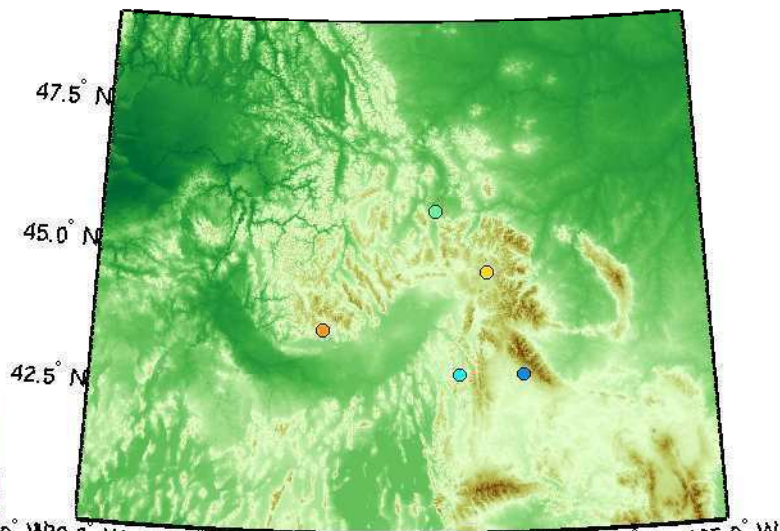
Baz = 314.0356  
 Mean xcor value = 0.72833  
 Range of  $t^*$  values is 0.68333  
 Median  $t^*$  err is 0.6612



travel time residuals

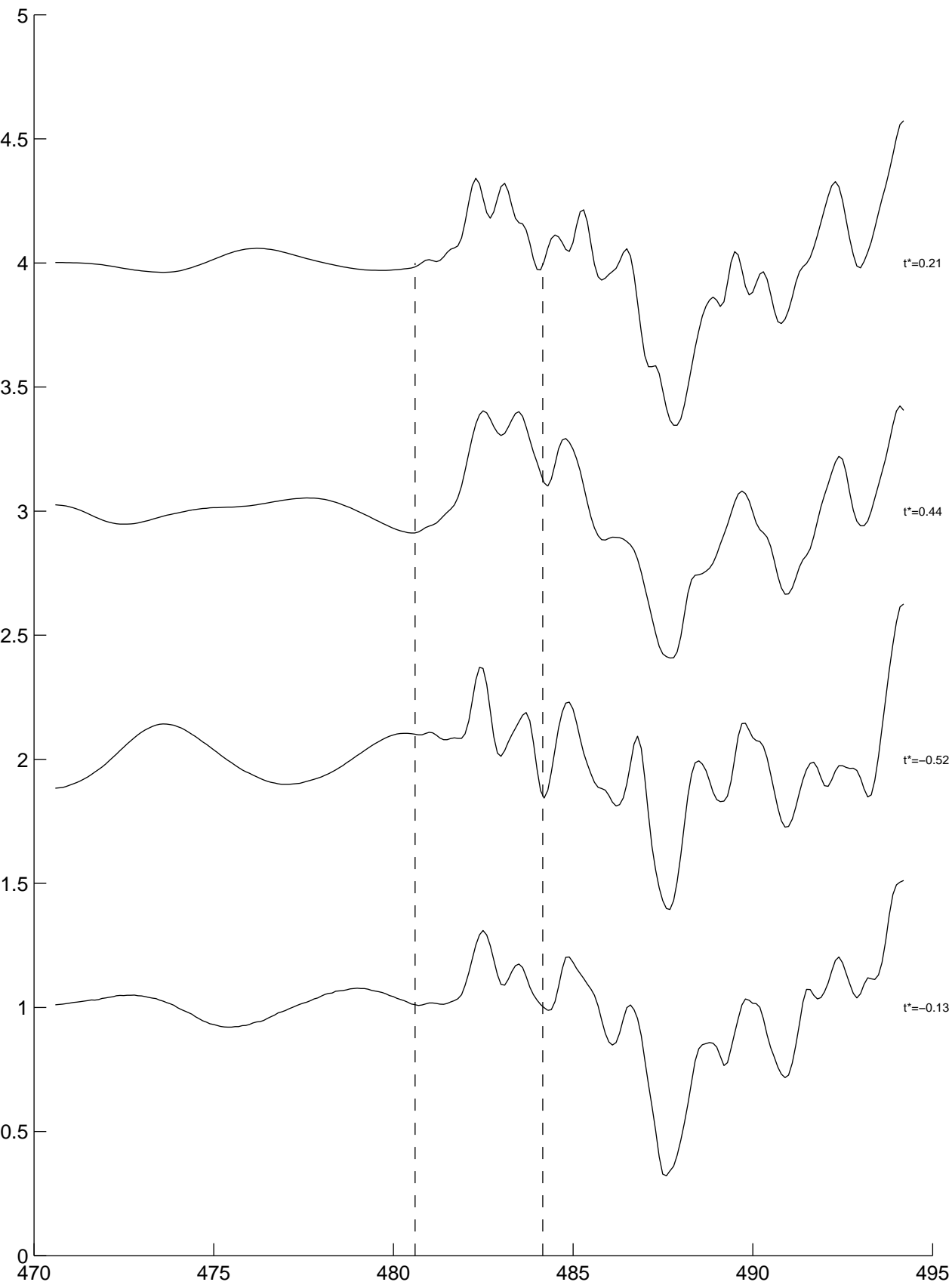


$t^*$  values



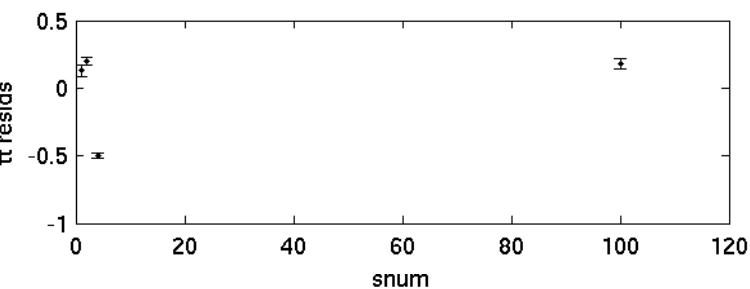
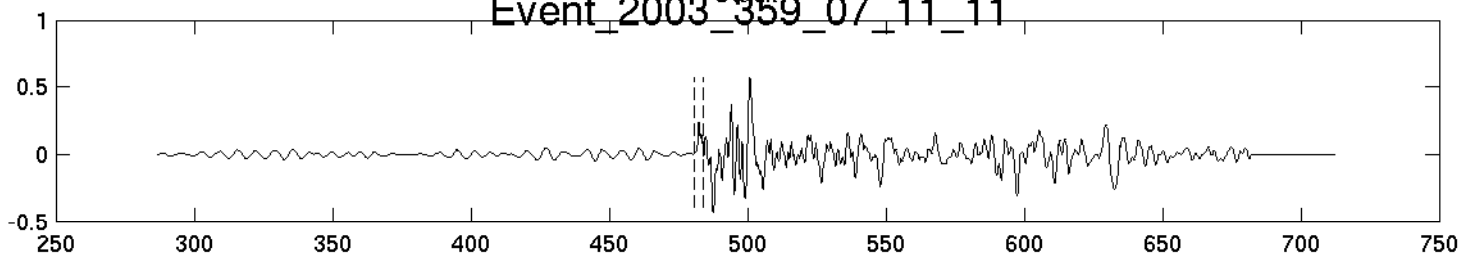


# Event\_2003\_359\_07\_11\_11

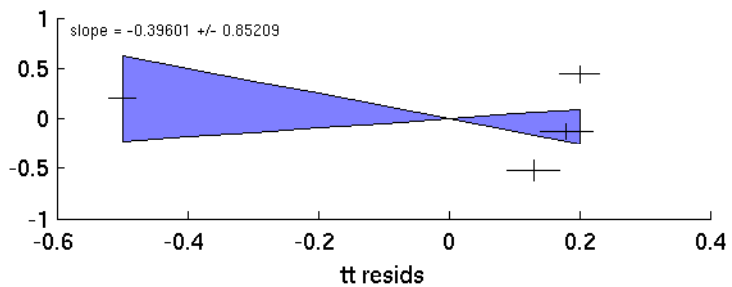
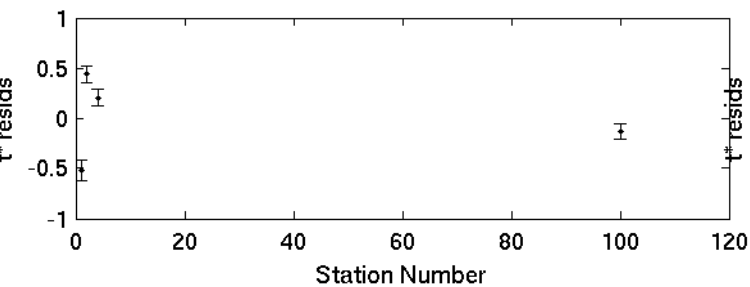


# Event\_2003\_359\_07\_11\_11

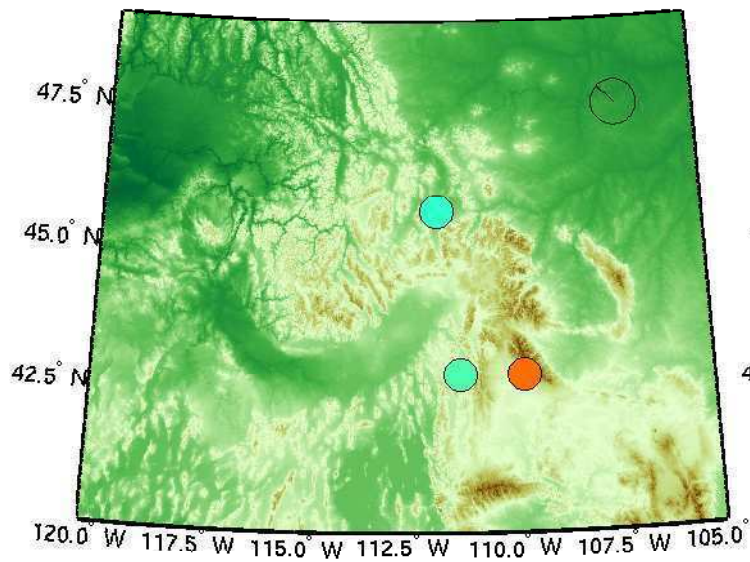
Stack



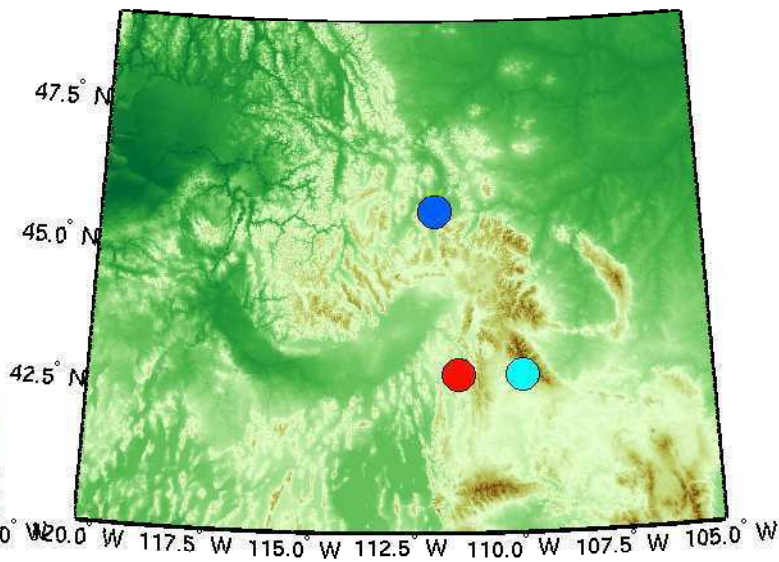
Baz = 136.4363  
Mean xcor value = 0.6775  
Range of  $t^*$  values is 0.96  
Median  $t^*$  err is 0.083561



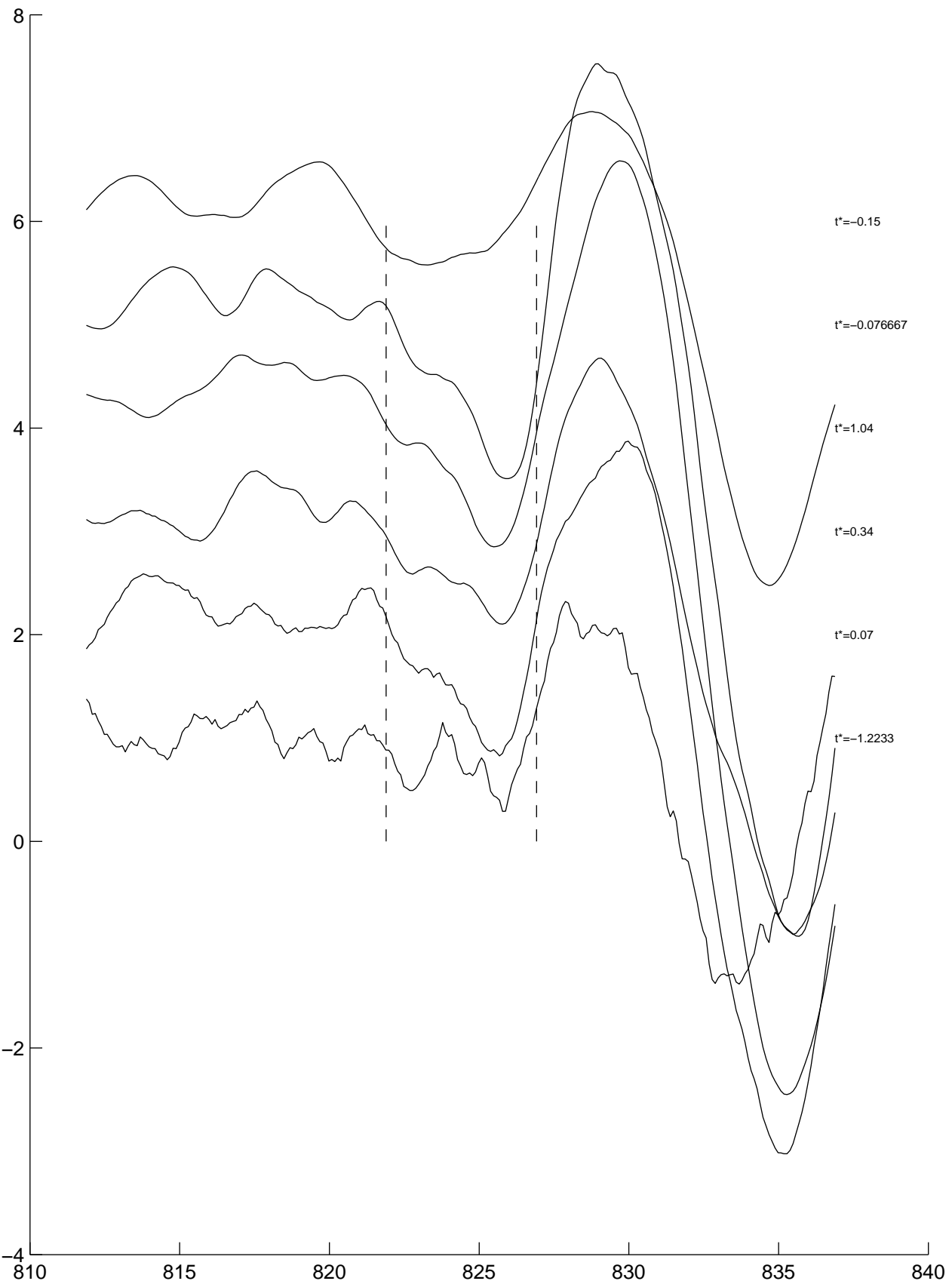
travel time residuals



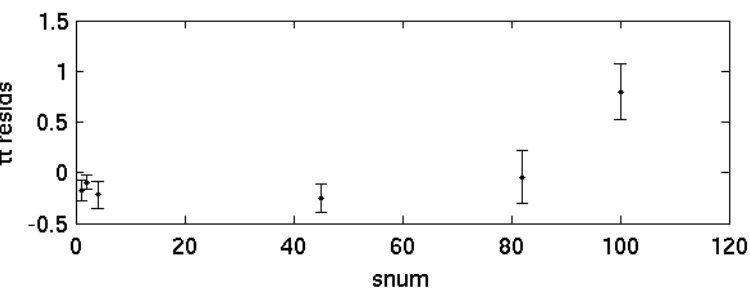
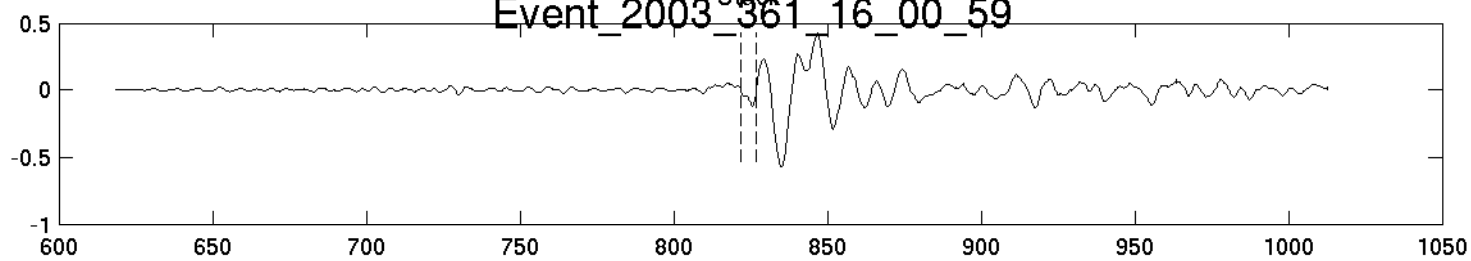
$t^*$  values



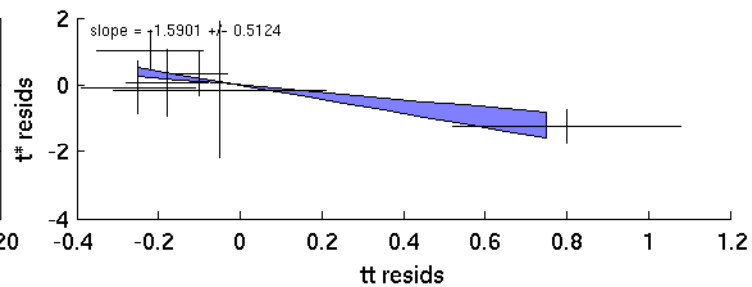
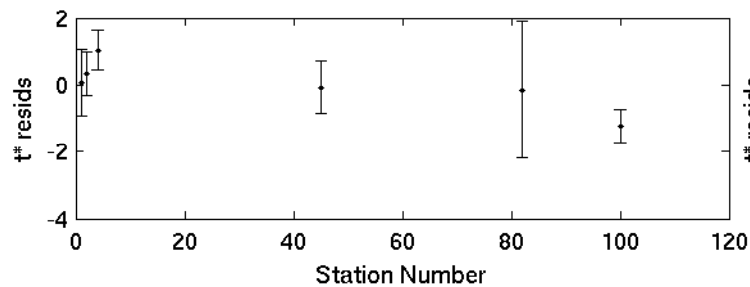
# Event\_2003\_361\_16\_00\_59



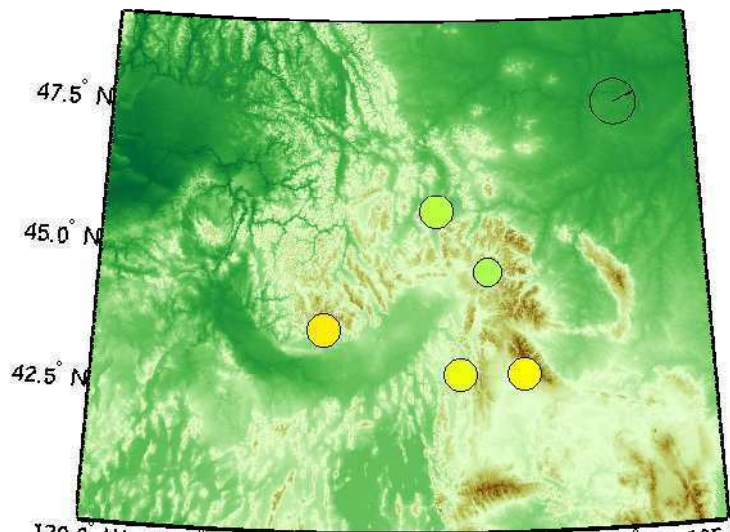
# Event\_2003\_361\_16\_00\_59



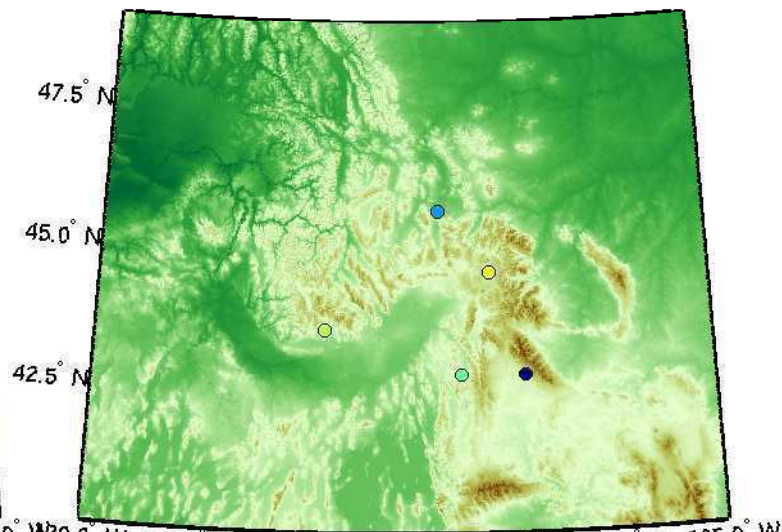
Baz = 246.4863  
Mean xcor value = 0.72333  
Range of  $t^*$  values is 2.2633  
Median  $t^*$  err is 0.71865



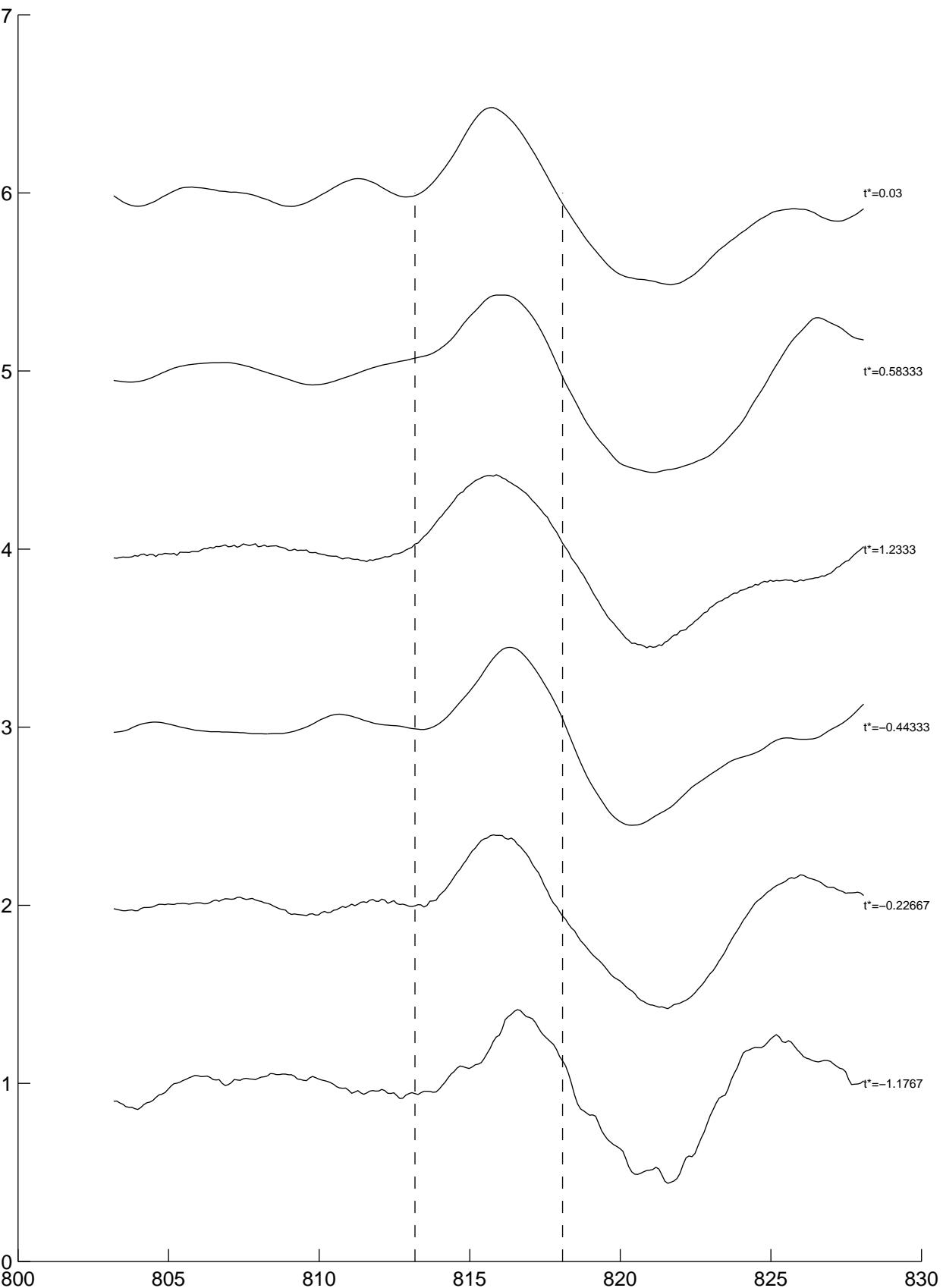
travel time residuals



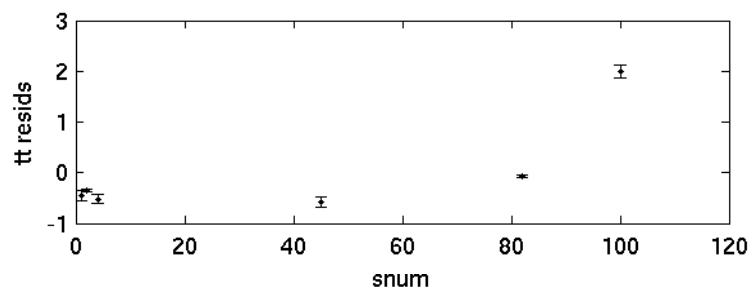
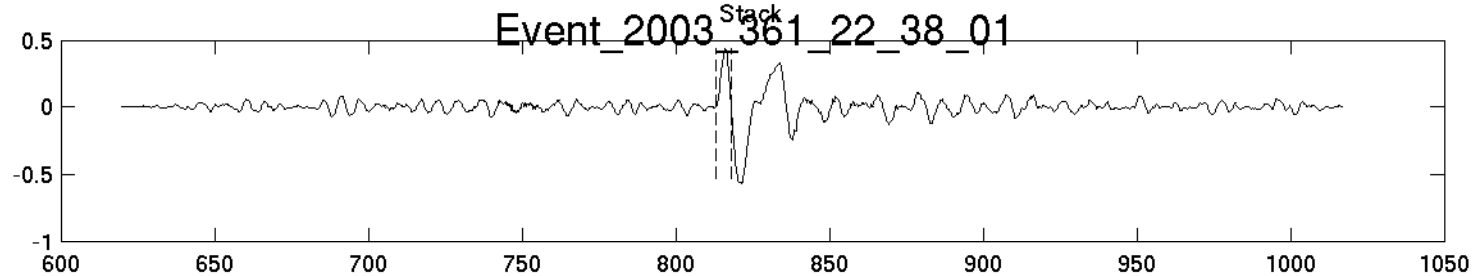
$t^*$  values



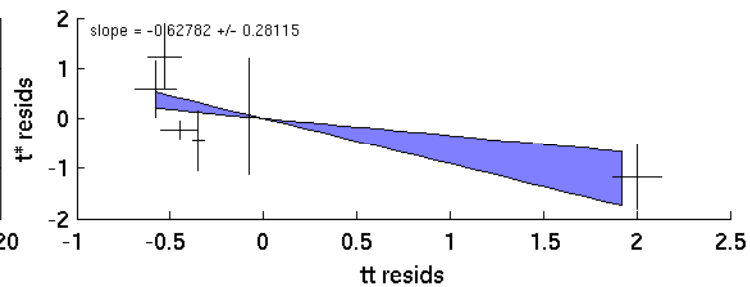
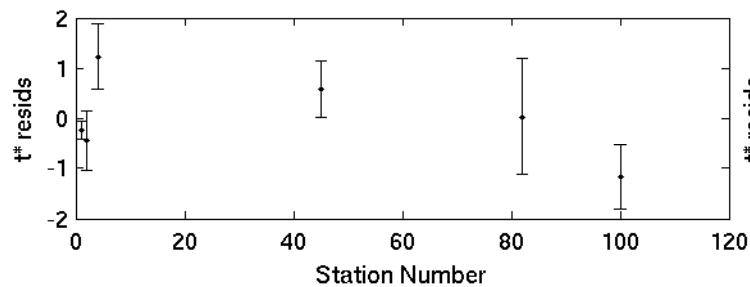
# Event\_2003\_361\_22\_38\_01



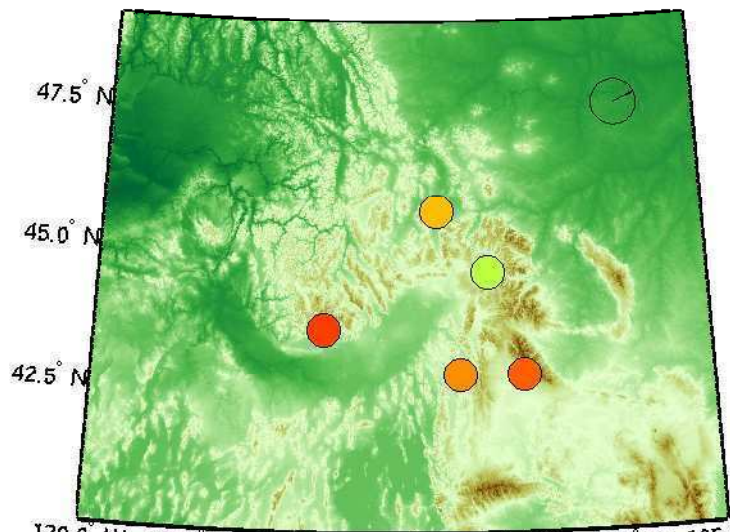
# Event\_2003\_361\_22\_38\_01



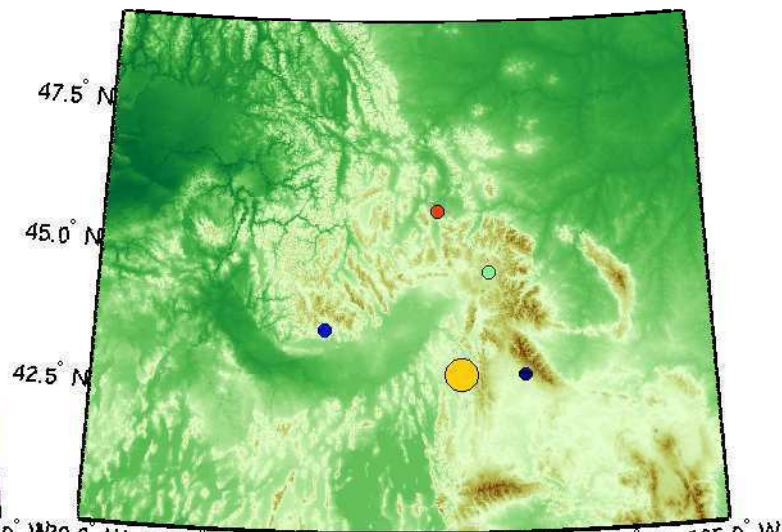
Baz = 246.6862  
 Mean xcor value = 0.75833  
 Range of  $t^*$  values is 2.41  
 Median  $t^*$  err is 0.61596



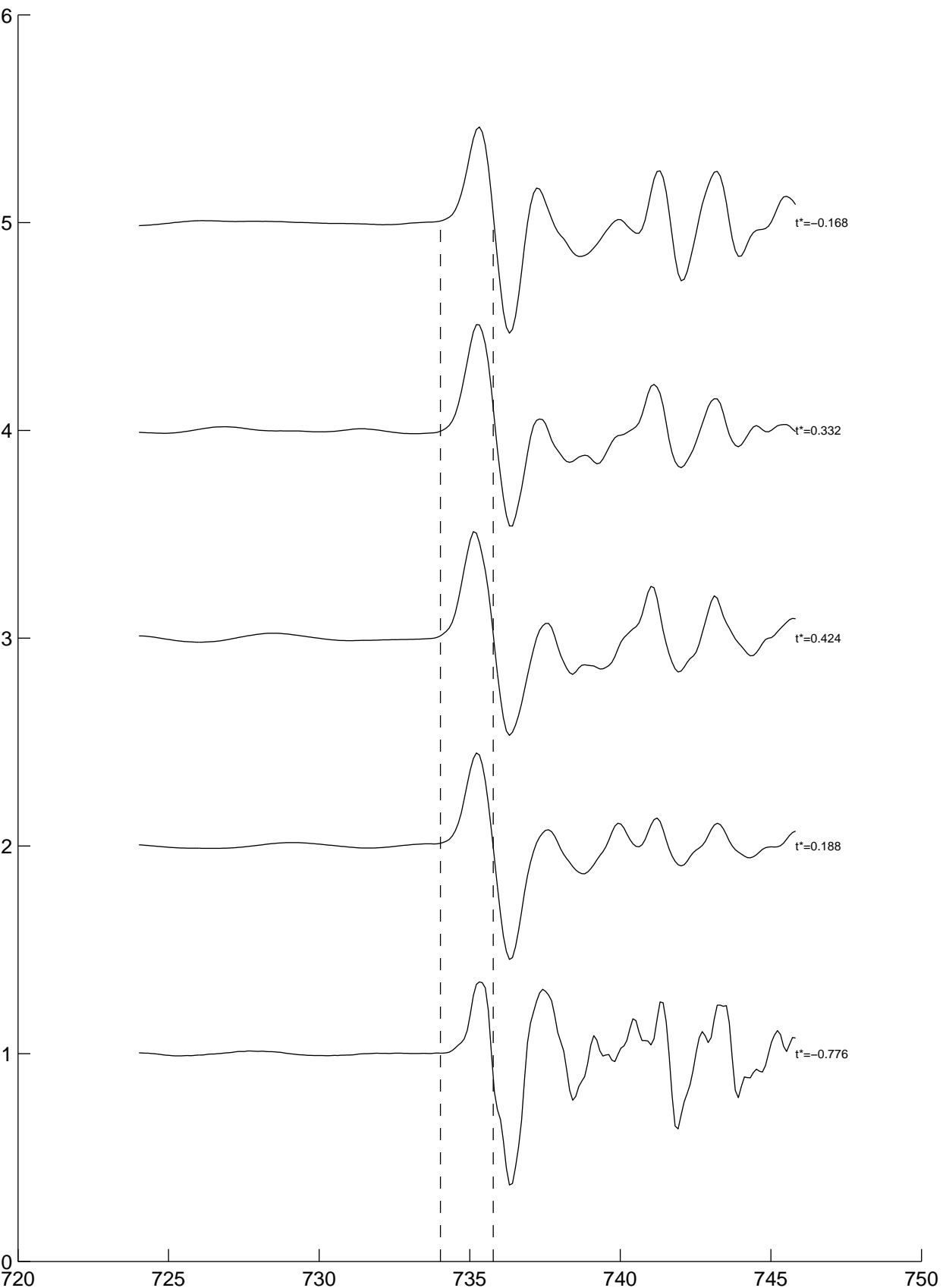
travel time residuals



$t^*$  values

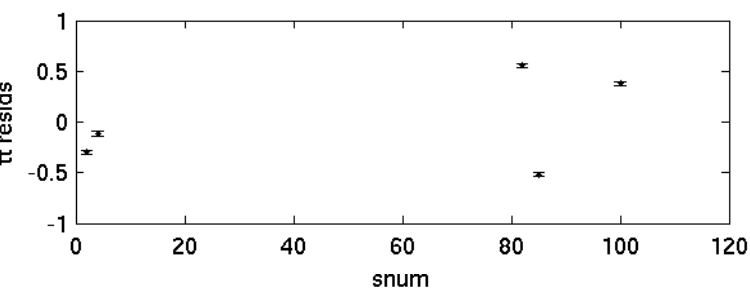
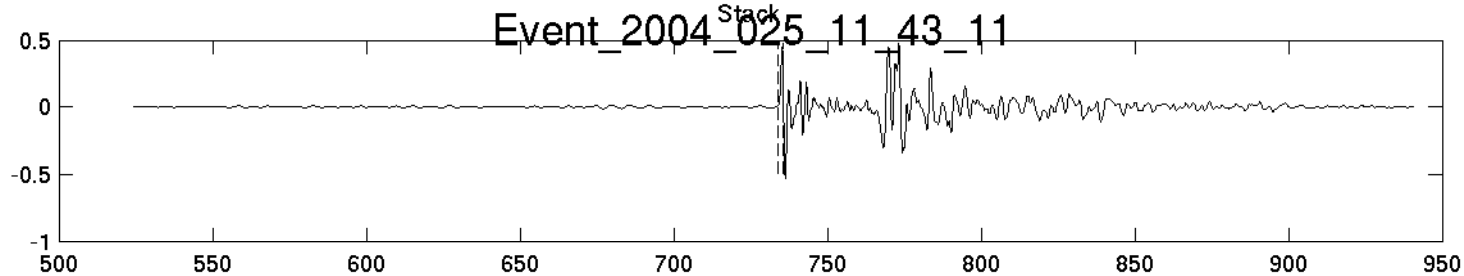


# Event\_2004\_025\_11\_43\_11

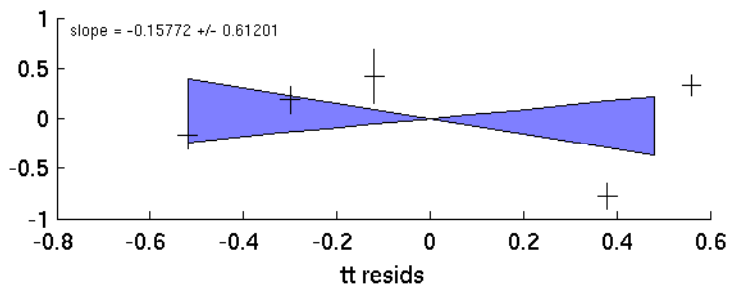
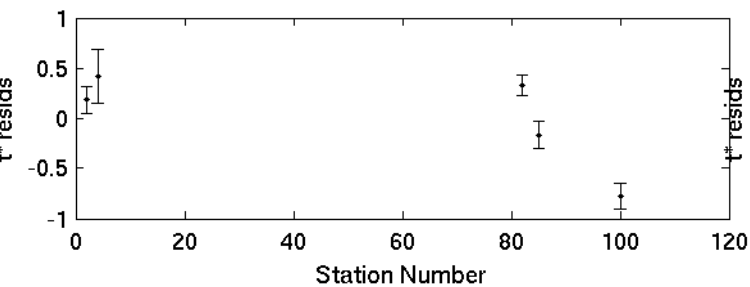




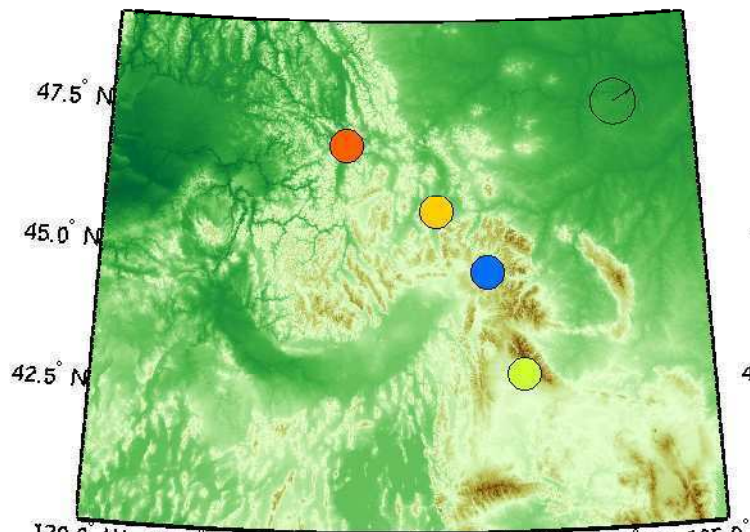
# Event\_2004\_025\_11\_43\_11



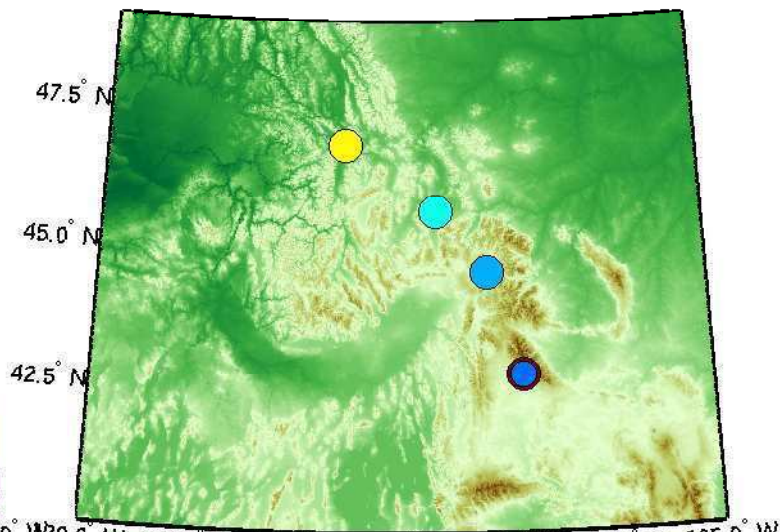
Baz = 239.2214  
Mean xcor value = 0.76  
Range of  $t^*$  values is 1.2  
Median  $t^*$  err is 0.13214



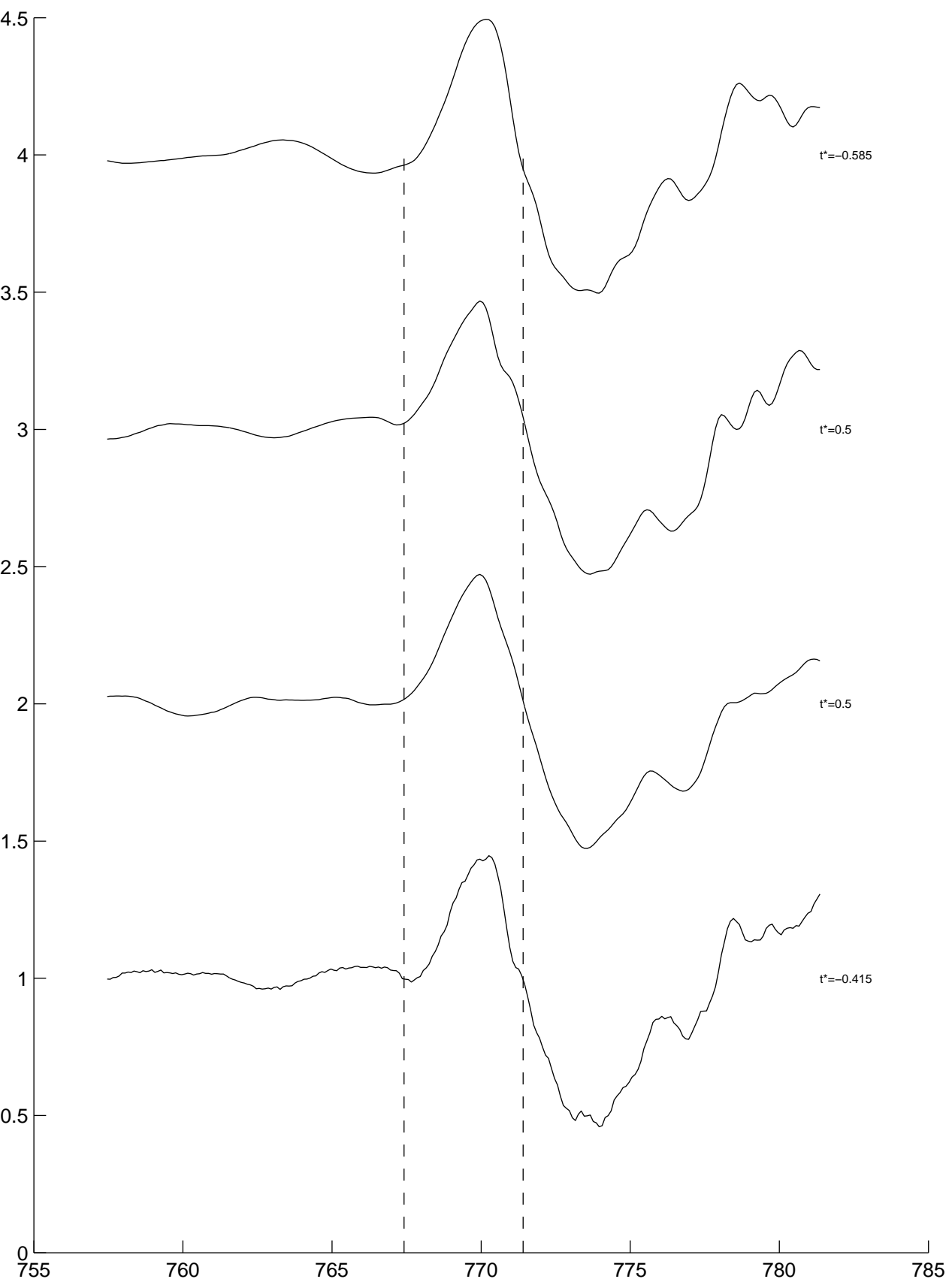
travel time residuals



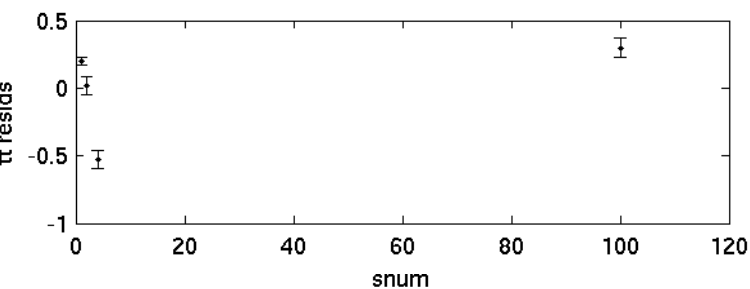
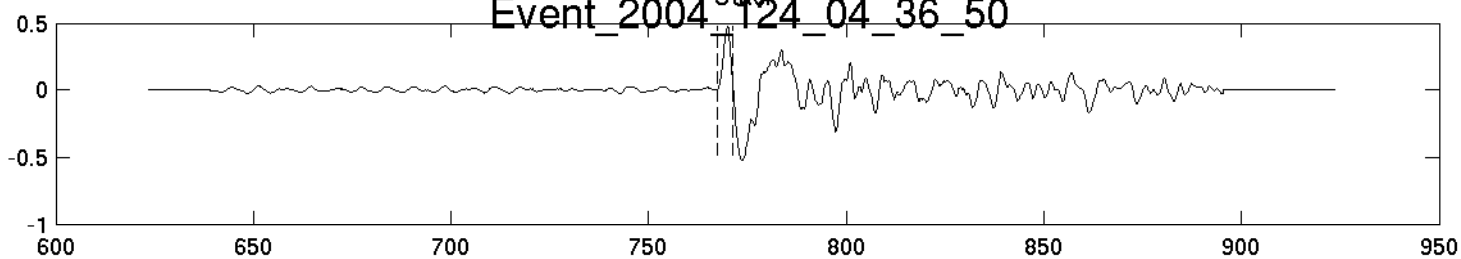
$t^*$  values



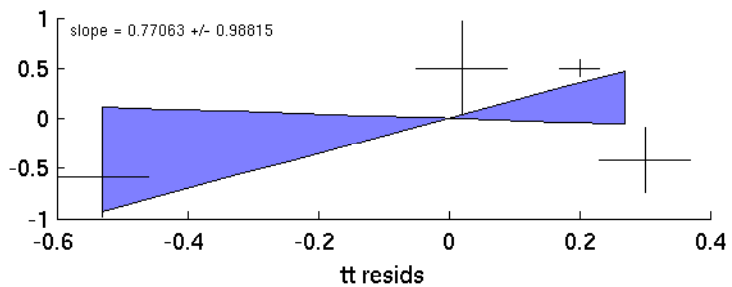
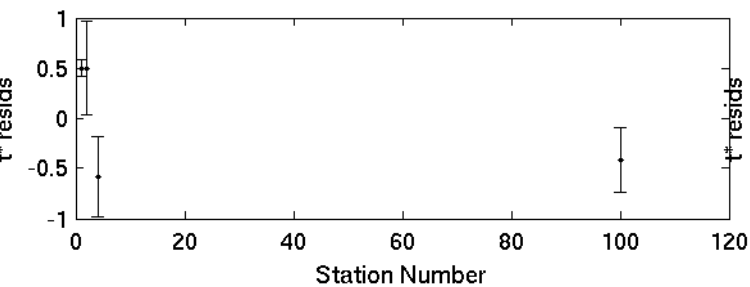
Event\_2004\_124\_04\_36\_50



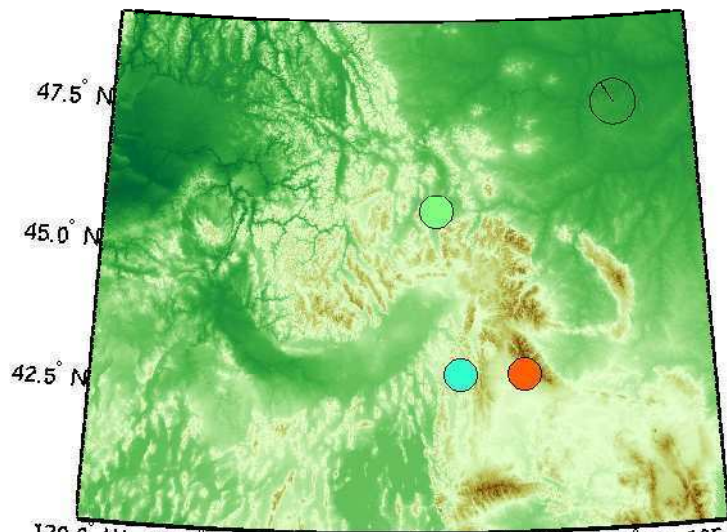
# Event\_2004\_124\_04\_36\_50



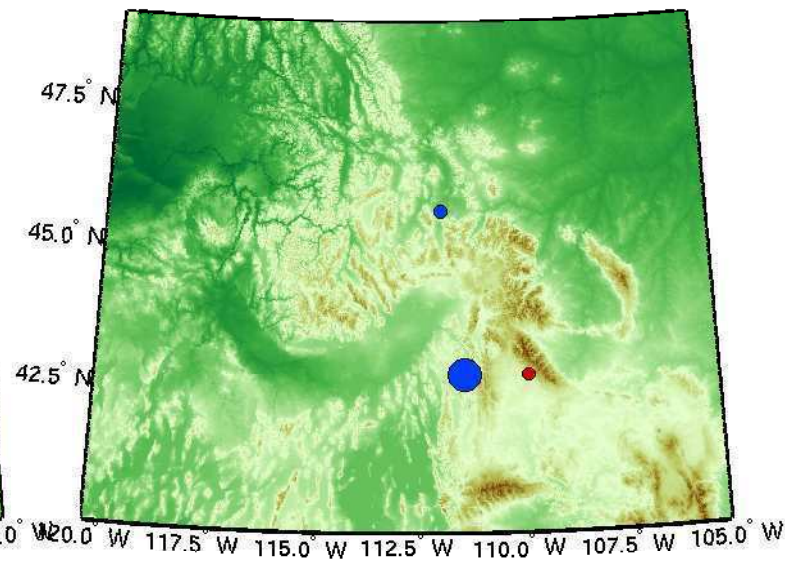
Baz = 151.0427  
 Mean xcor value = 0.7025  
 Range of  $t^*$  values is 1.085  
 Median  $t^*$  err is 0.36423



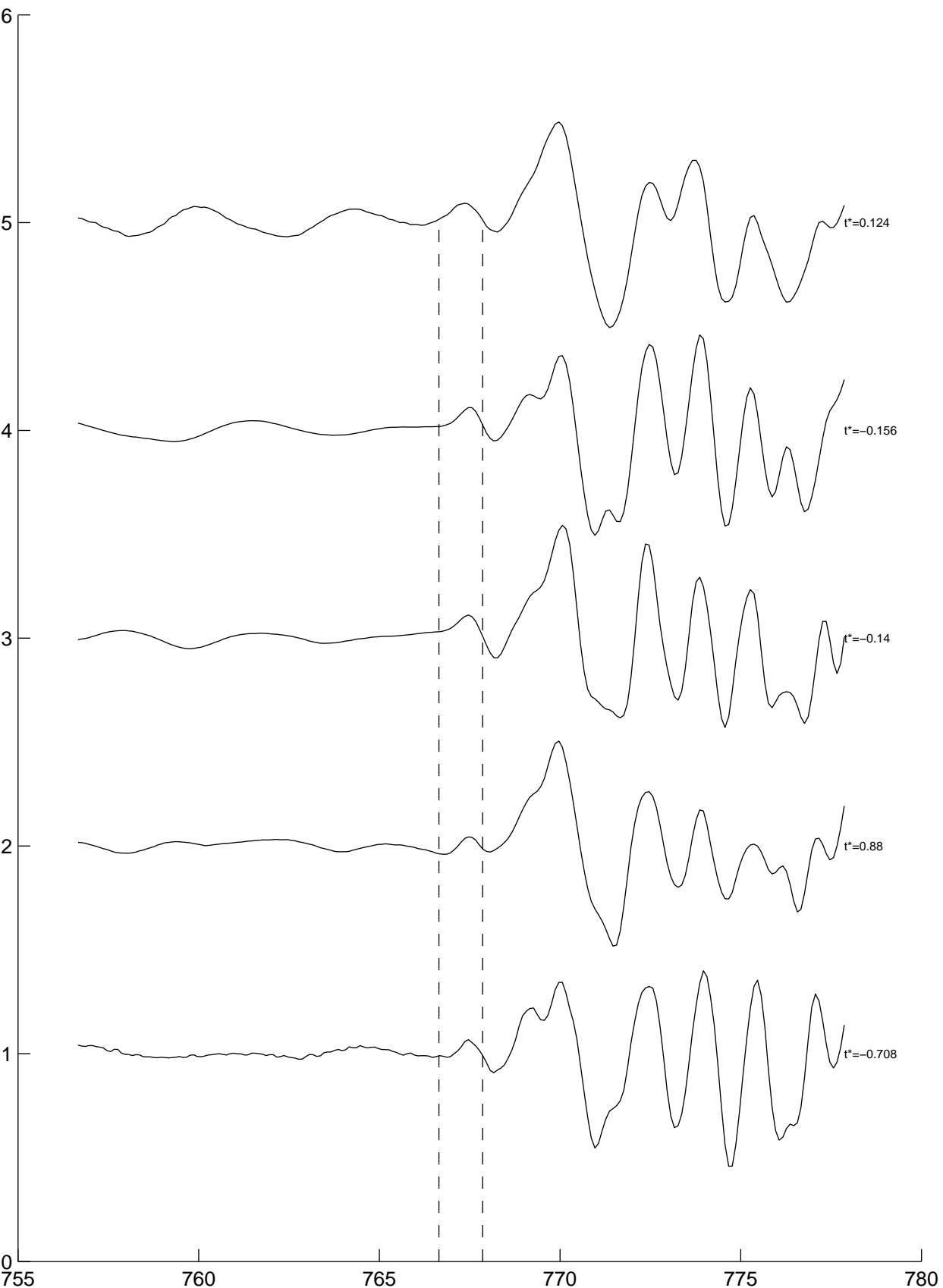
travel time residuals



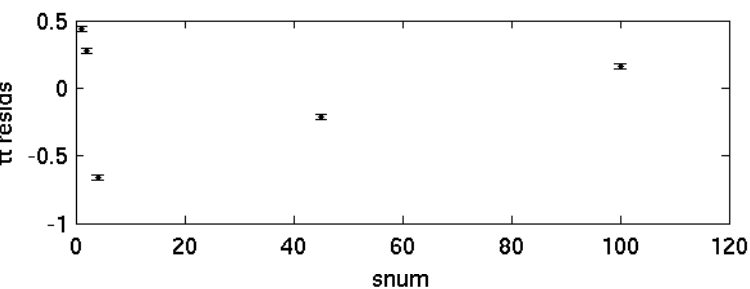
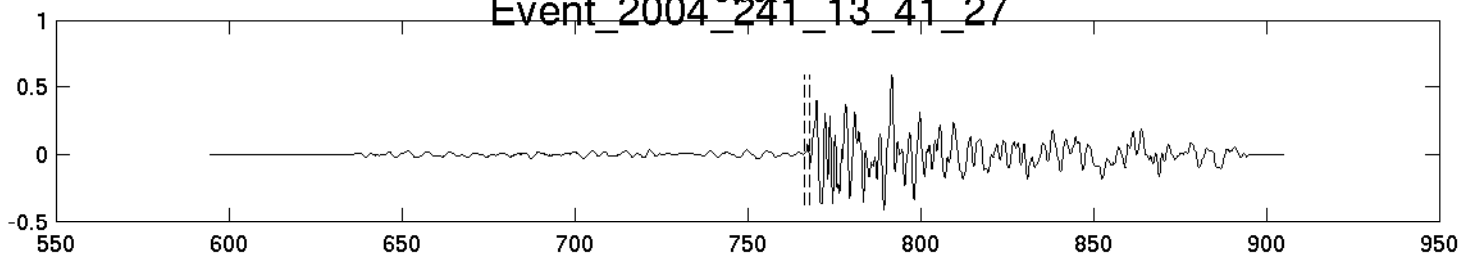
$t^*$  values



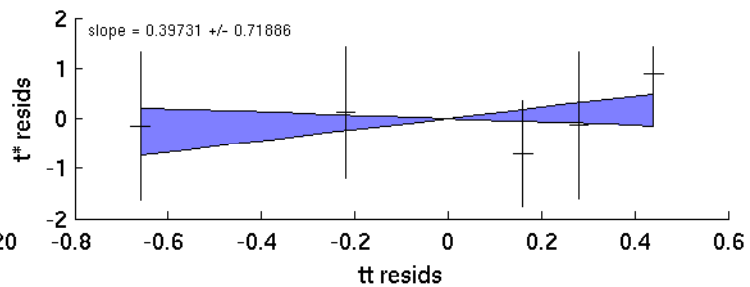
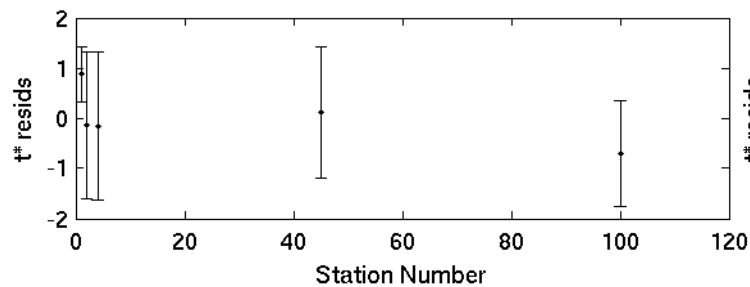
# Event\_2004\_241\_13\_41\_27



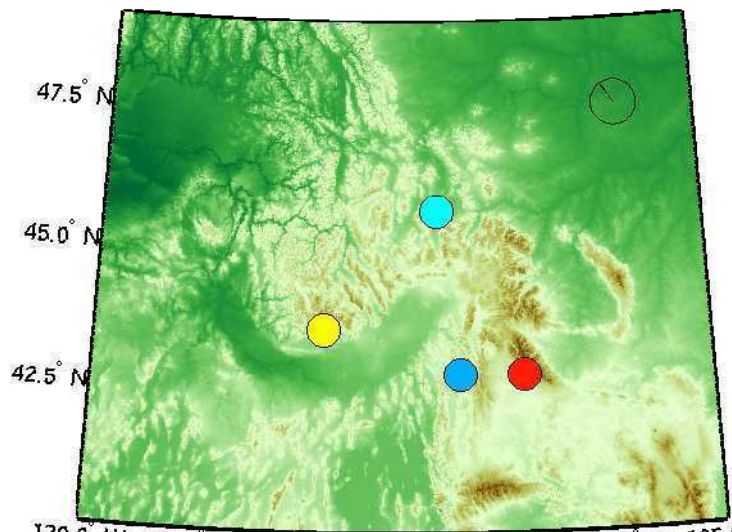
# Event\_2004\_241\_13\_41\_27



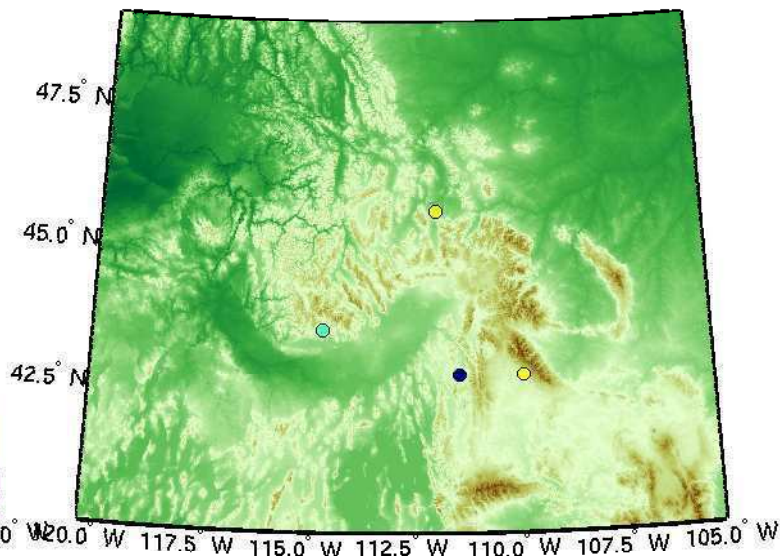
Baz = 147.1873  
 Mean xcor value = 0.75  
 Range of  $t^*$  values is 1.588  
 Median  $t^*$  err is 1.3127



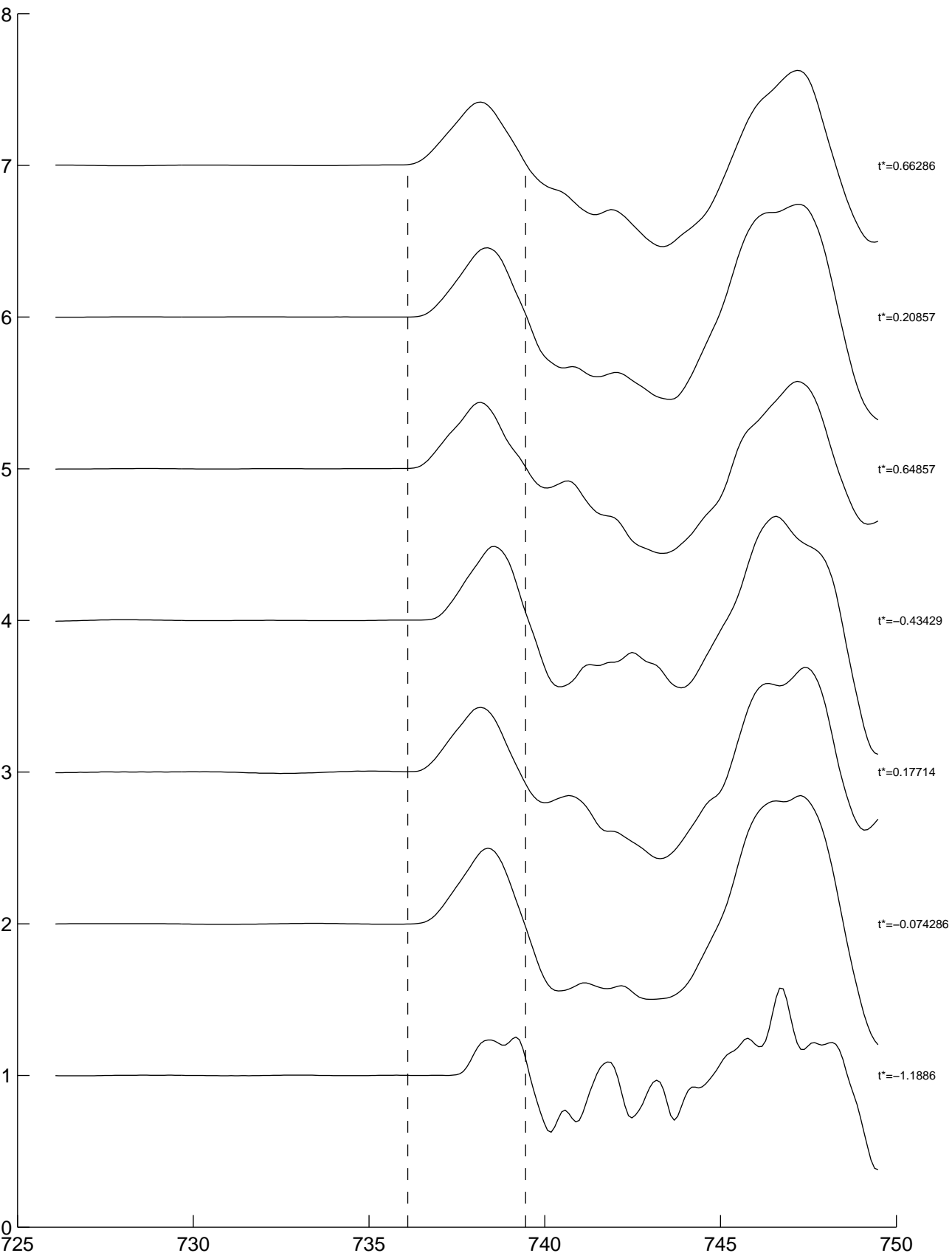
travel time residuals



$t^*$  values

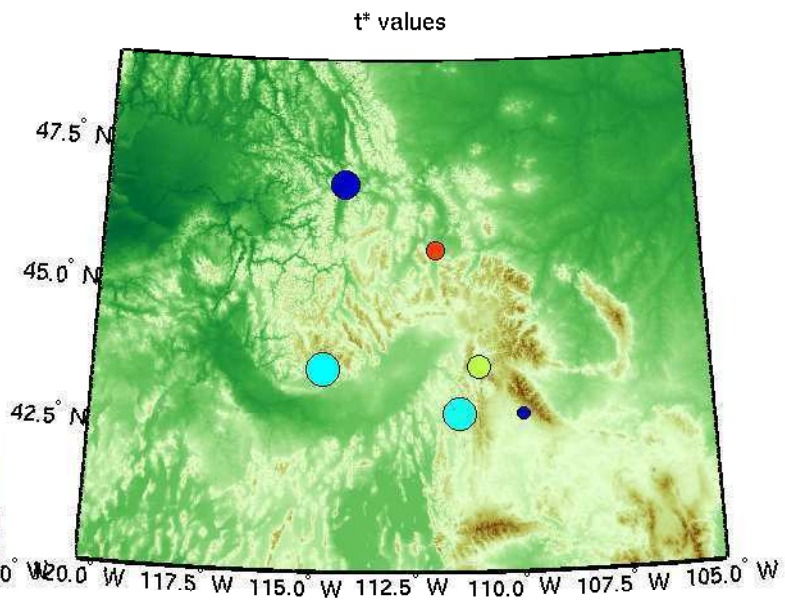
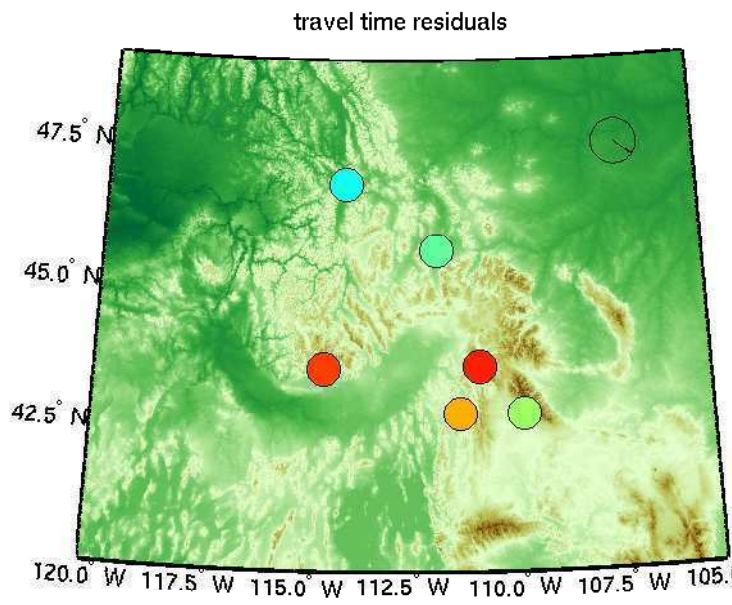
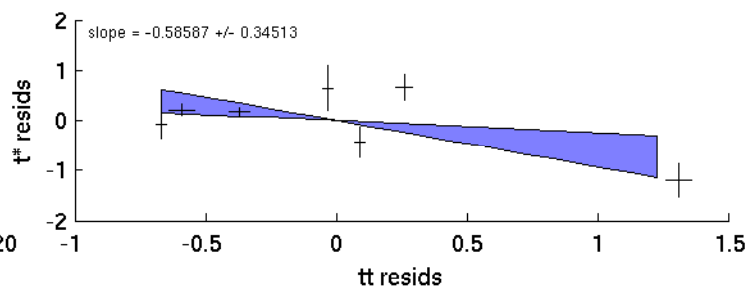
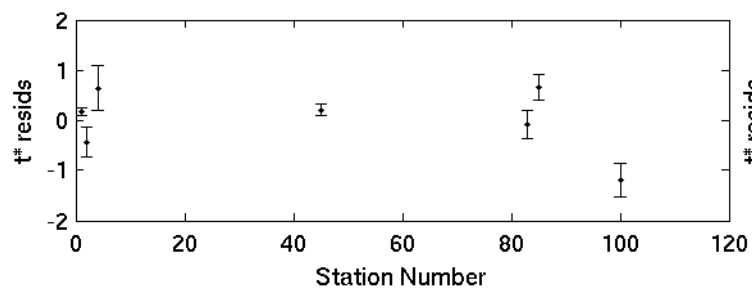
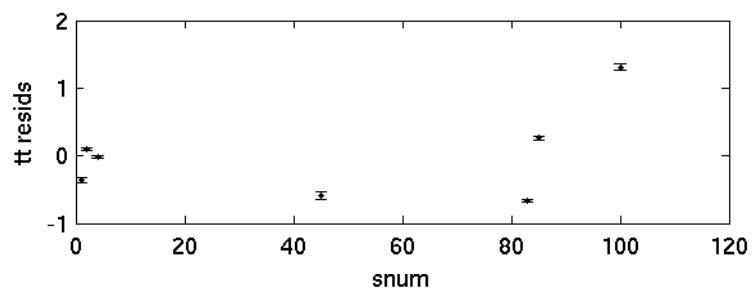
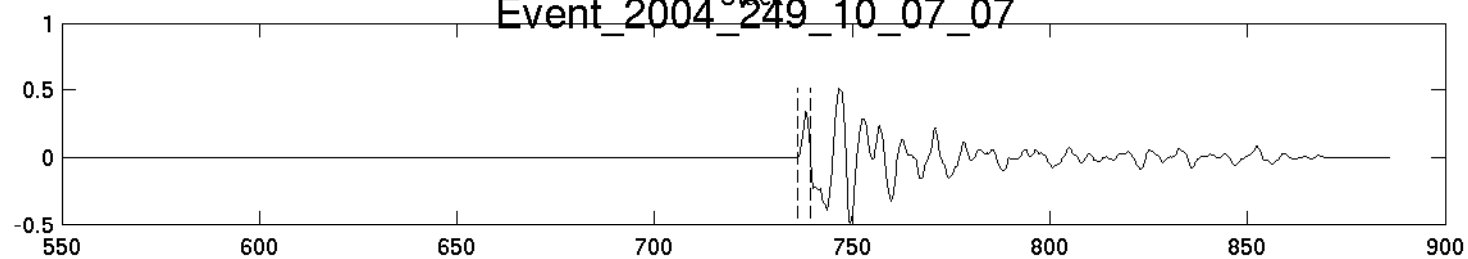


# Event\_2004\_249\_10\_07\_07



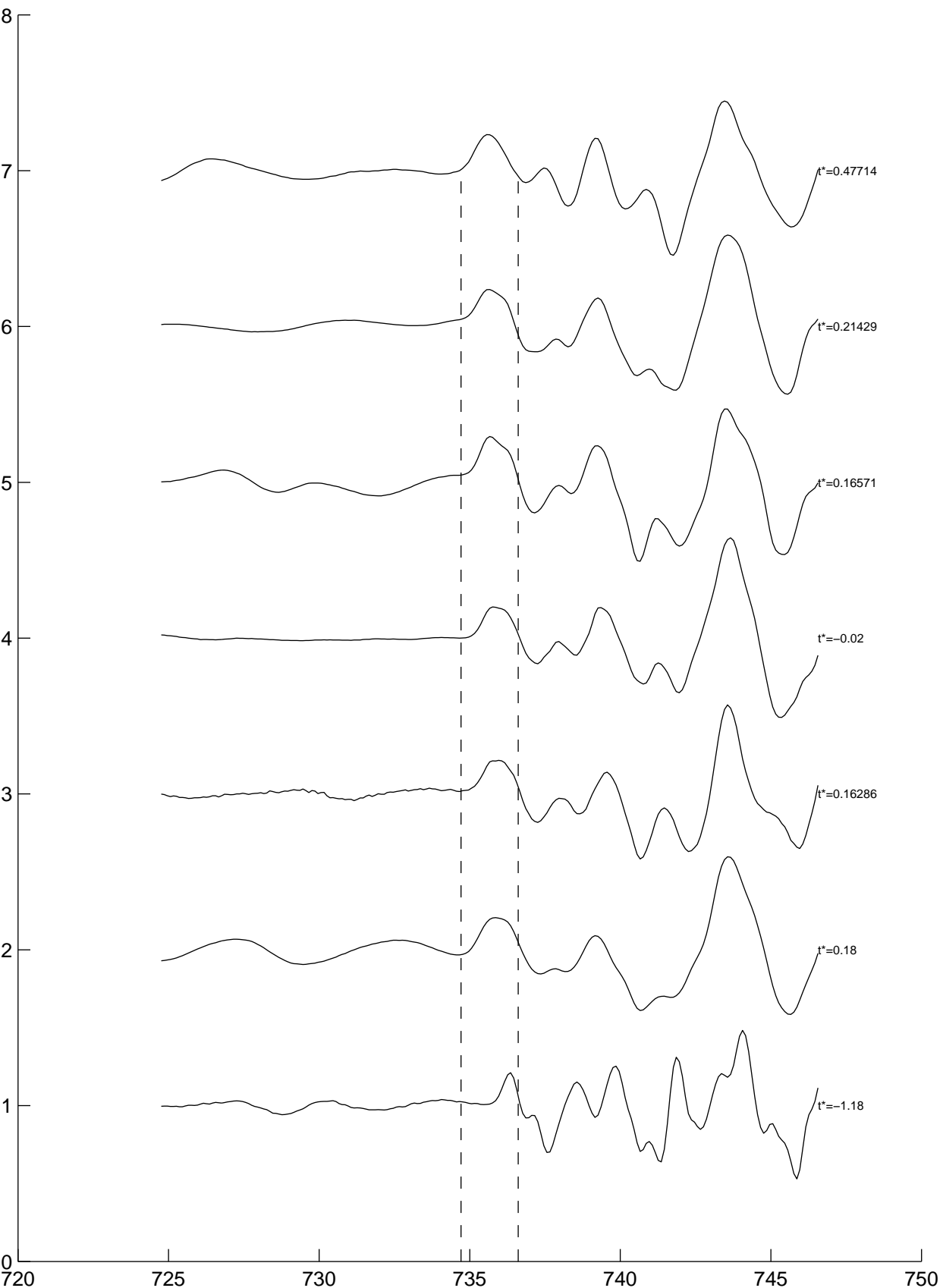


# Event\_2004\_249\_10\_07\_07

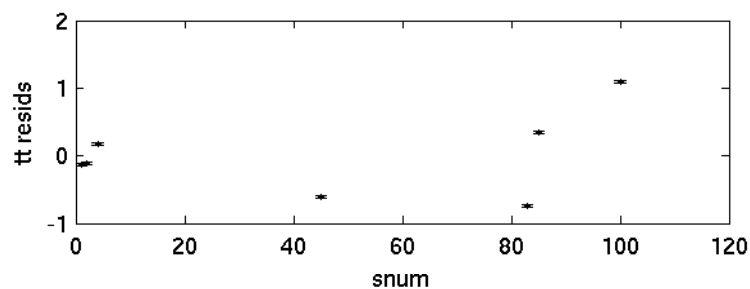
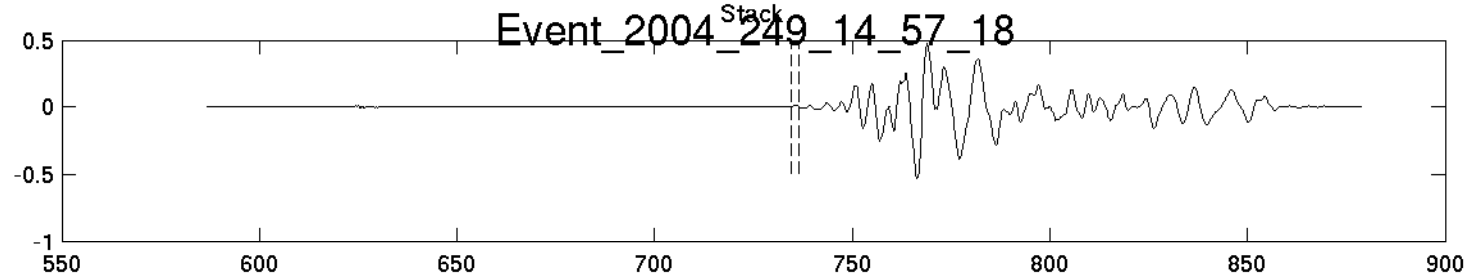




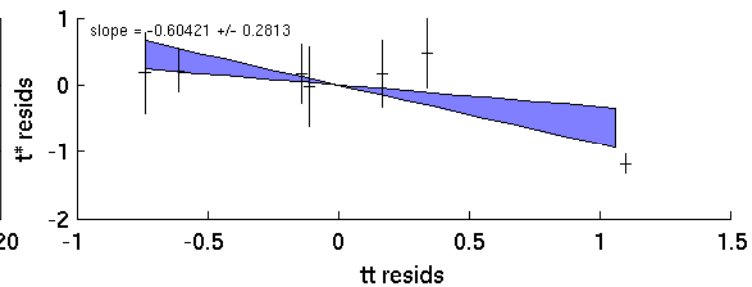
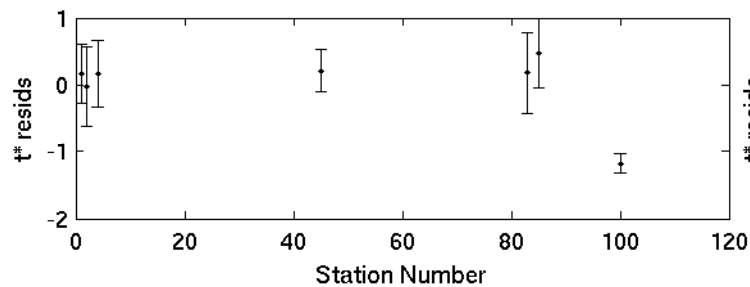
# Event\_2004\_249\_14\_57\_18



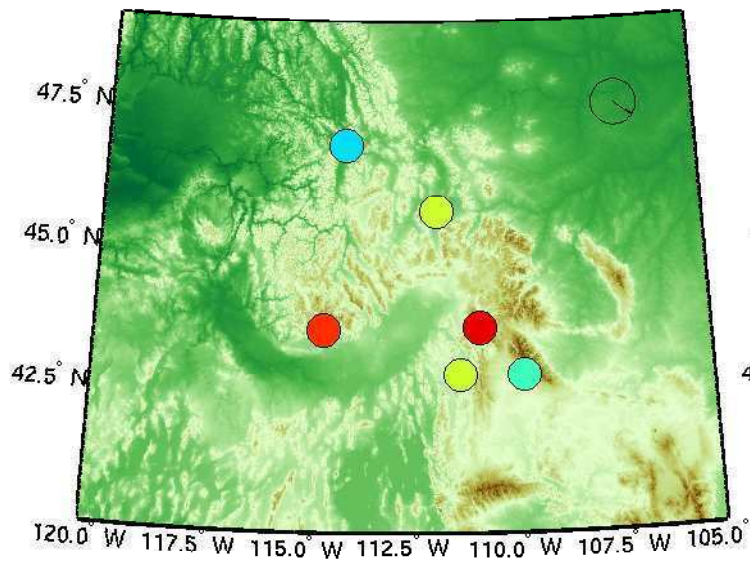
# Event\_2004\_249\_14\_57\_18



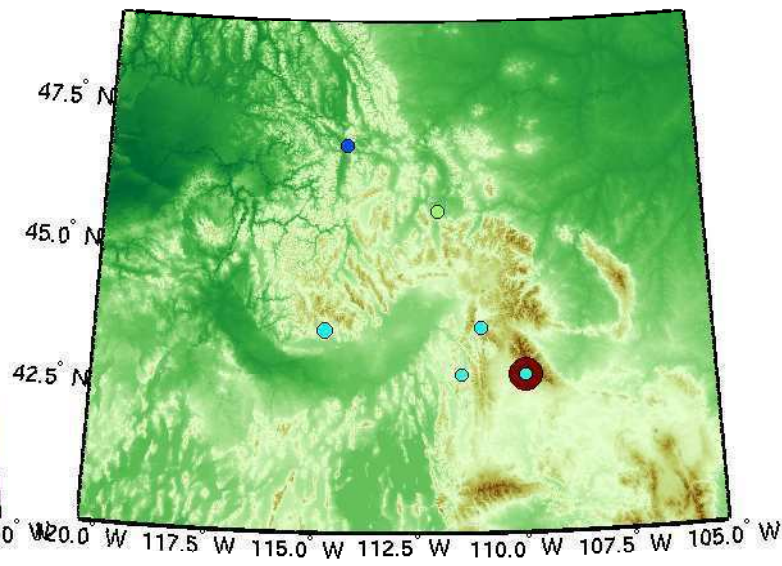
Baz = 307.8378  
Mean xcor value = 0.85857  
Range of  $t^*$  values is 1.6571  
Median  $t^*$  err is 0.49517



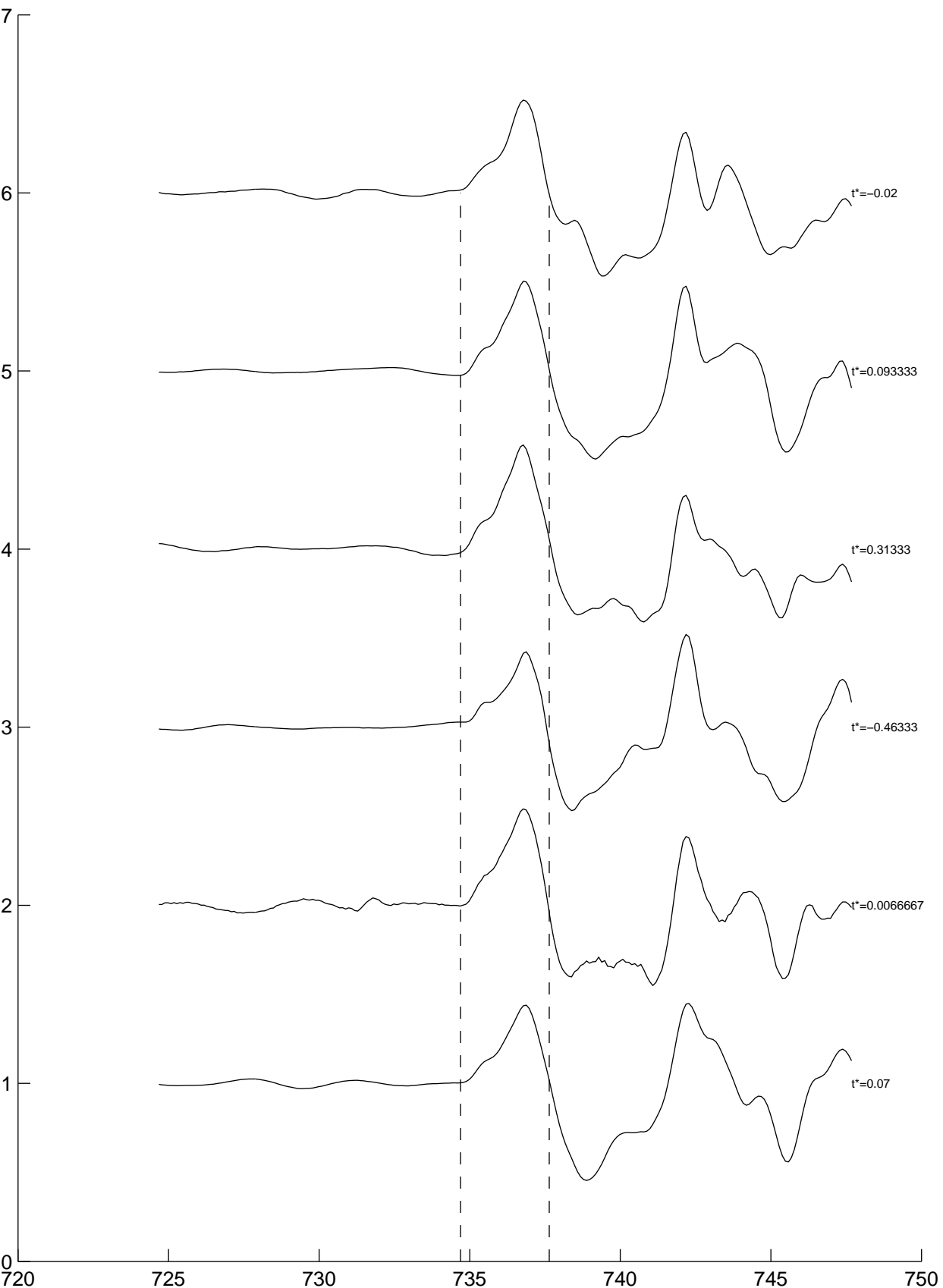
travel time residuals



$t^*$  values

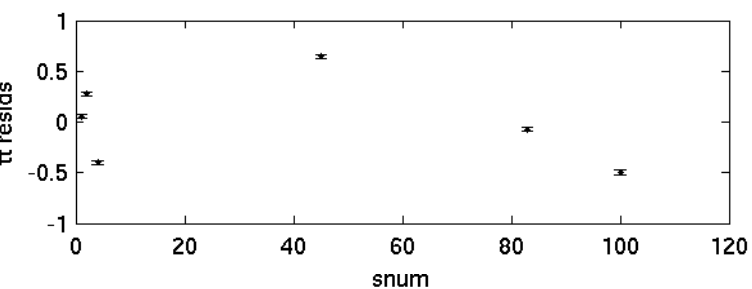
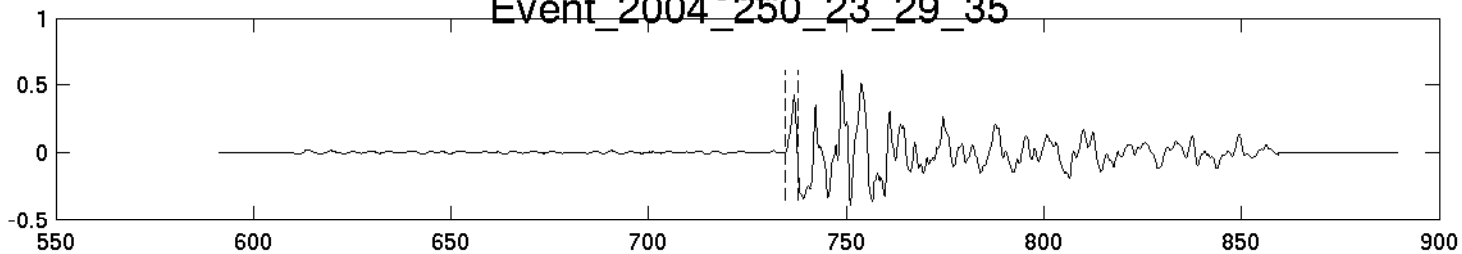


# Event\_2004\_250\_23\_29\_35

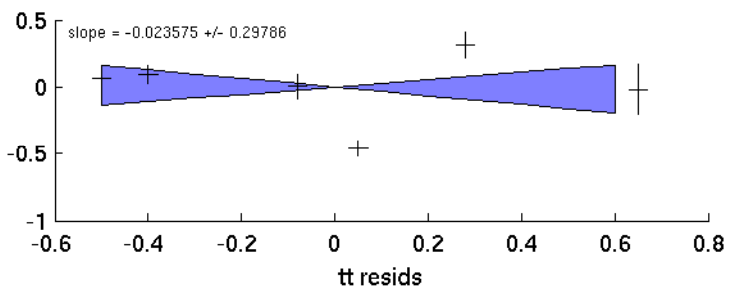
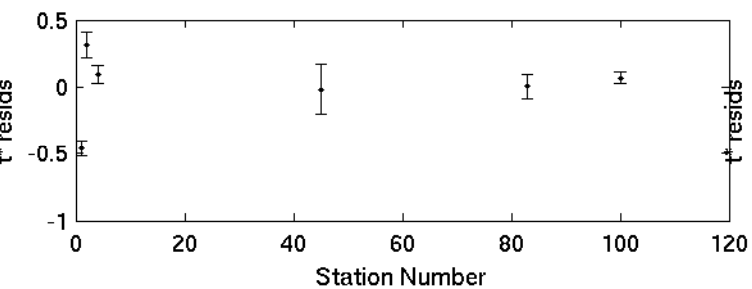


# Event\_2004\_250\_23\_29\_35

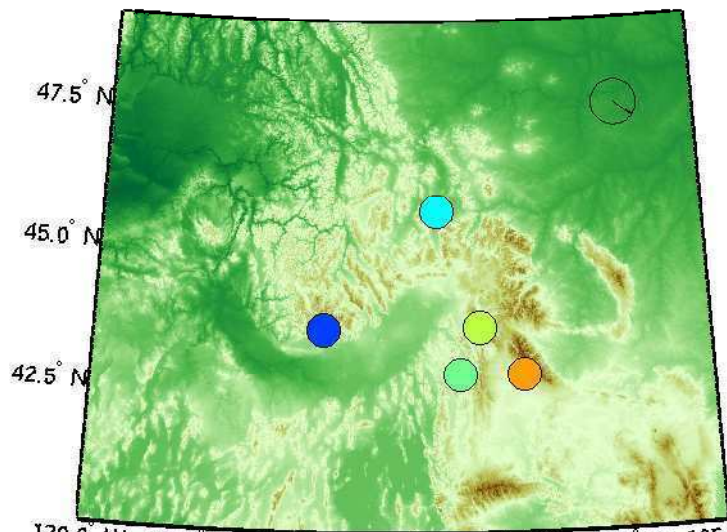
Stack



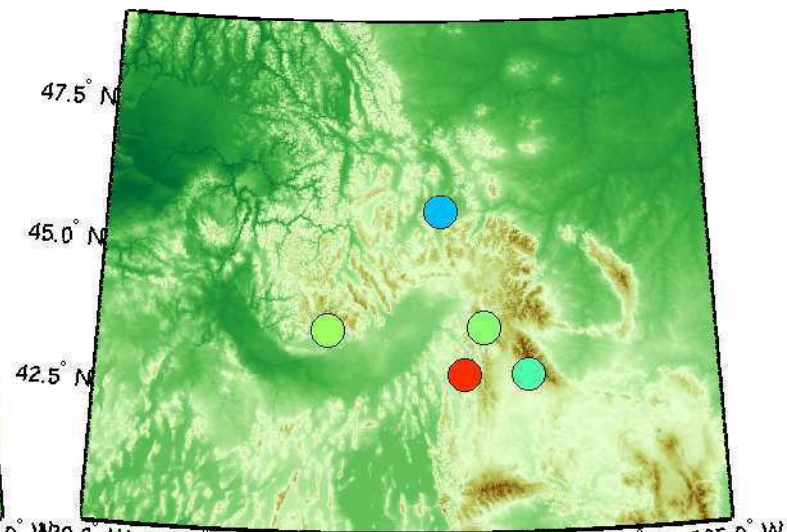
Baz = 307.7551  
Mean xcor value = 0.80333  
Range of  $t^*$  values is 0.77667  
Median  $t^*$  err is 0.077944



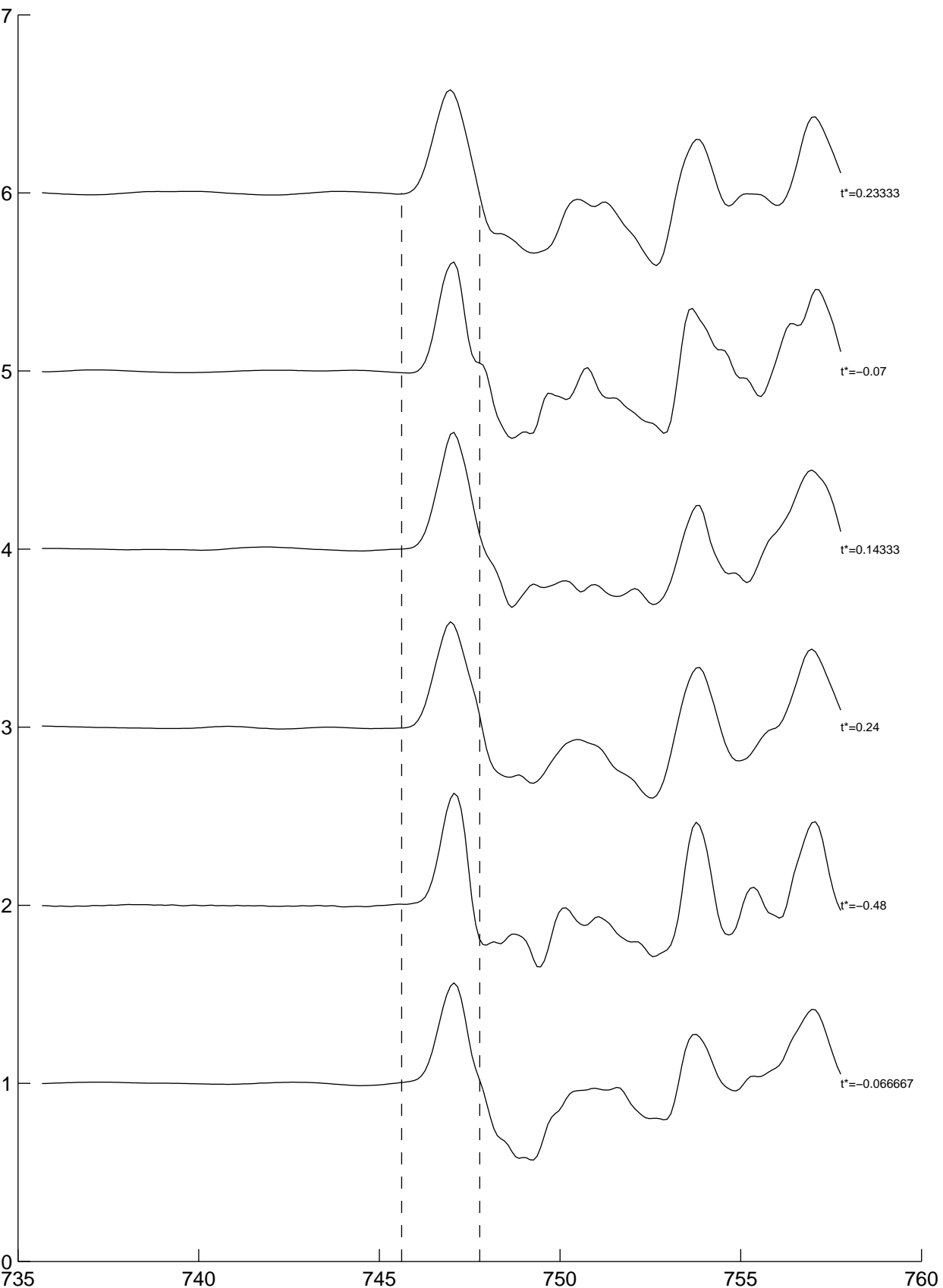
travel time residuals



$t^*$  values

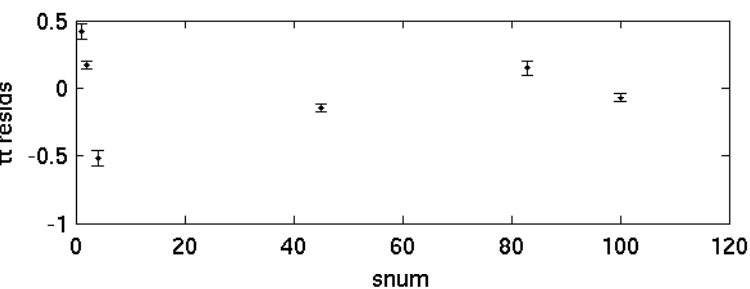
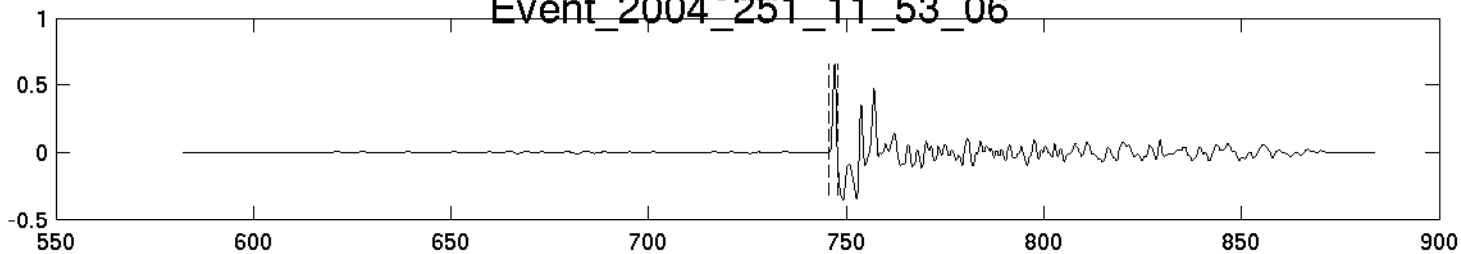


# Event\_2004\_251\_11\_53\_06

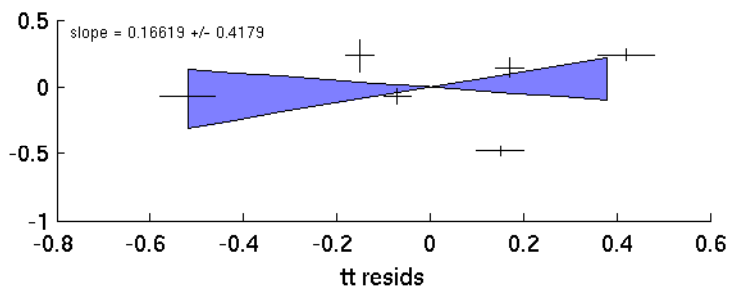
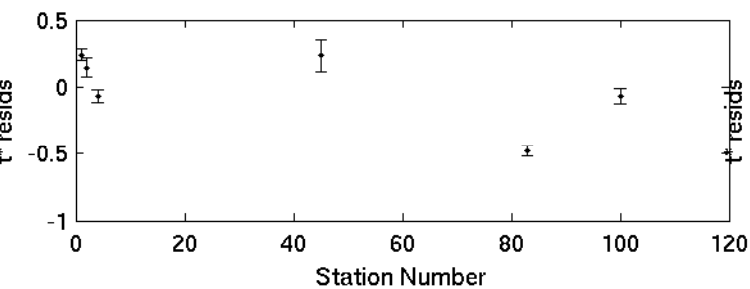


# Event\_2004\_251\_11\_53\_06

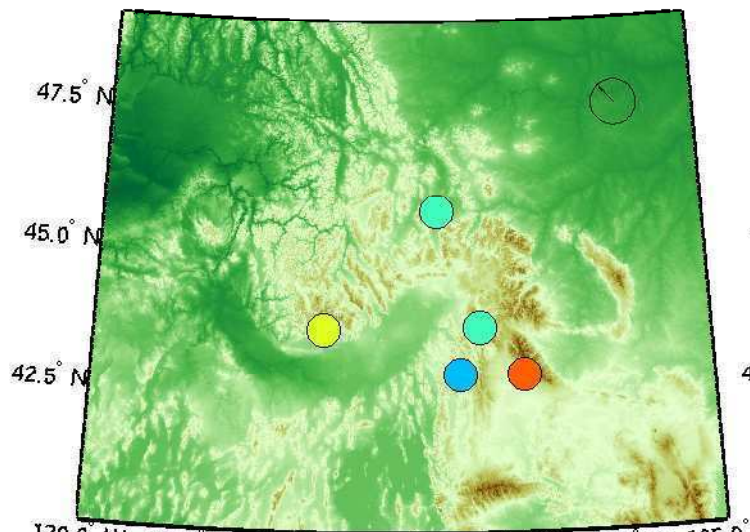
Stack



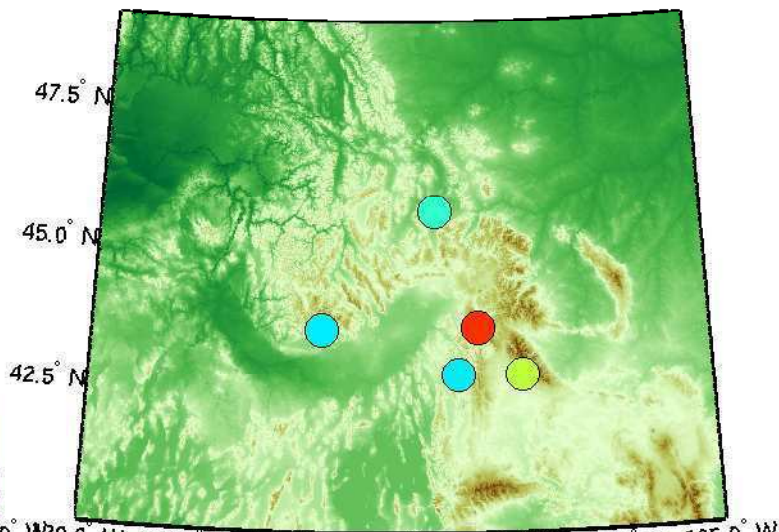
Baz = 140.7695  
Mean xcor value = 0.83667  
Range of  $t^*$  values is 0.72  
Median  $t^*$  err is 0.052678



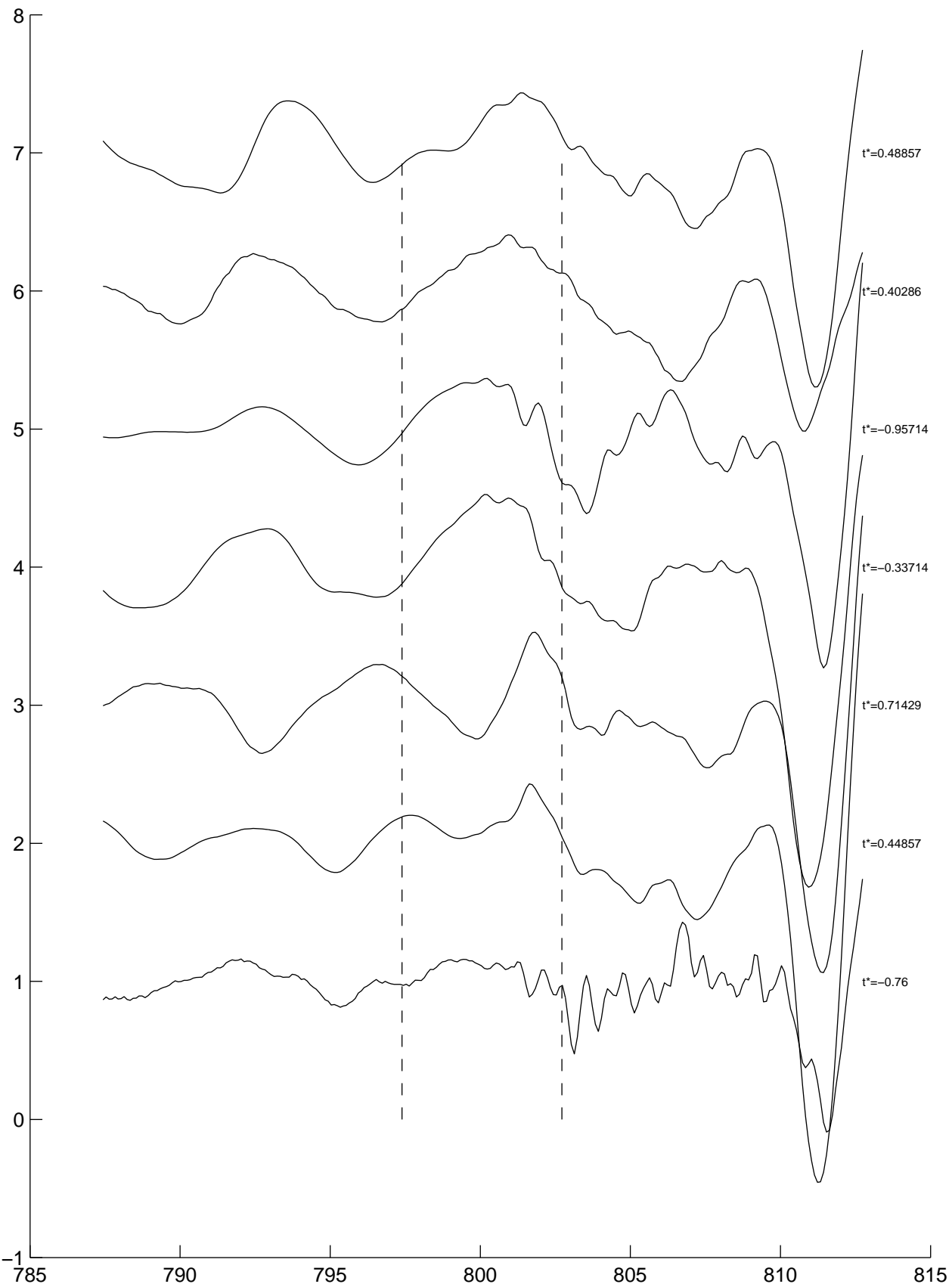
travel time residuals



$t^*$  values



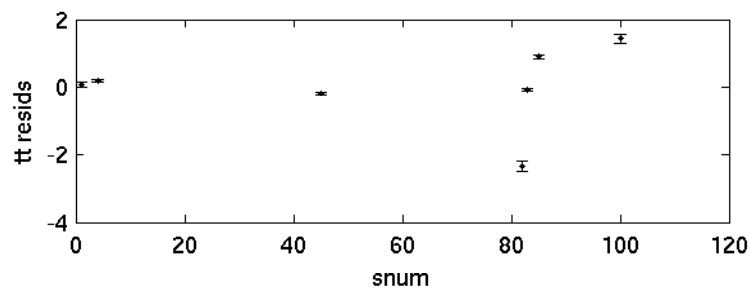
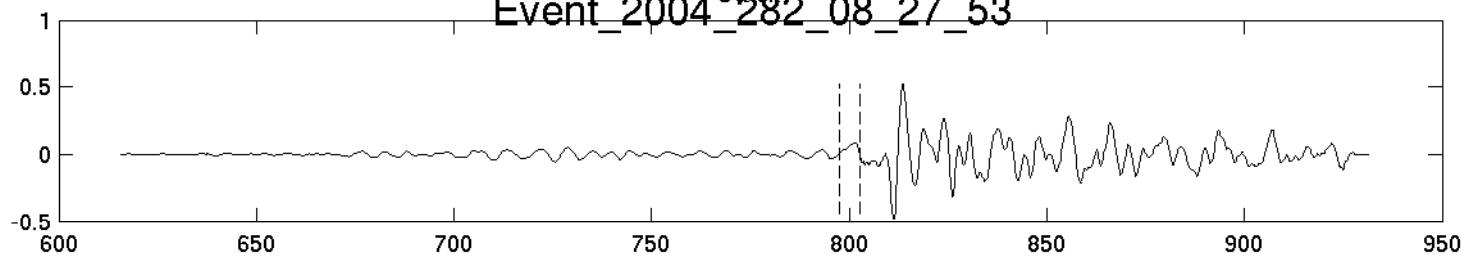
# Event\_2004\_282\_08\_27\_53



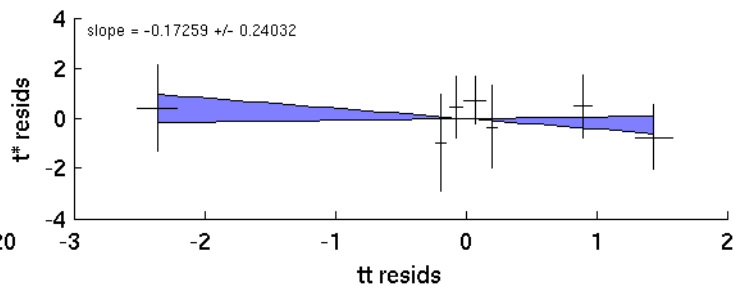
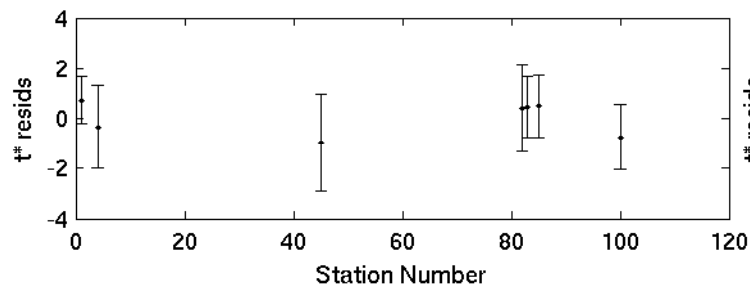


# Event\_2004\_282\_08\_27\_53

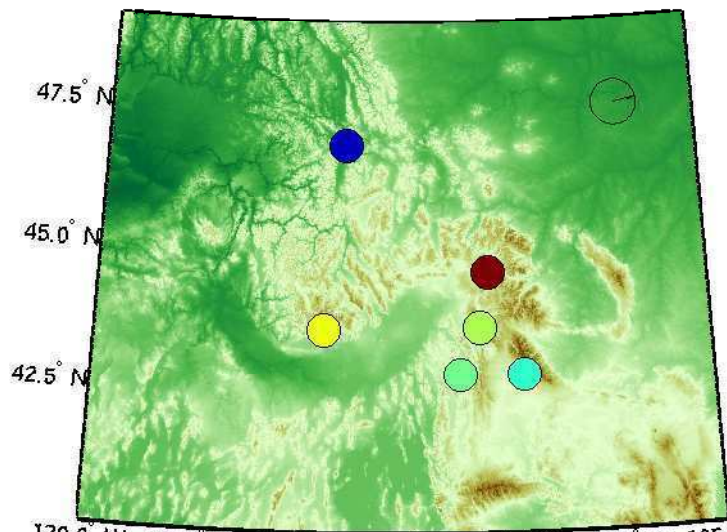
Stack



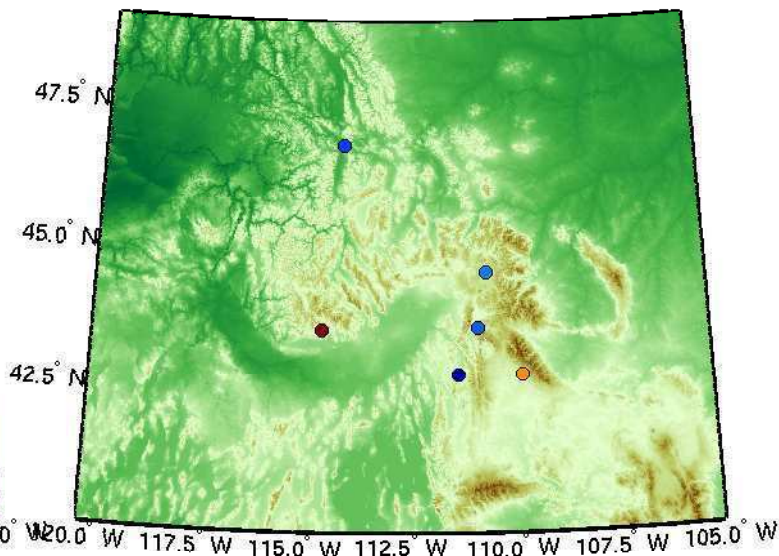
Baz = 259.6378  
Mean xcor value = 0.81  
Range of  $t^*$  values is 1.6714  
Median  $t^*$  err is 1.3016



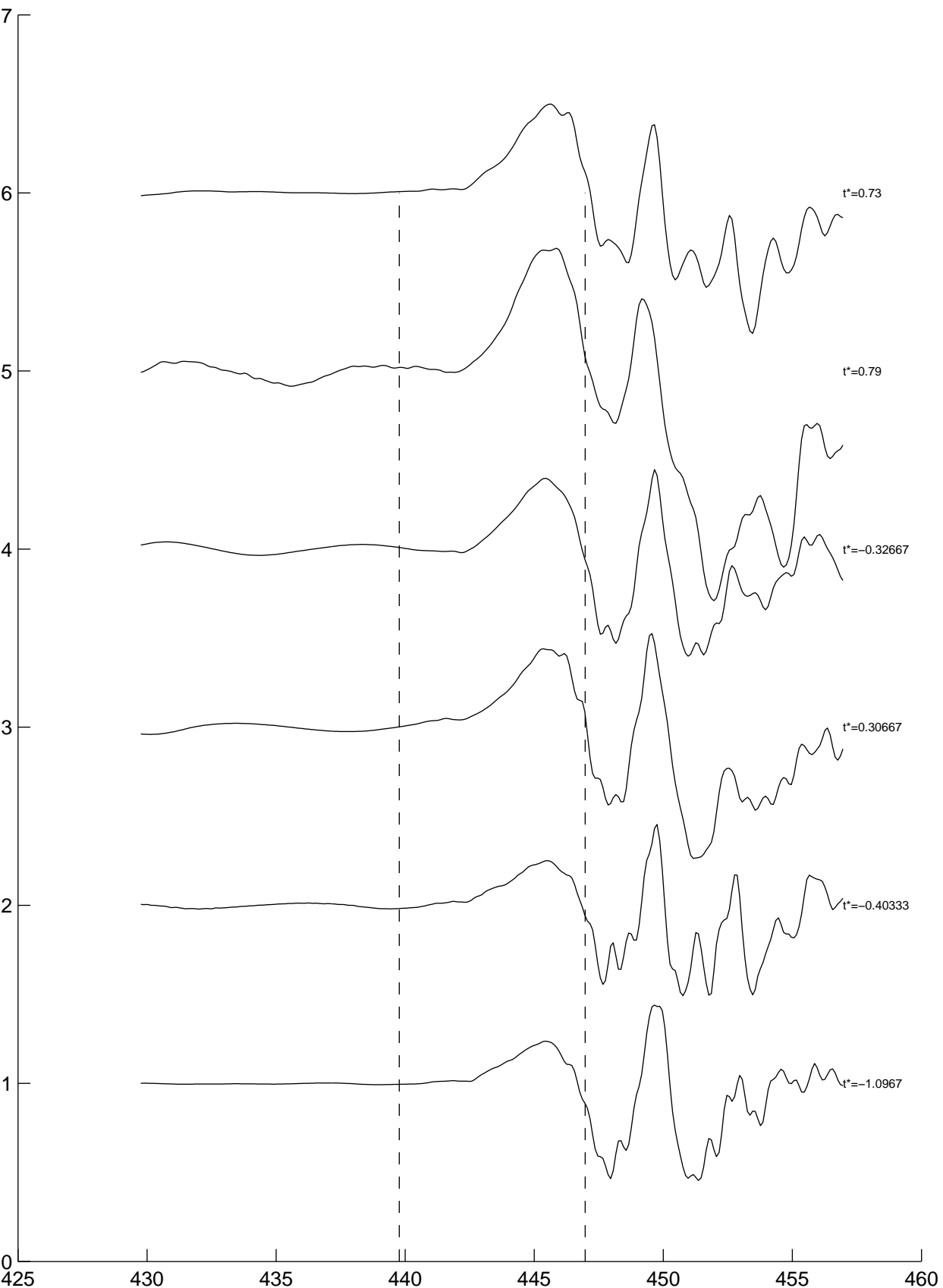
travel time residuals



$t^*$  values

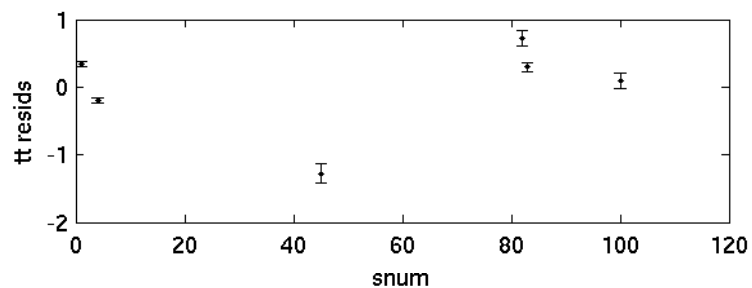
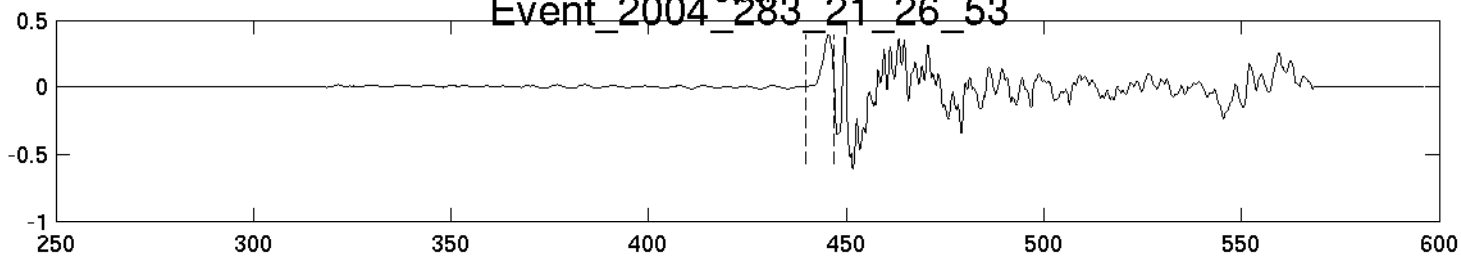


# Event\_2004\_283\_21\_26\_53

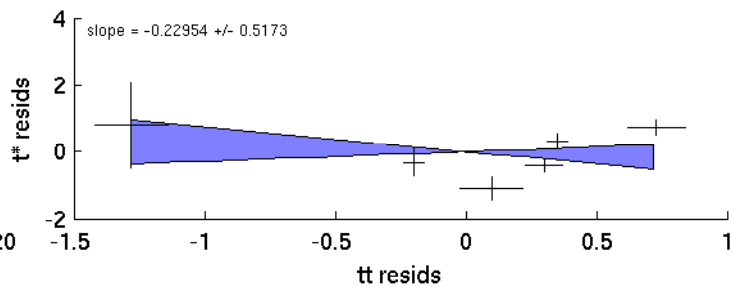
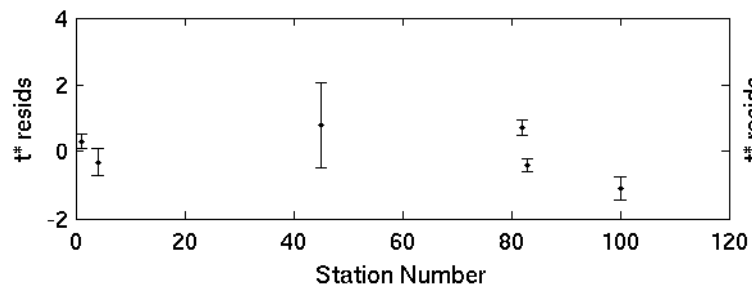


# Event\_2004\_283\_21\_26\_53

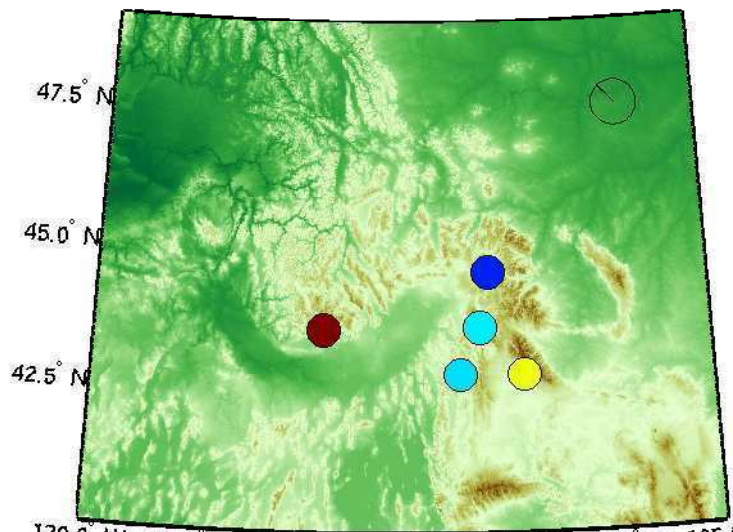
Stack



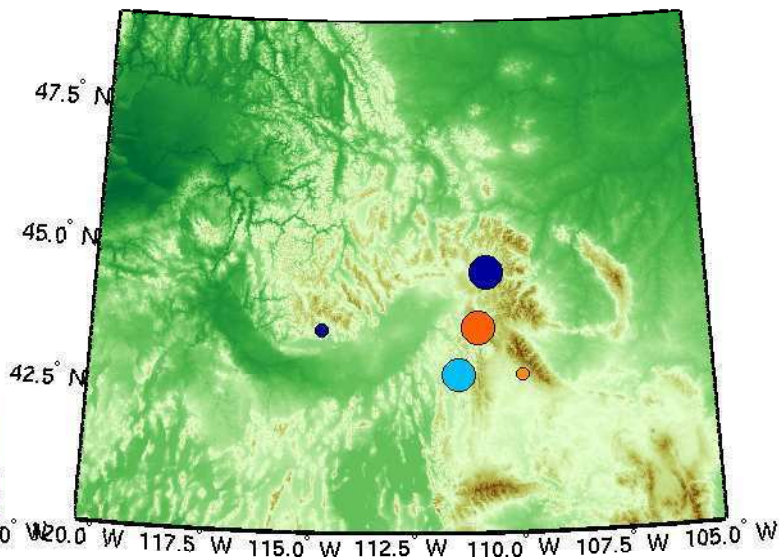
Baz = 139.1867  
Mean xcor value = 0.73333  
Range of  $t^*$  values is 1.8867  
Median  $t^*$  err is 0.29307



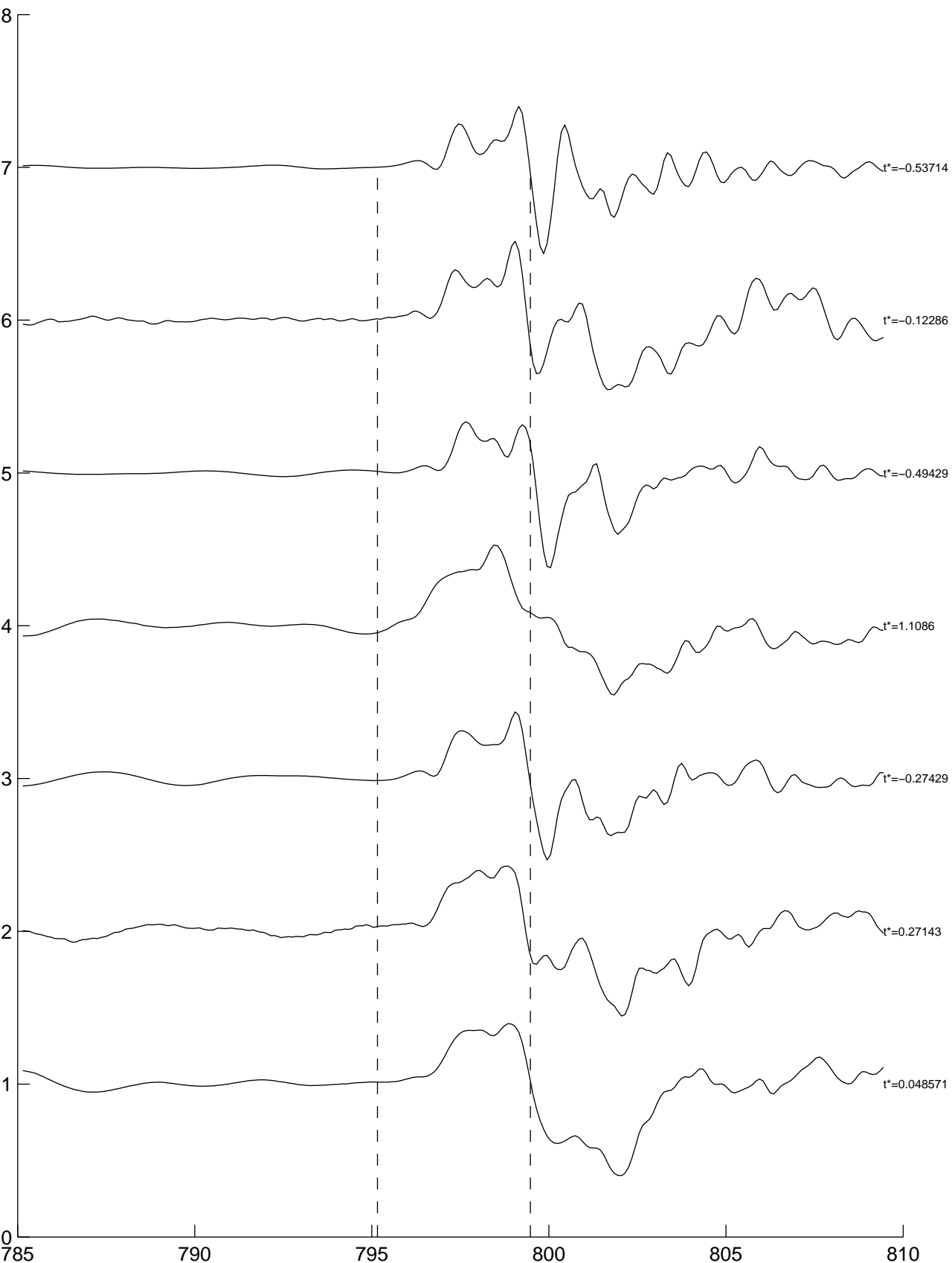
travel time residuals



$t^*$  values

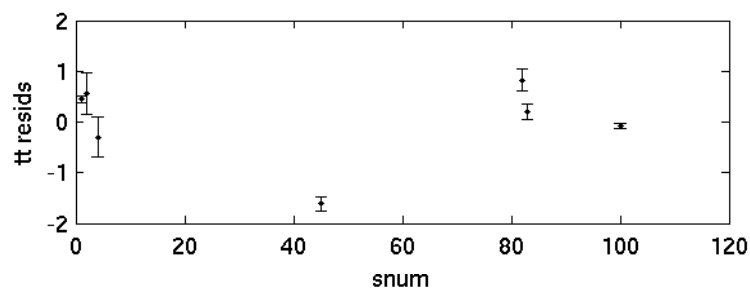
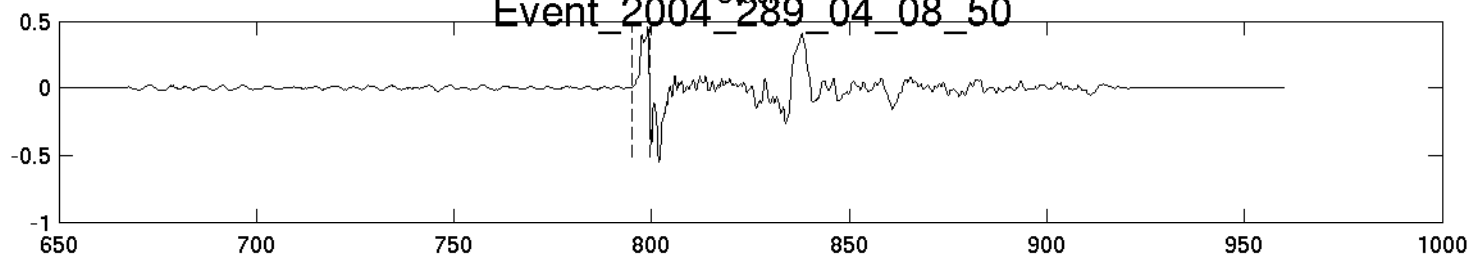


# Event\_2004\_289\_04\_08\_50

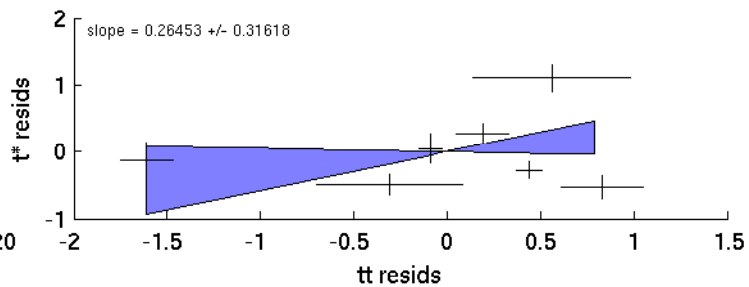
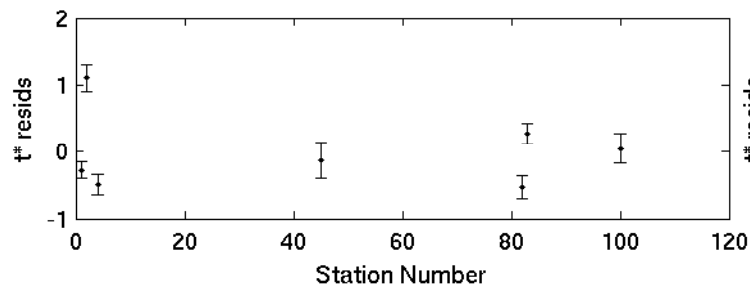


# Event\_2004\_289\_04\_08\_50

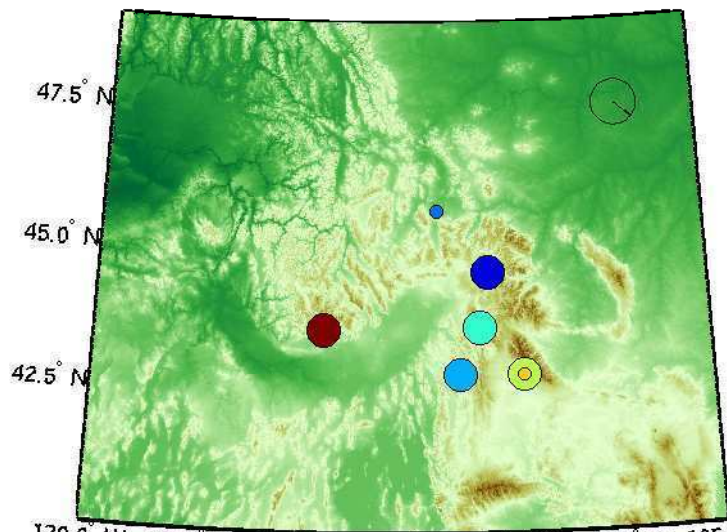
Stack



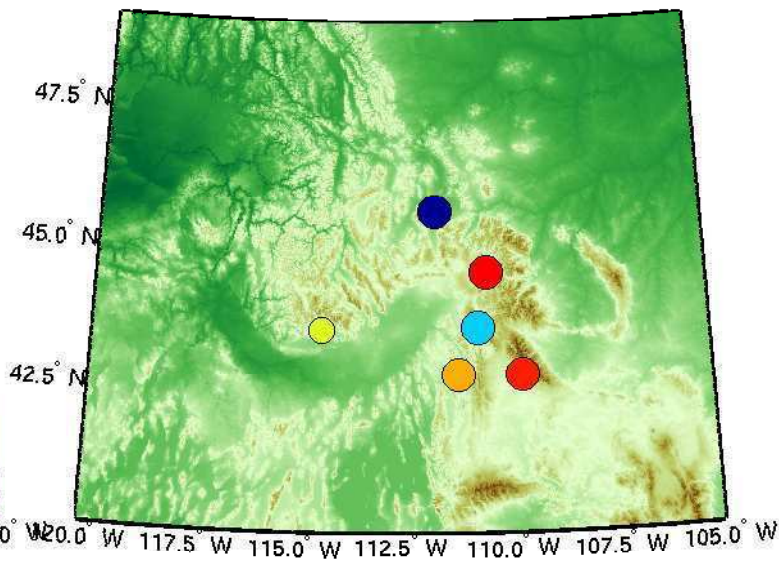
Baz = 312.242  
Mean xcor value = 0.68429  
Range of  $t^*$  values is 1.6457  
Median  $t^*$  err is 0.17433



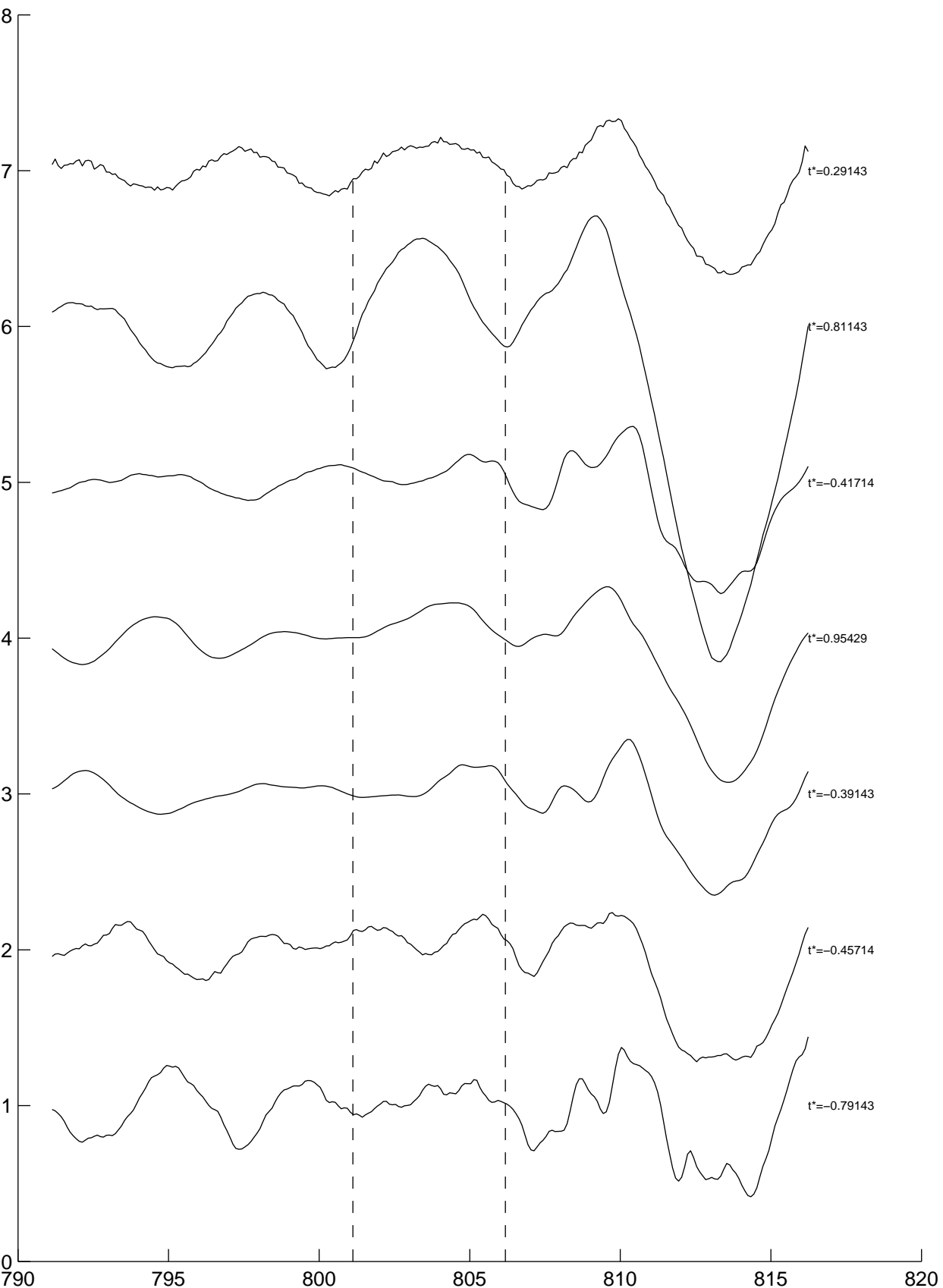
travel time residuals



$t^*$  values



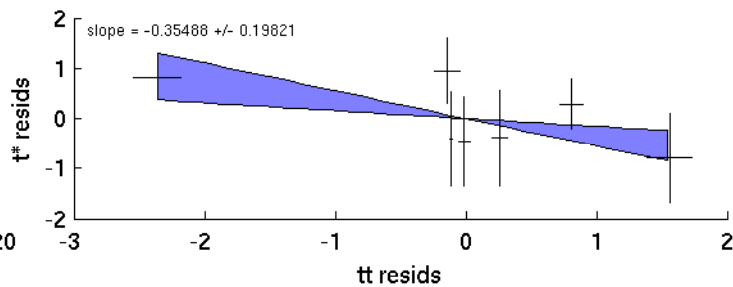
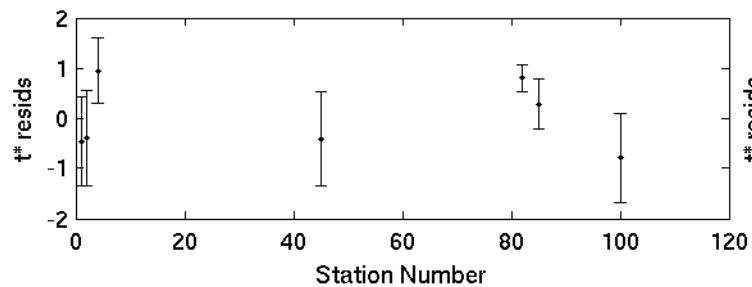
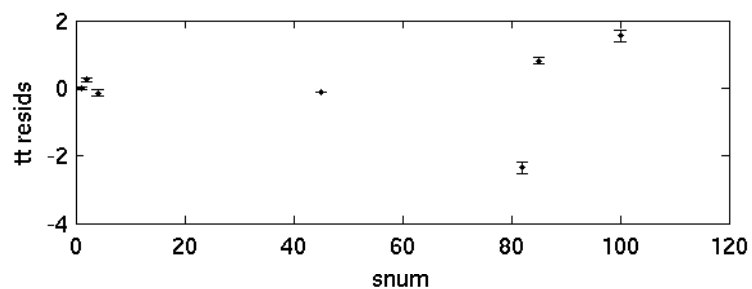
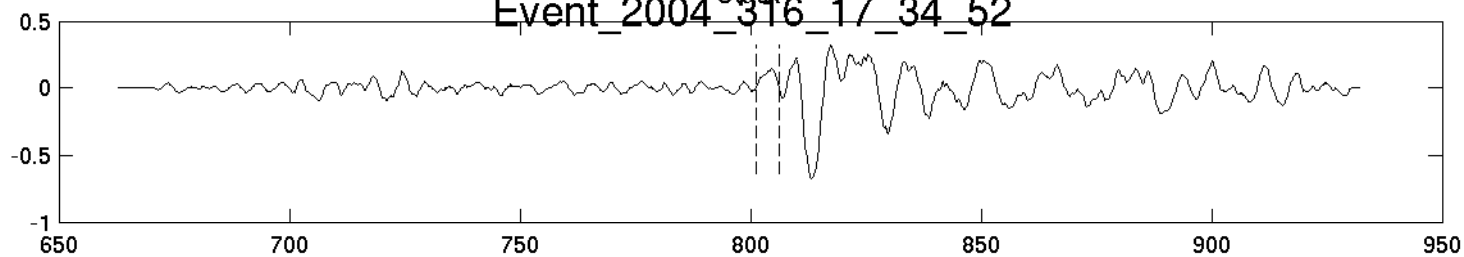
# Event\_2004\_316\_17\_34\_52



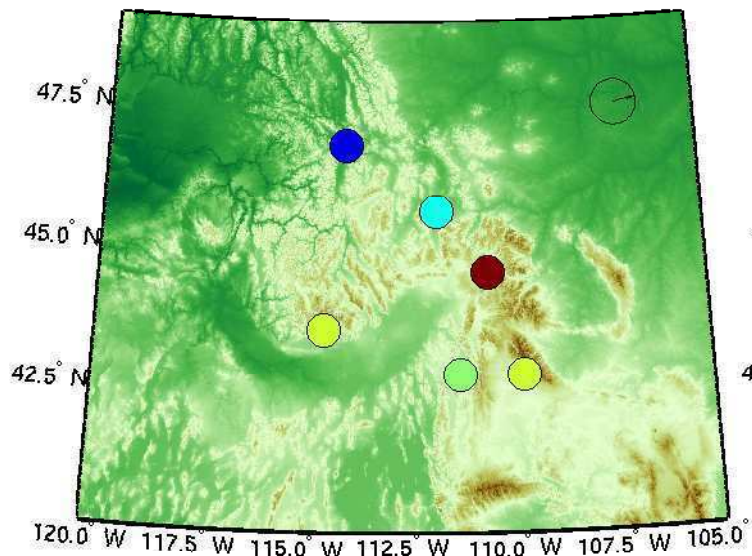


# Event\_2004\_316\_17\_34\_52

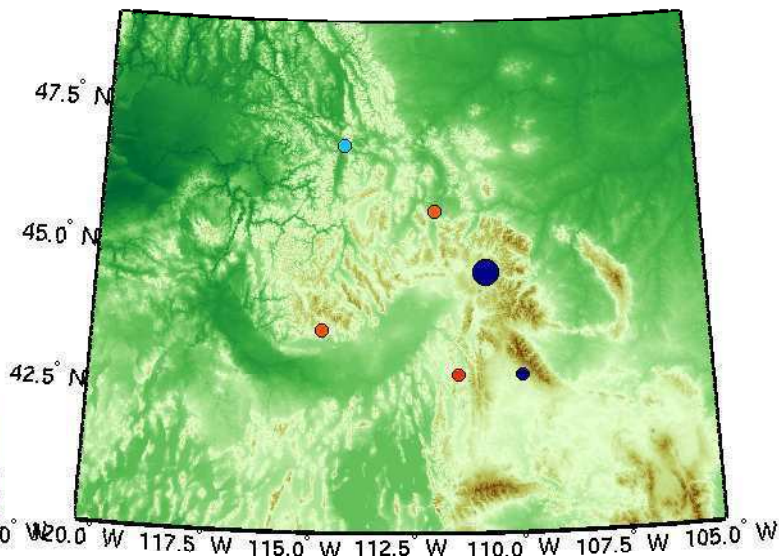
Stack



travel time residuals

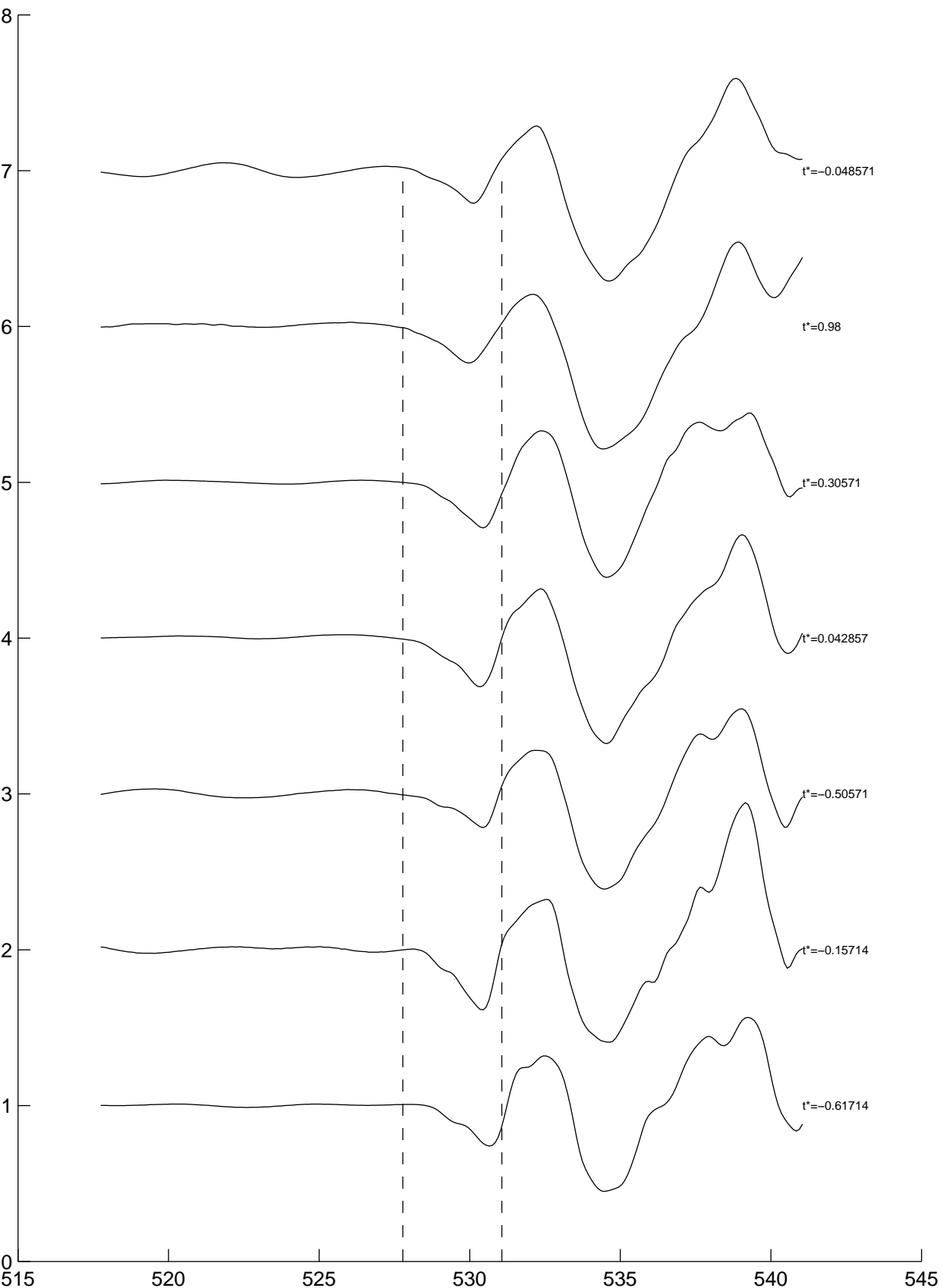


$t^*$  values

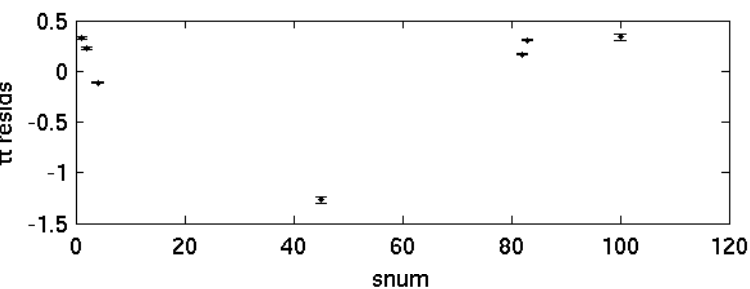
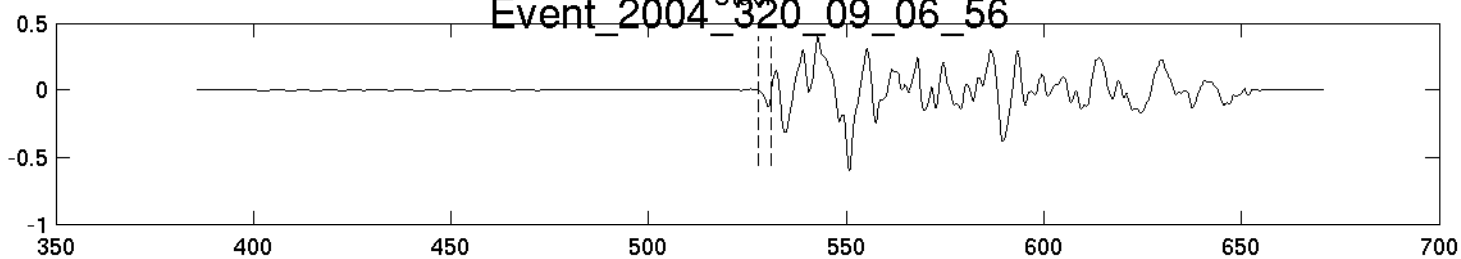




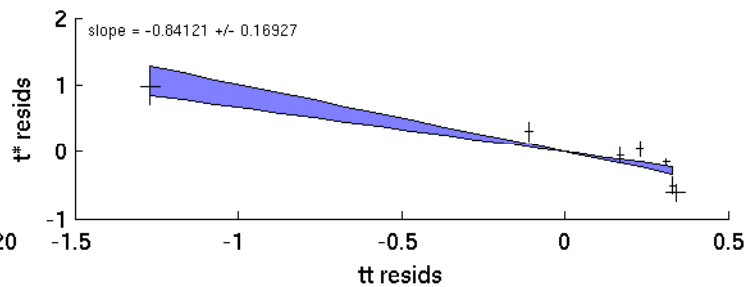
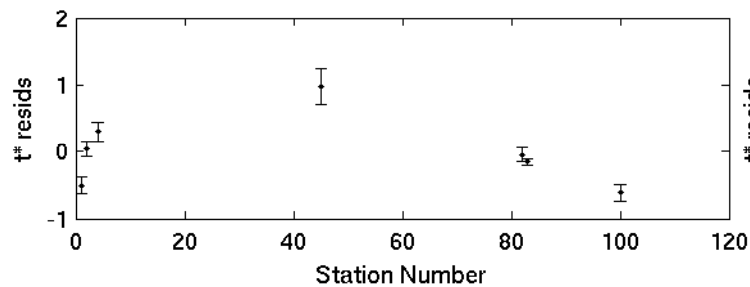
# Event\_2004\_320\_09\_06\_56



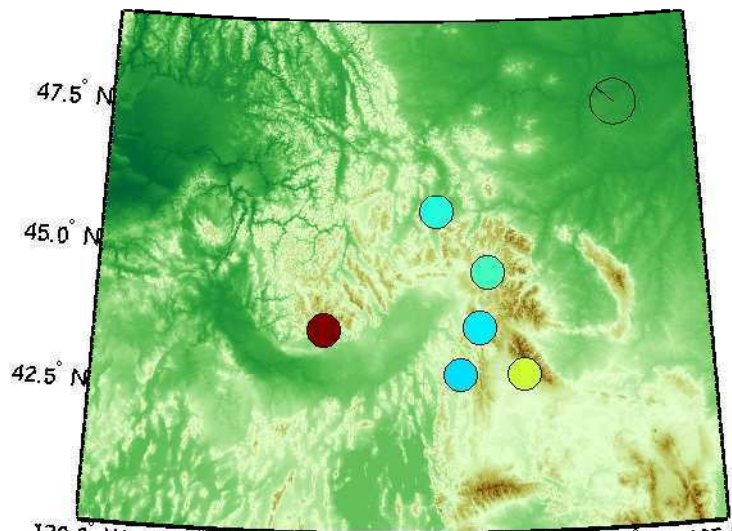
# Event\_2004\_320\_09\_06\_56



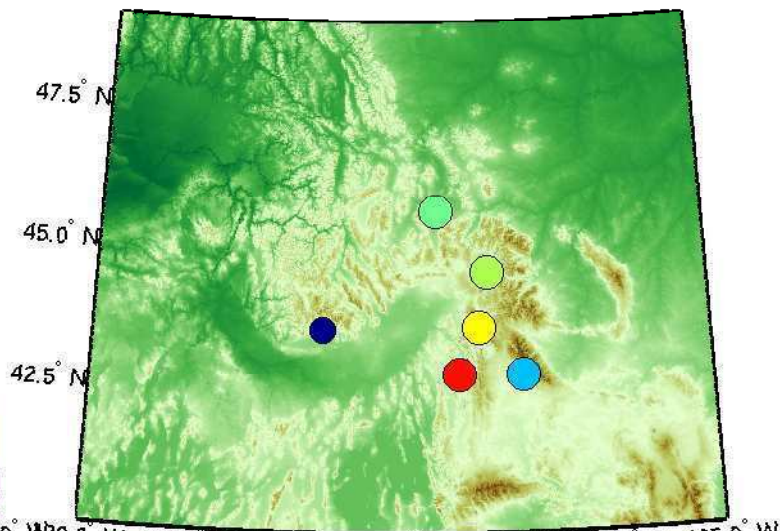
Baz = 132.9086  
 Mean xcor value = 0.84286  
 Range of  $t^*$  values is 1.5971  
 Median  $t^*$  err is 0.11952



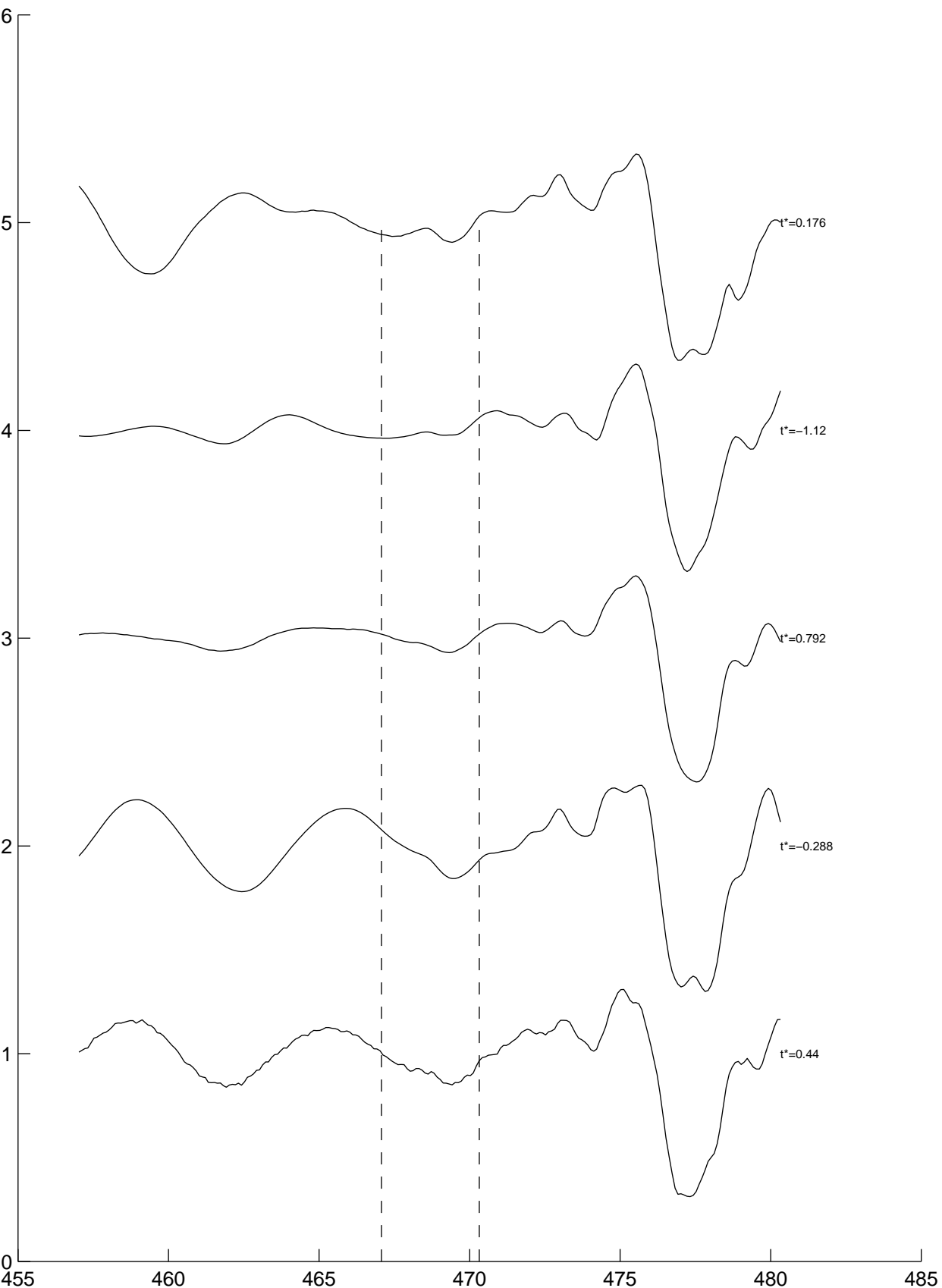
travel time residuals



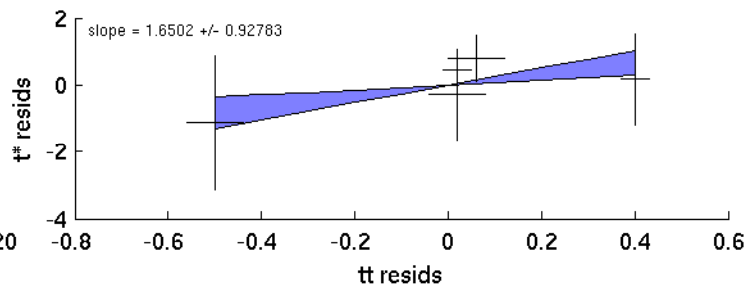
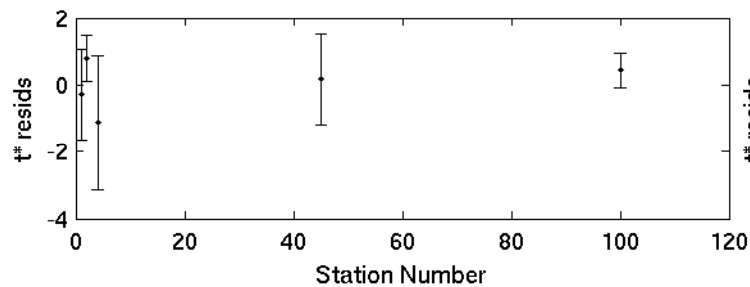
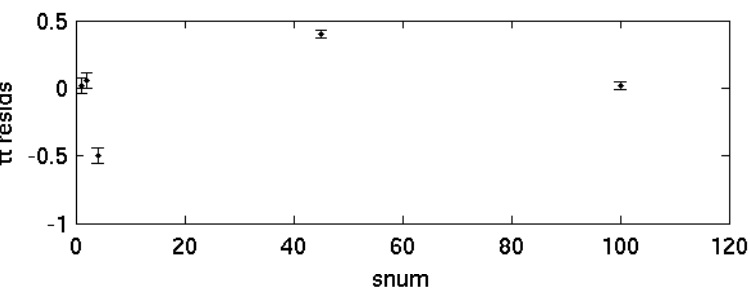
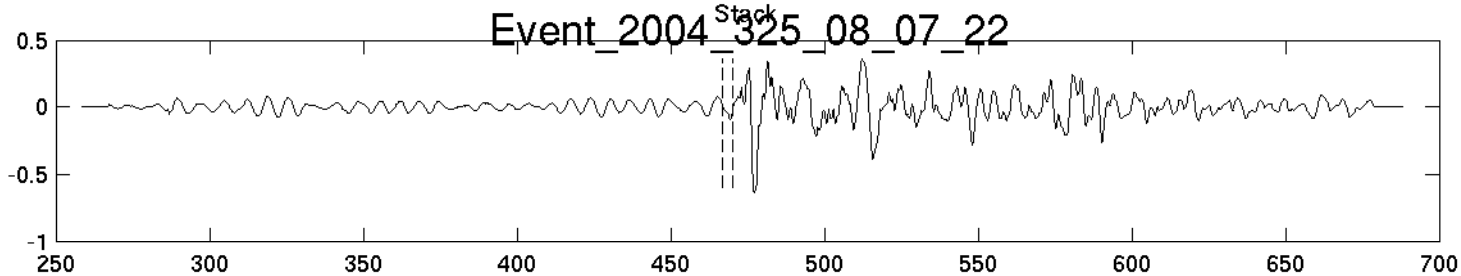
$t^*$  values



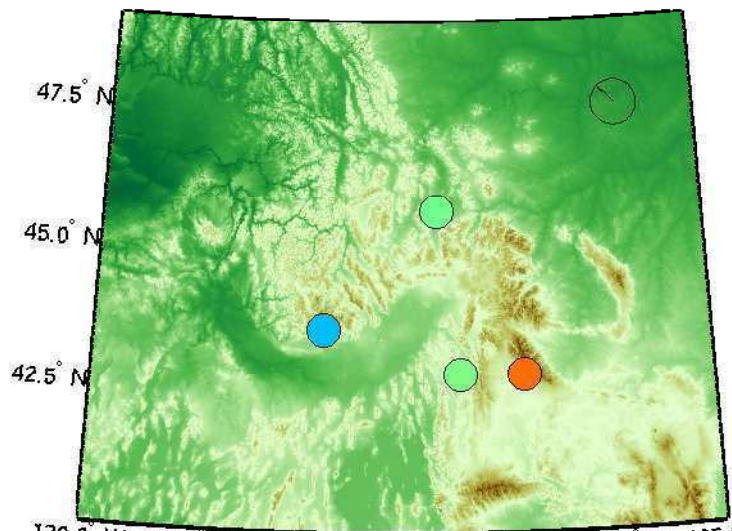
# Event\_2004\_325\_08\_07\_22



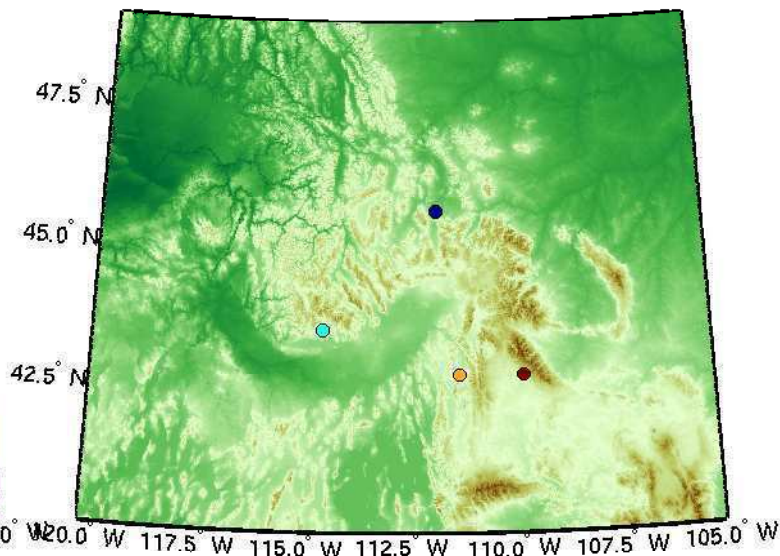
# Event\_2004\_325\_08\_07\_22



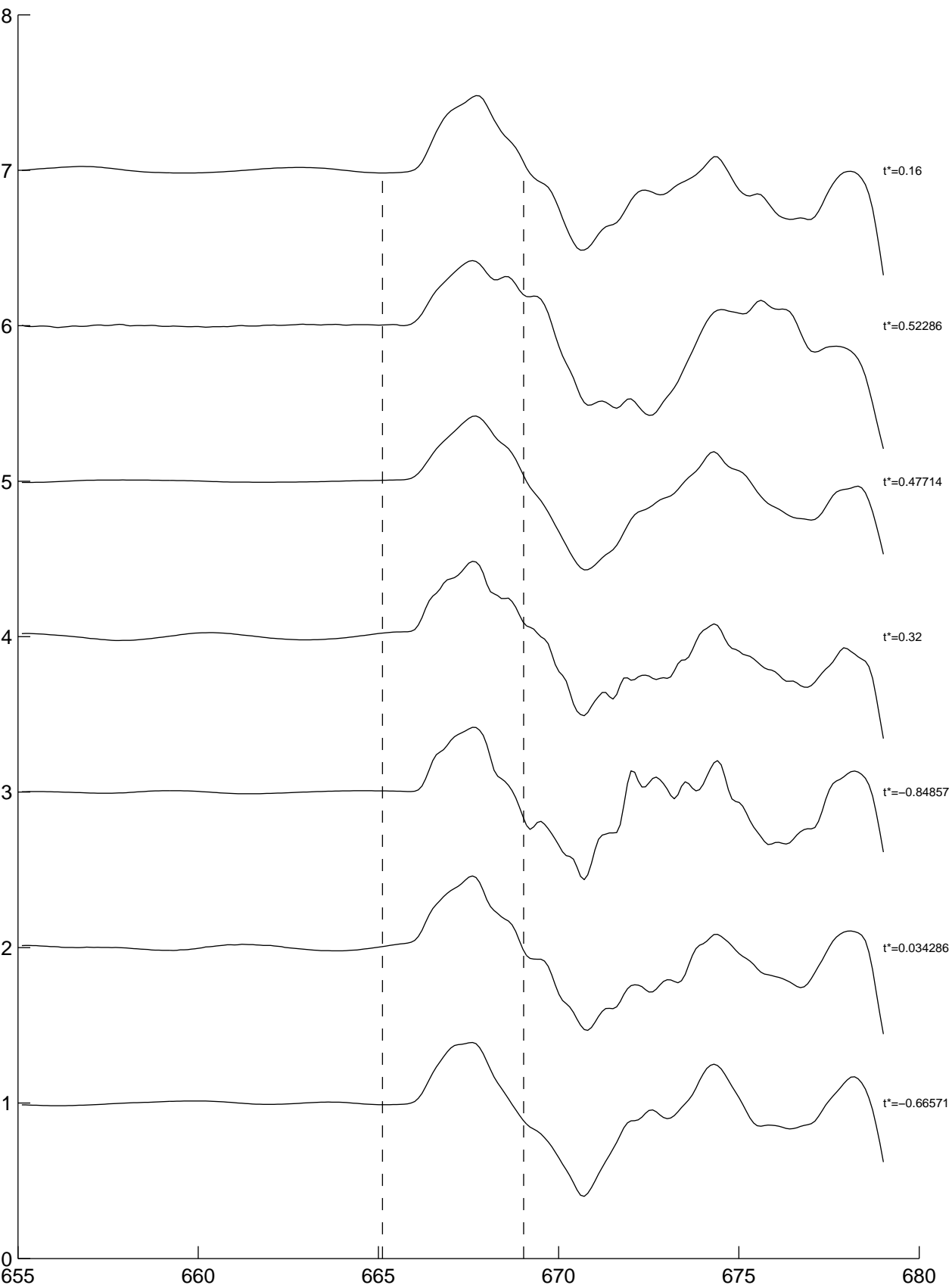
travel time residuals



$t^*$  values

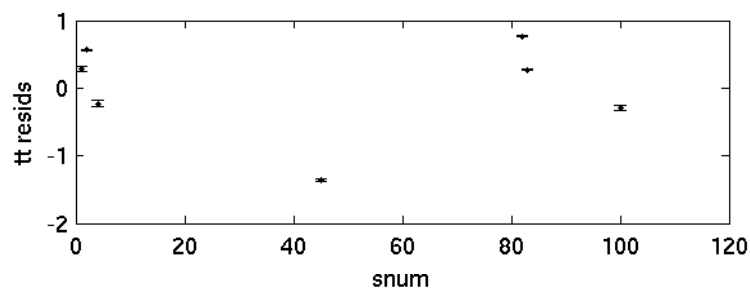
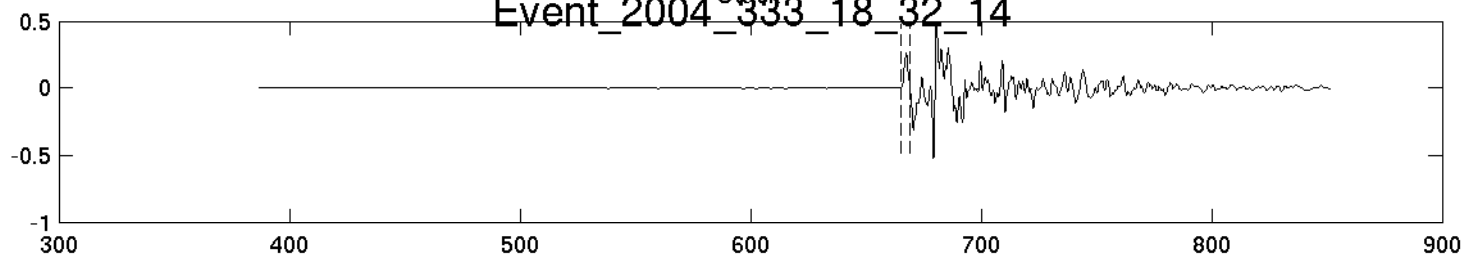


# Event\_2004\_333\_18\_32\_14

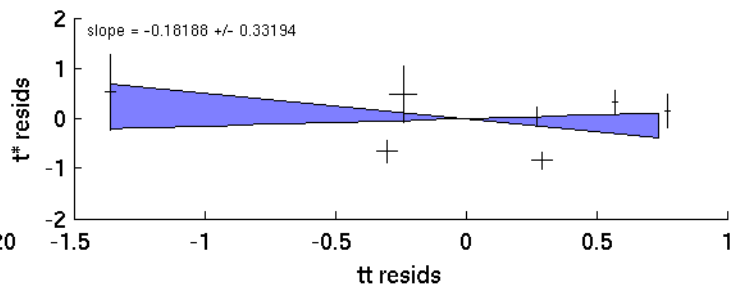
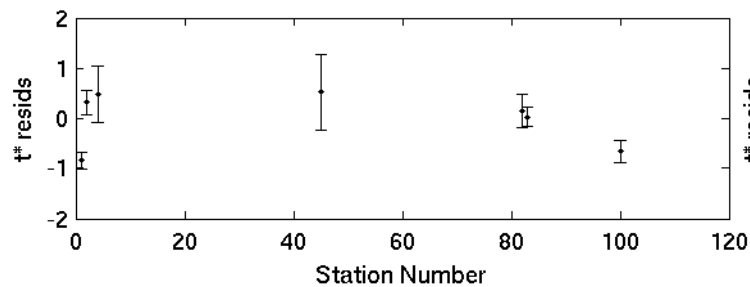


# Event\_2004\_333\_18\_32\_14

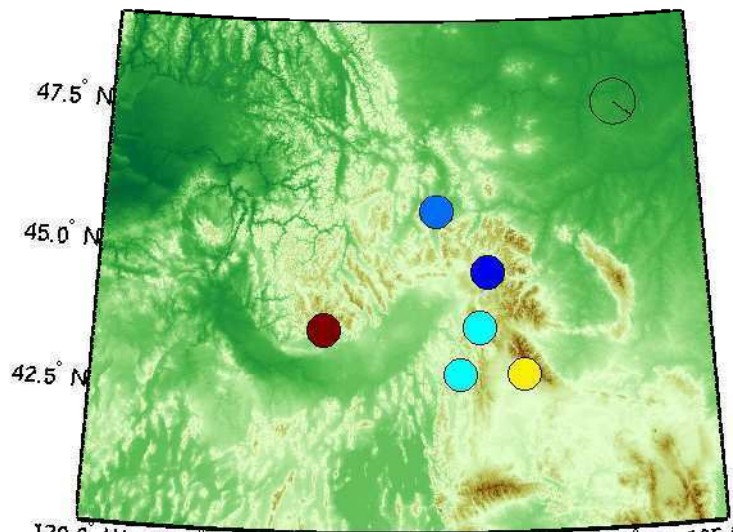
Stack



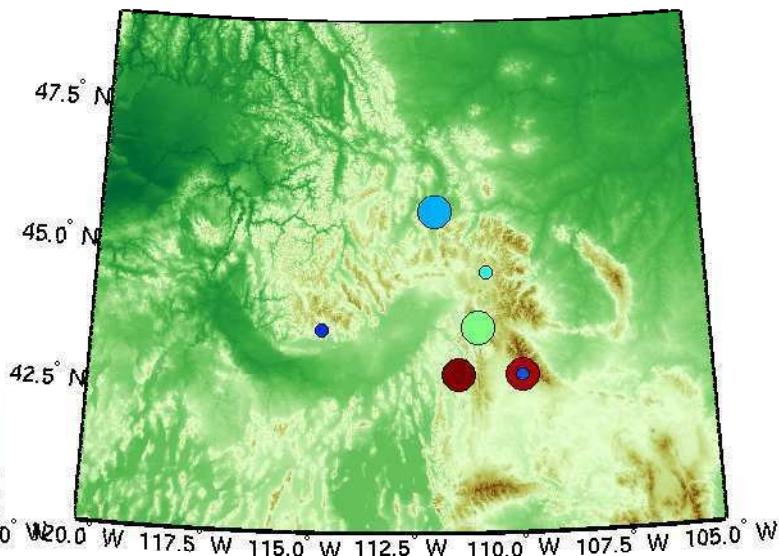
Baz = 310.5399  
Mean xcor value = 0.81286  
Range of  $t^*$  values is 1.3714  
Median  $t^*$  err is 0.23598



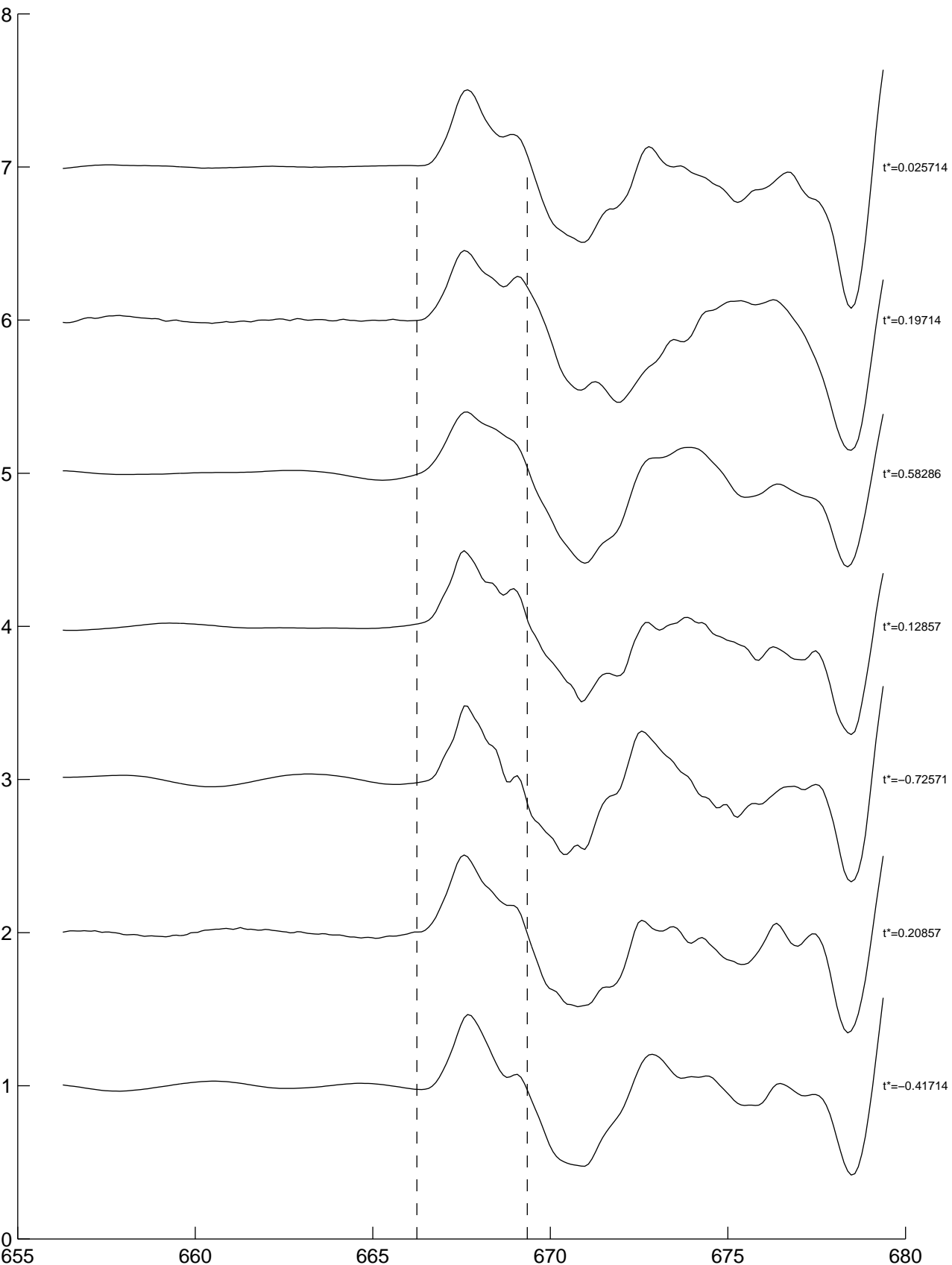
travel time residuals



$t^*$  values

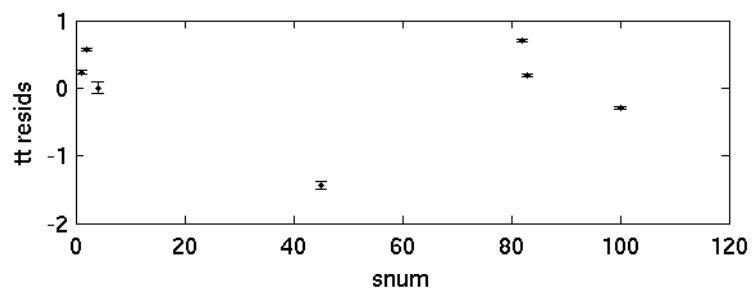
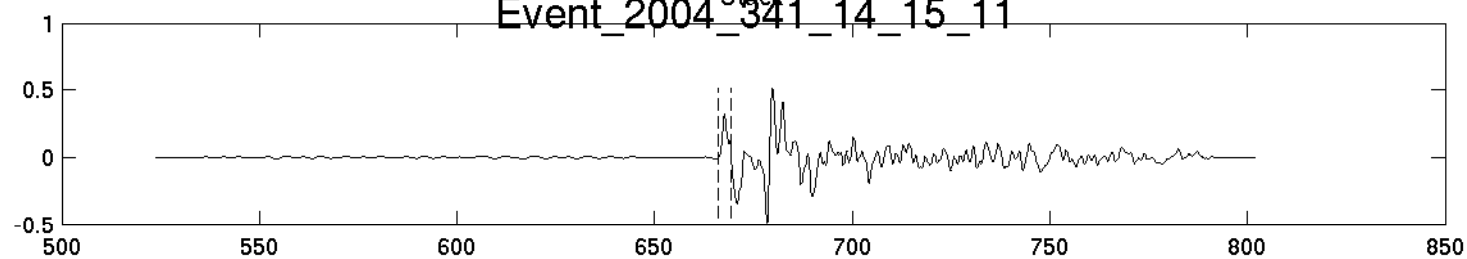


# Event\_2004\_341\_14\_15\_11

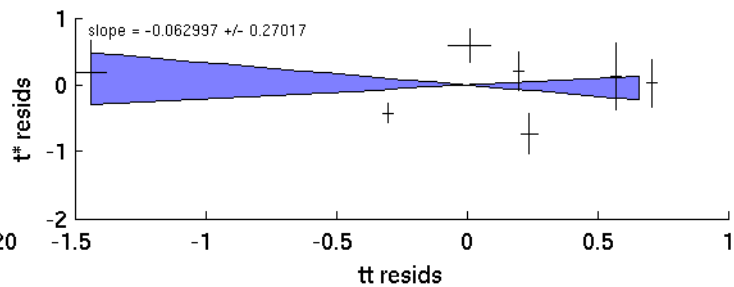
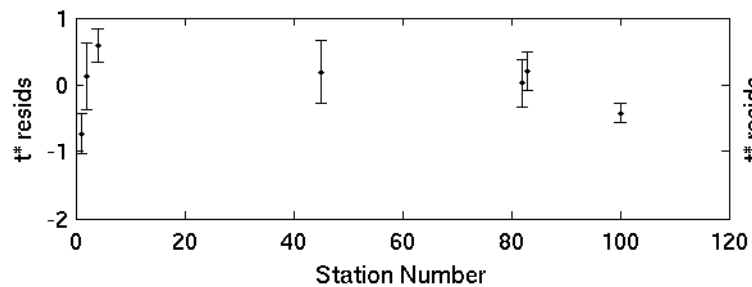




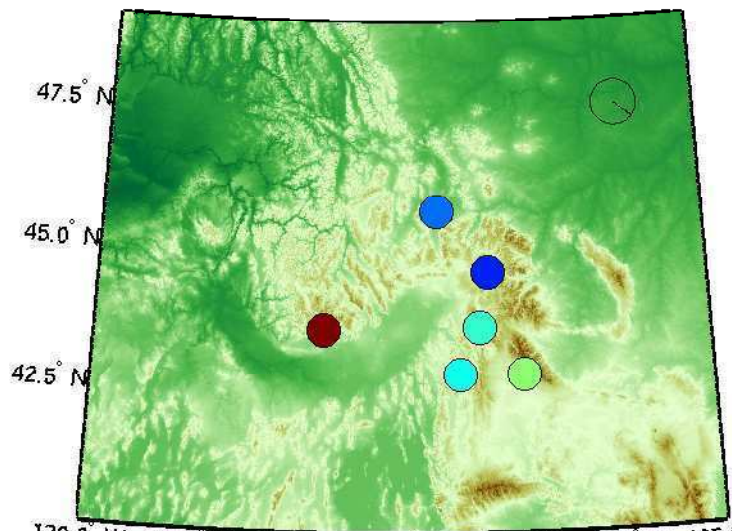
# Event\_2004\_341\_14\_15\_11



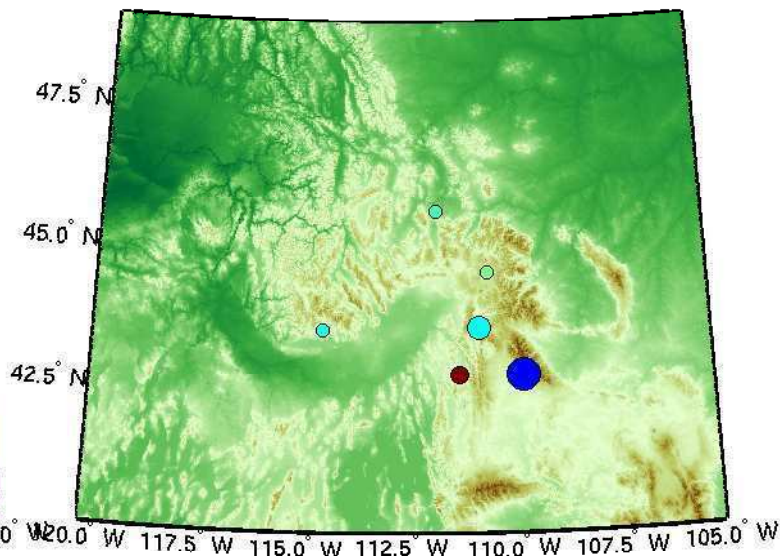
Baz = 310.3986  
 Mean xcor value = 0.81  
 Range of  $t^*$  values is 1.3086  
 Median  $t^*$  err is 0.30036



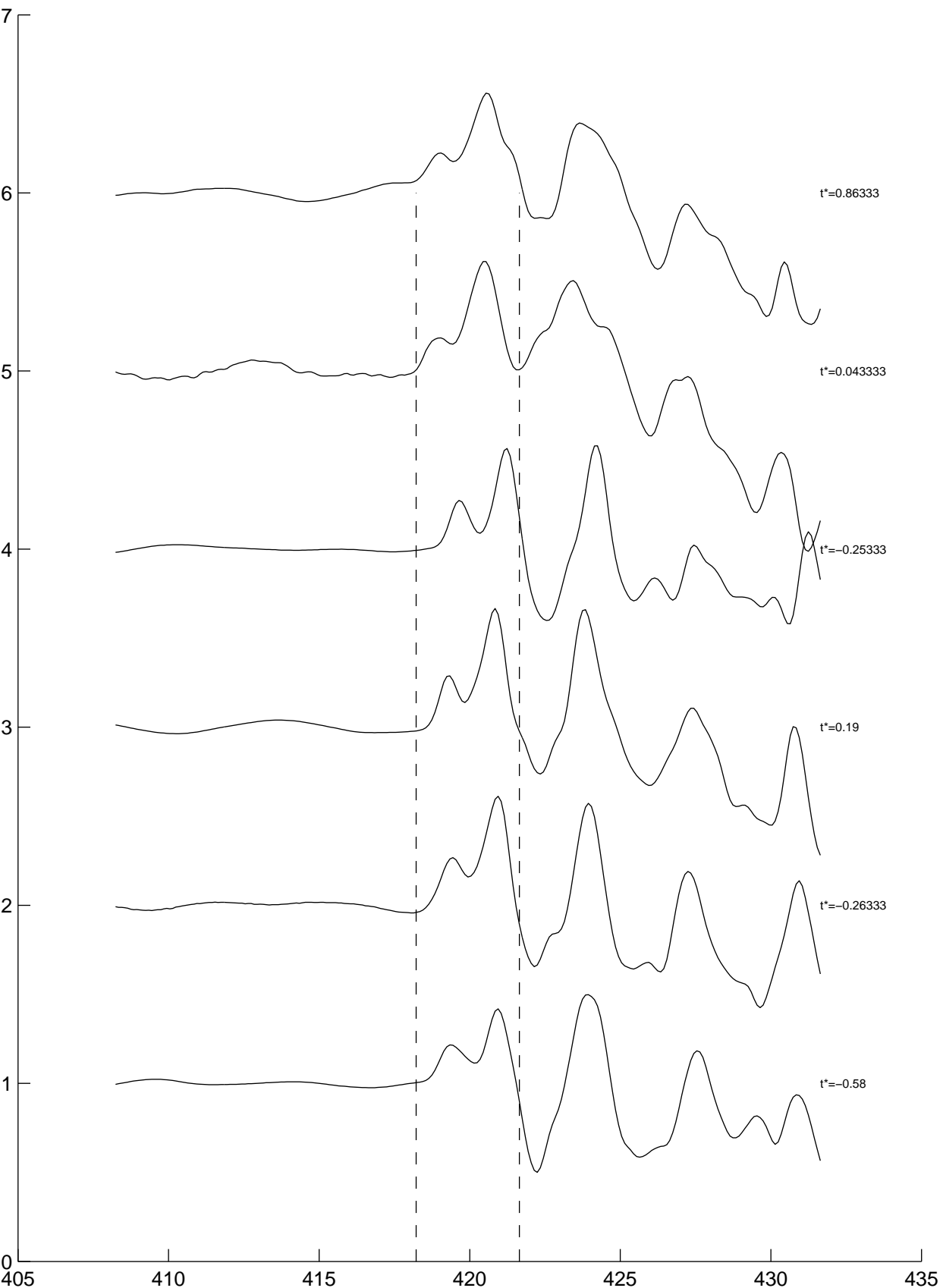
travel time residuals



$t^*$  values

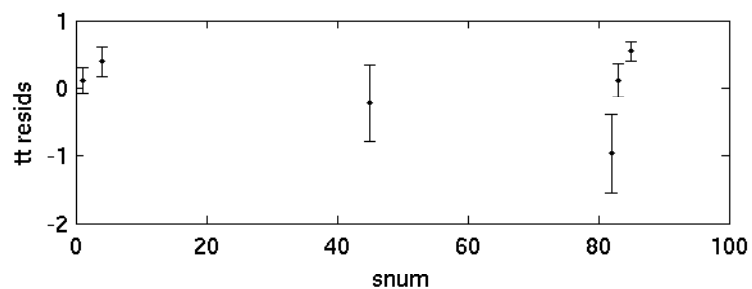
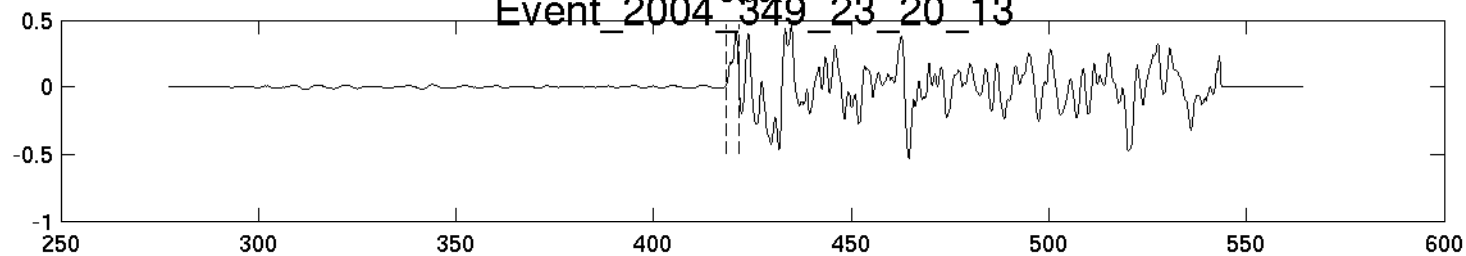


# Event\_2004\_349\_23\_20\_13

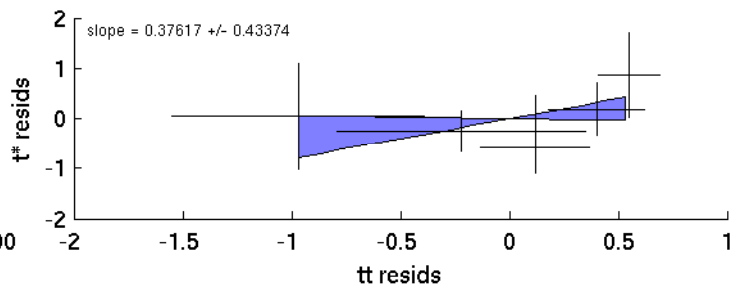
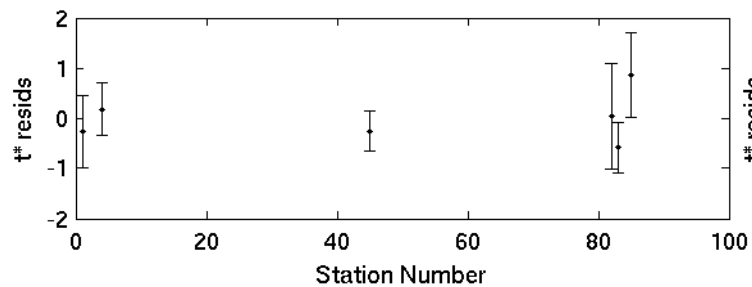


# Event\_2004\_349\_23\_20\_13

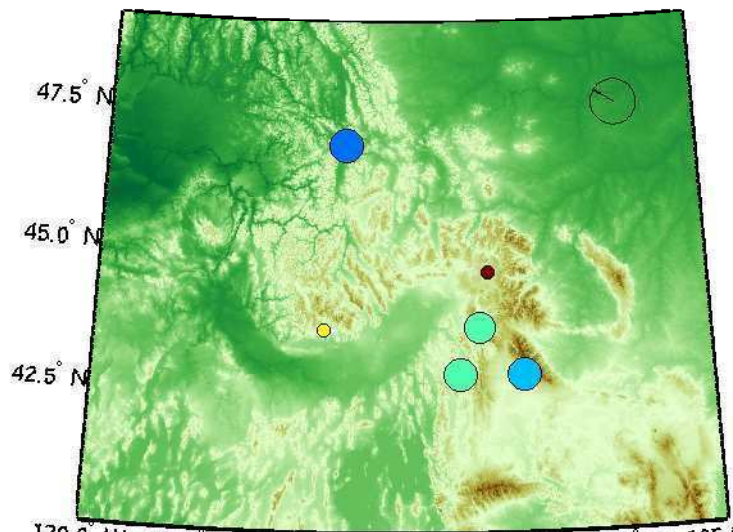
Stack



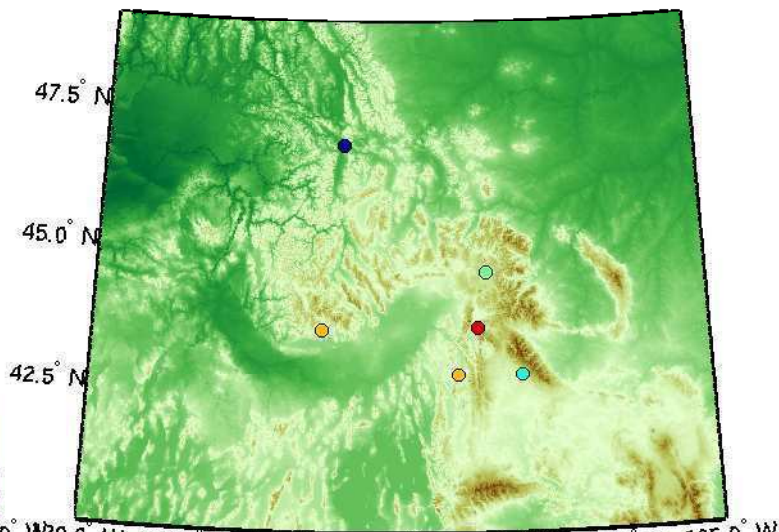
Baz = 125.0275  
Mean xcor value = 0.76833  
Range of  $t^*$  values is 1.4433  
Median  $t^*$  err is 0.62038



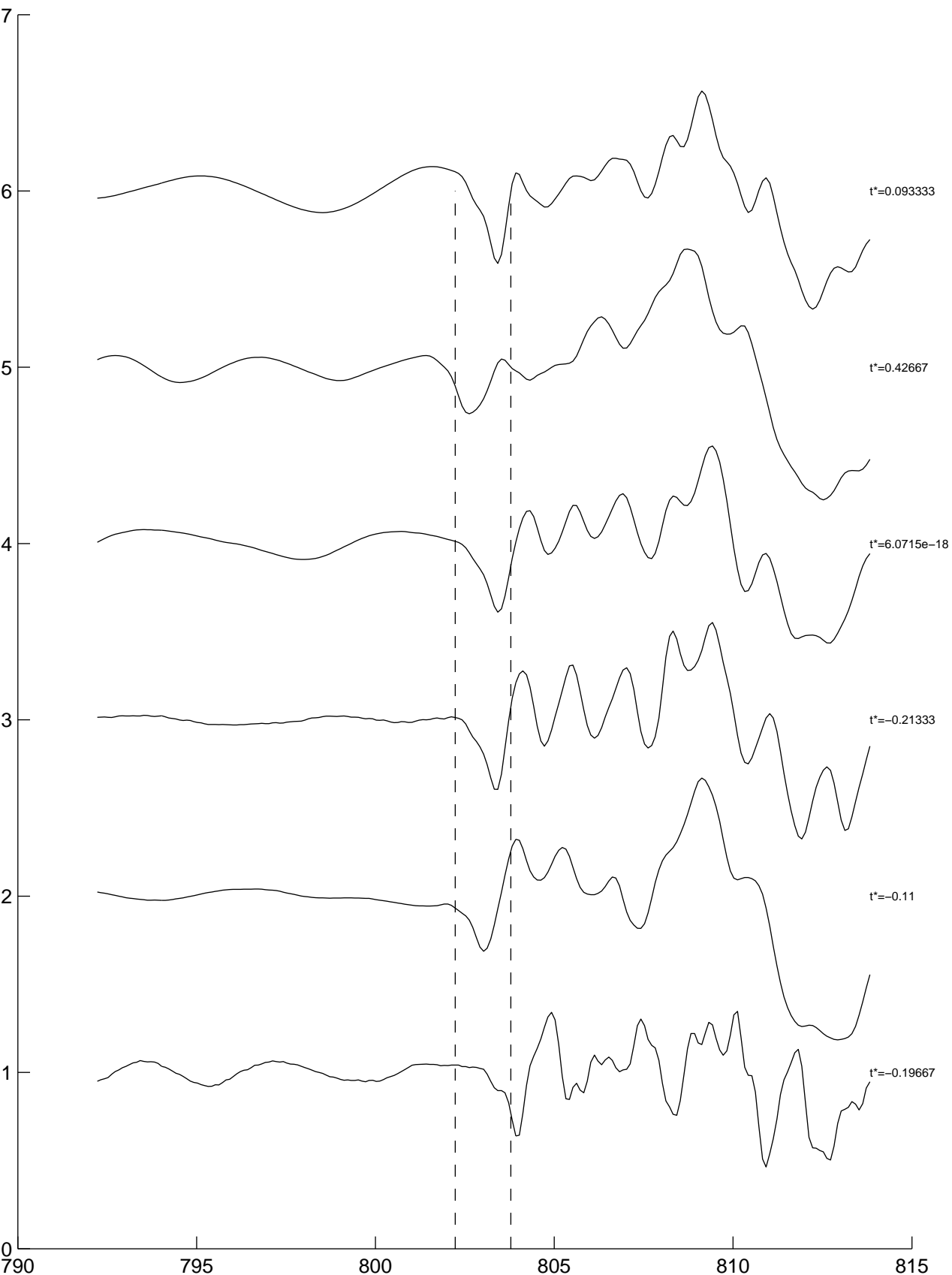
travel time residuals



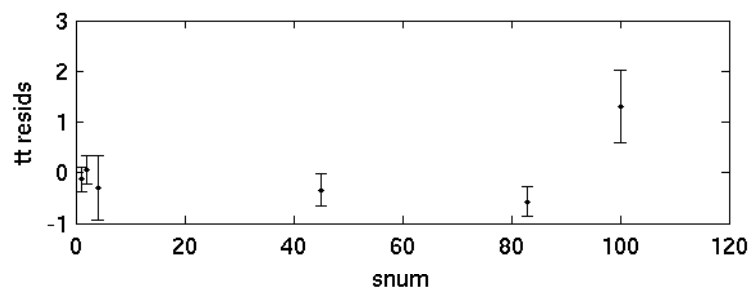
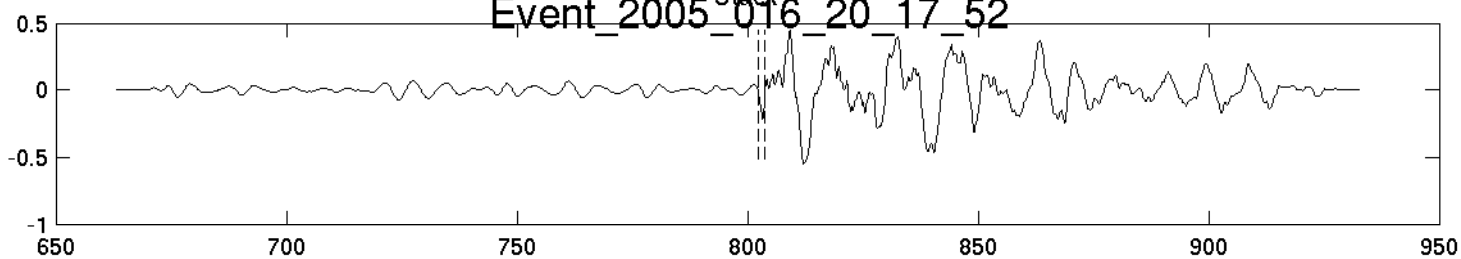
$t^*$  values



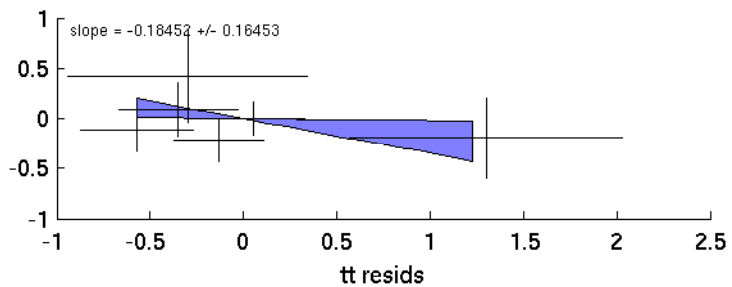
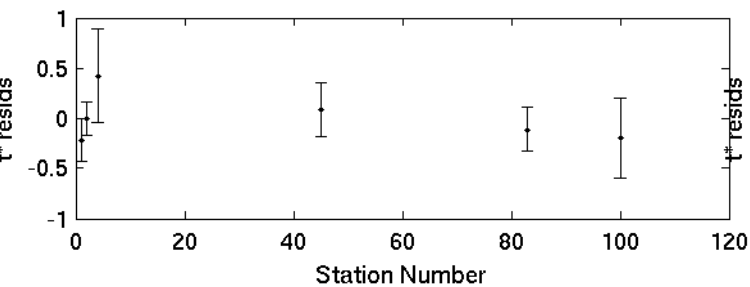
# Event\_2005\_016\_20\_17\_52



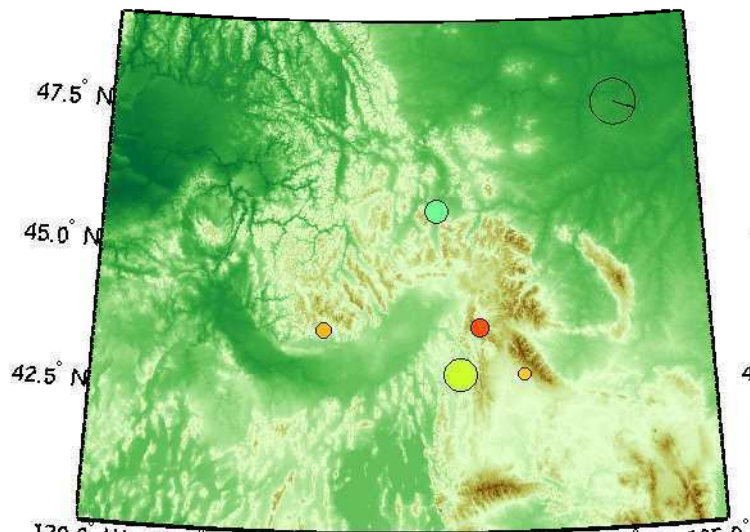
# Event\_2005\_016\_20\_17\_52



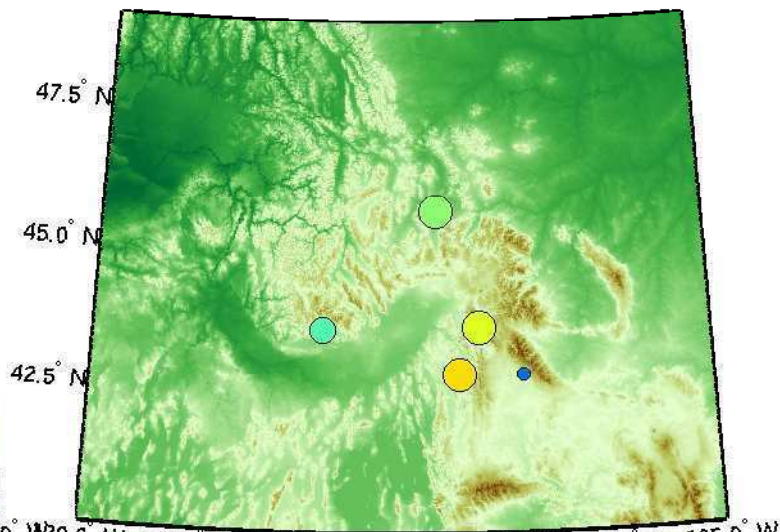
Baz = 290.3623  
 Mean xcor value = 0.76833  
 Range of  $t^*$  values is 0.64  
 Median  $t^*$  err is 0.24293



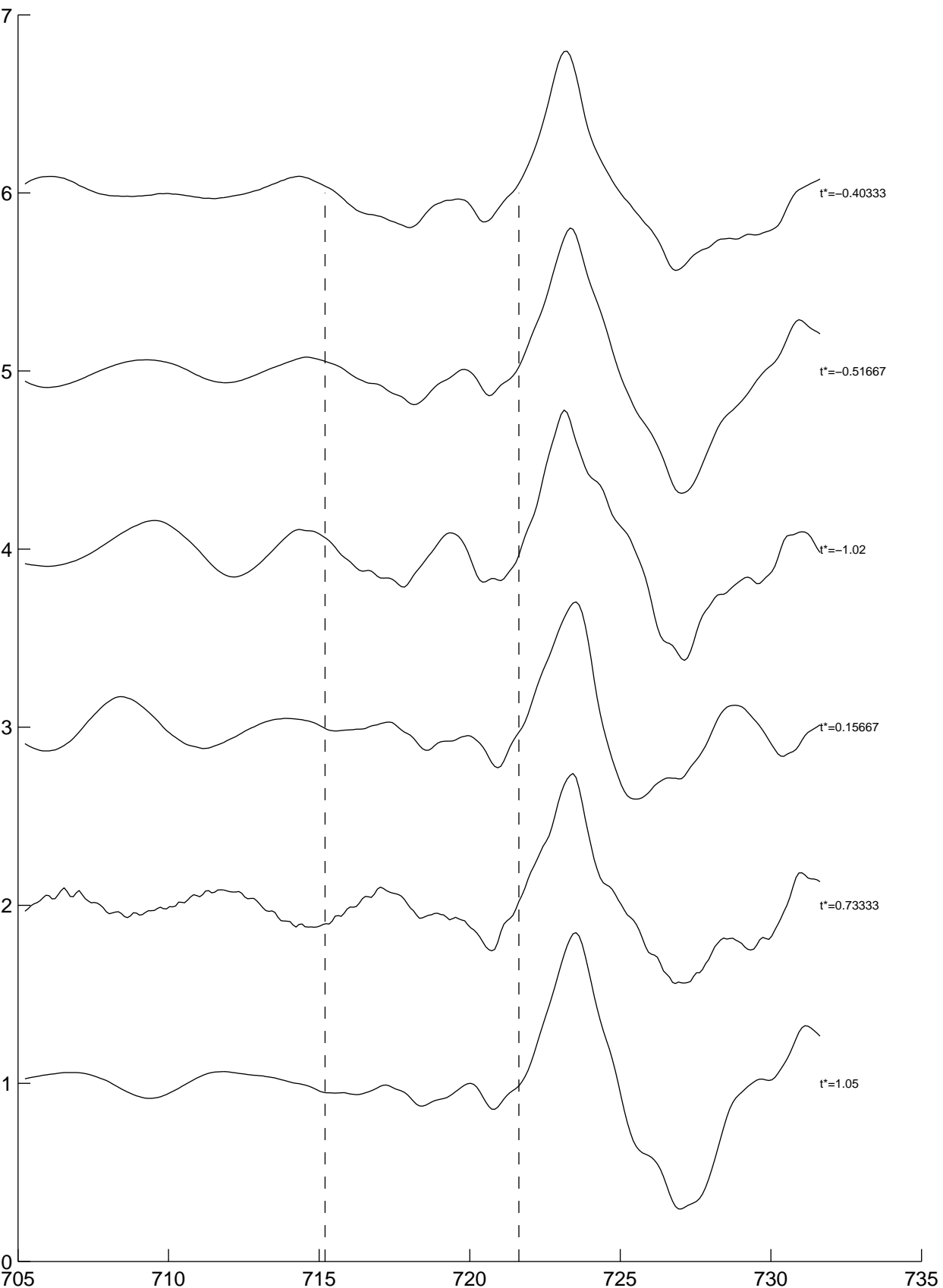
travel time residuals



$t^*$  values

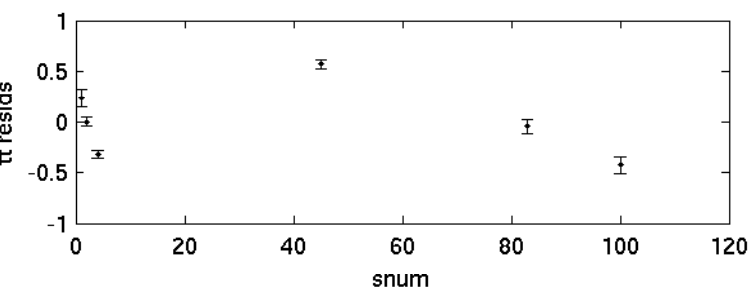
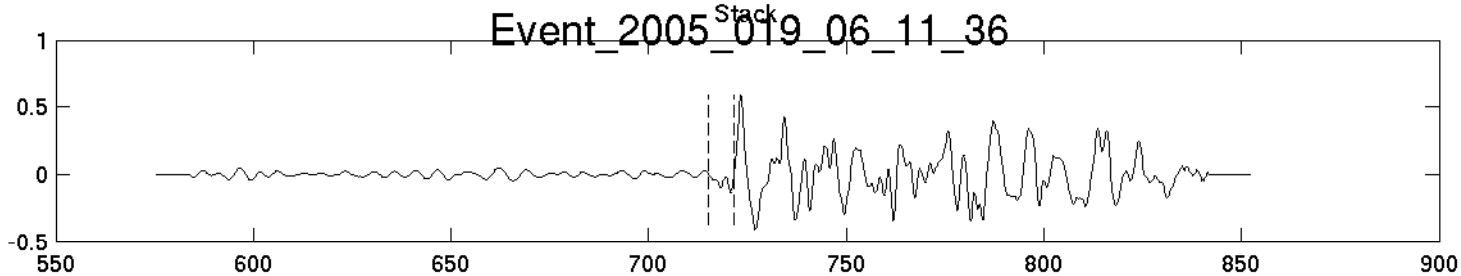


# Event\_2005\_019\_06\_11\_36

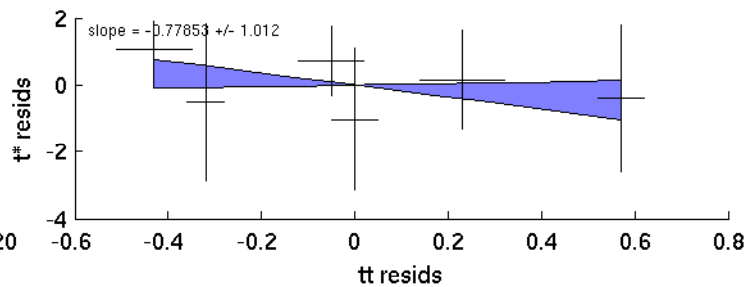
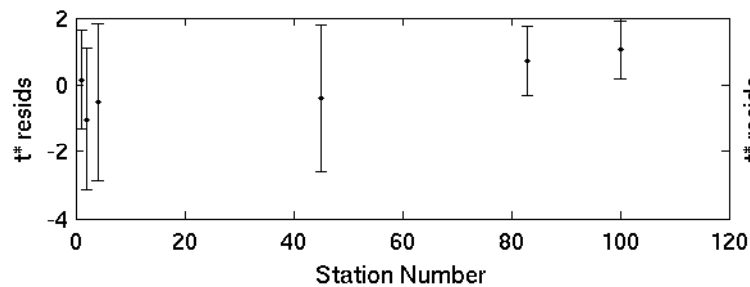




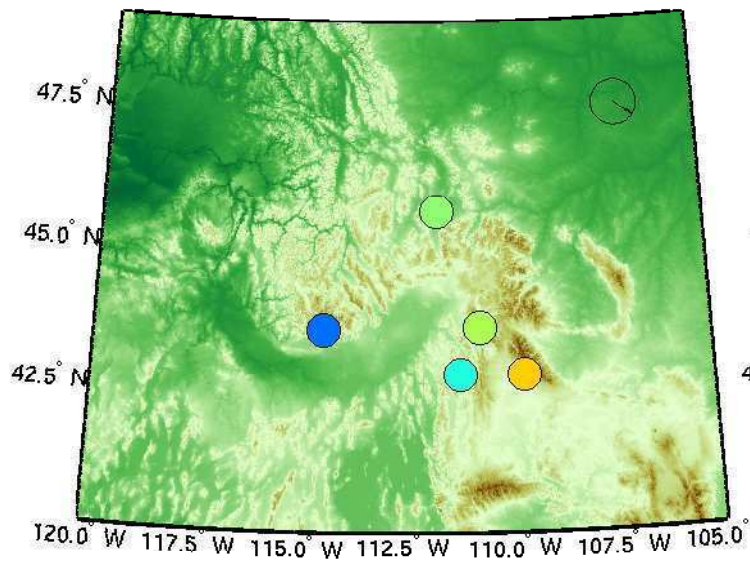
# Event\_2005\_019\_06\_11\_36



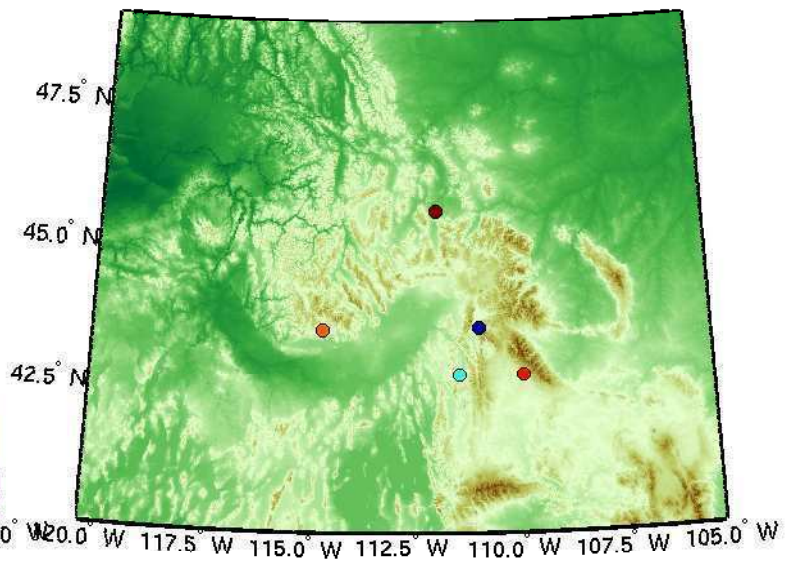
Baz = 305.7495  
 Mean xcor value = 0.80333  
 Range of  $t^*$  values is 2.07  
 Median  $t^*$  err is 1.806



travel time residuals

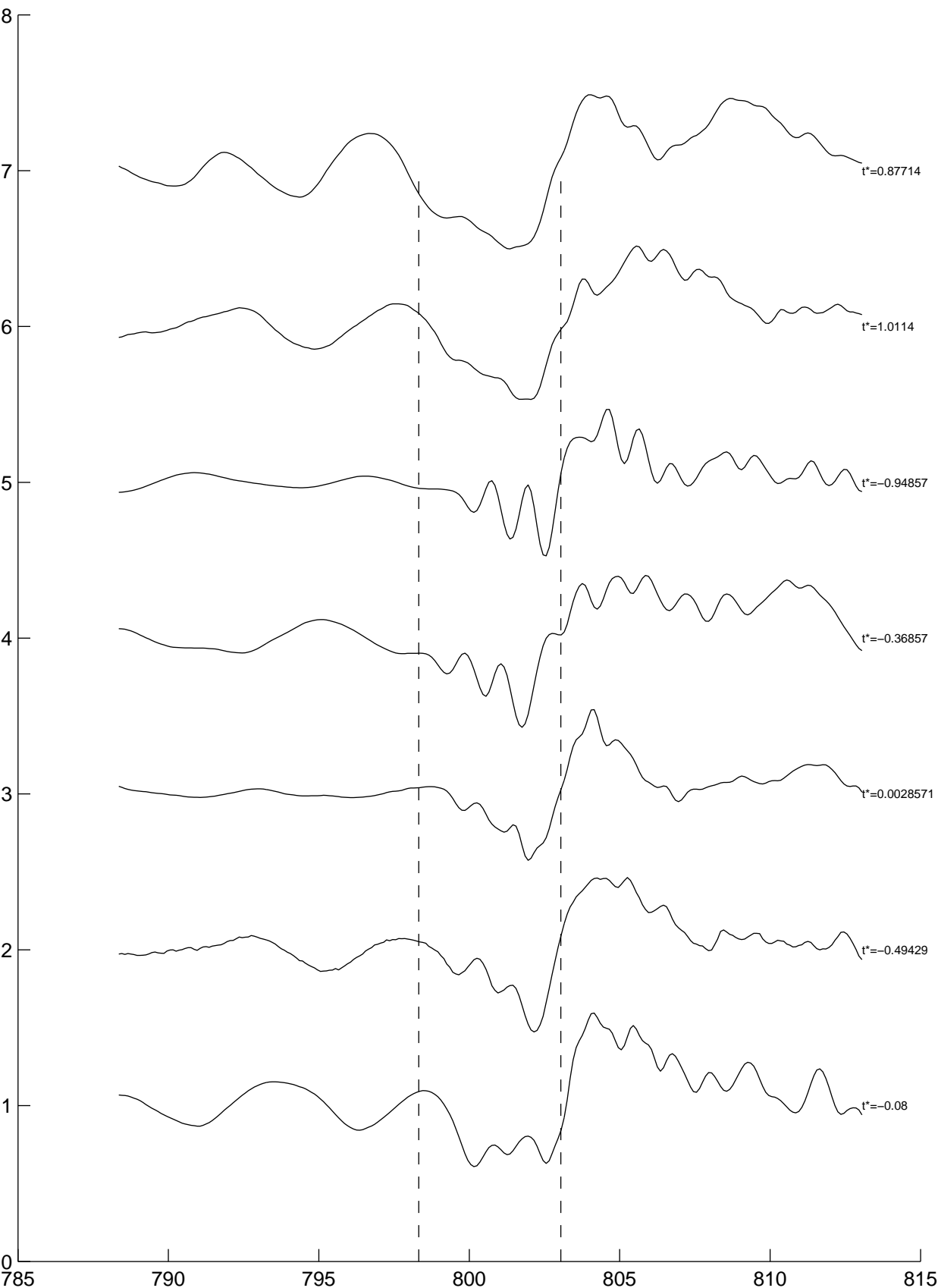


$t^*$  values

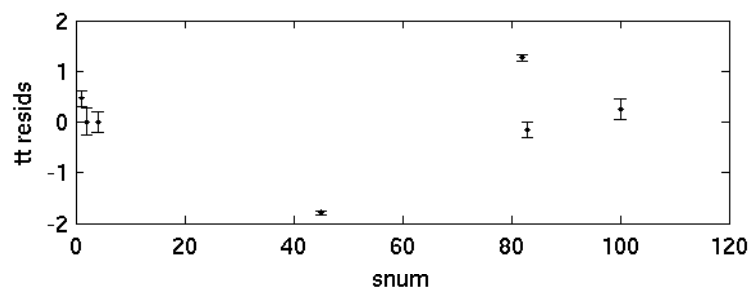
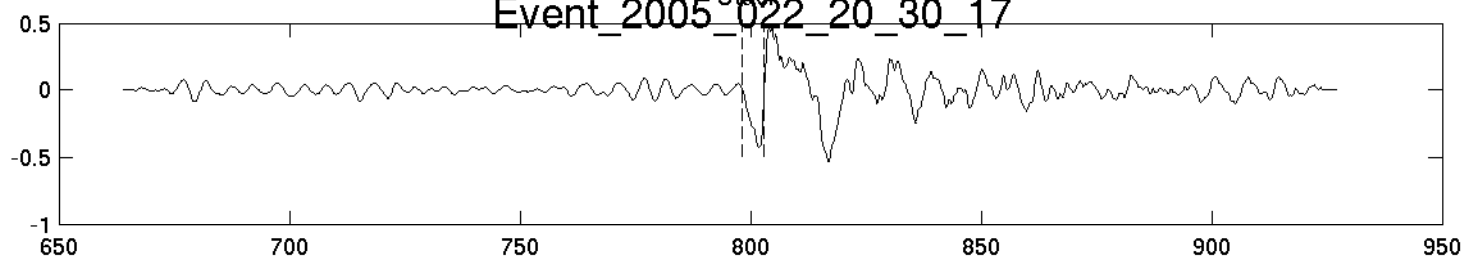




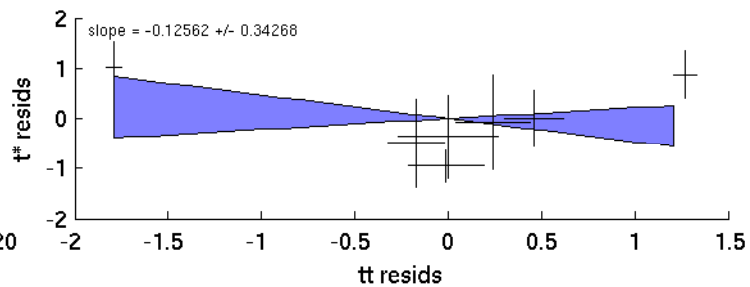
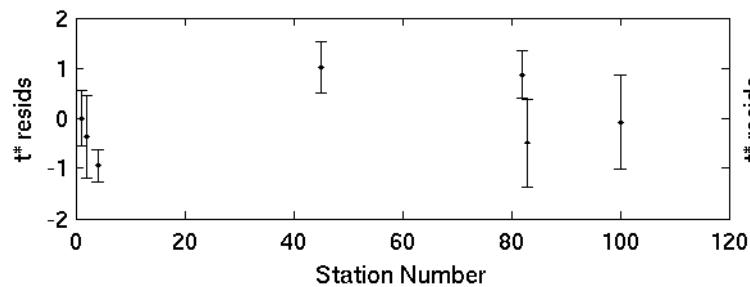
# Event\_2005\_022\_20\_30\_17



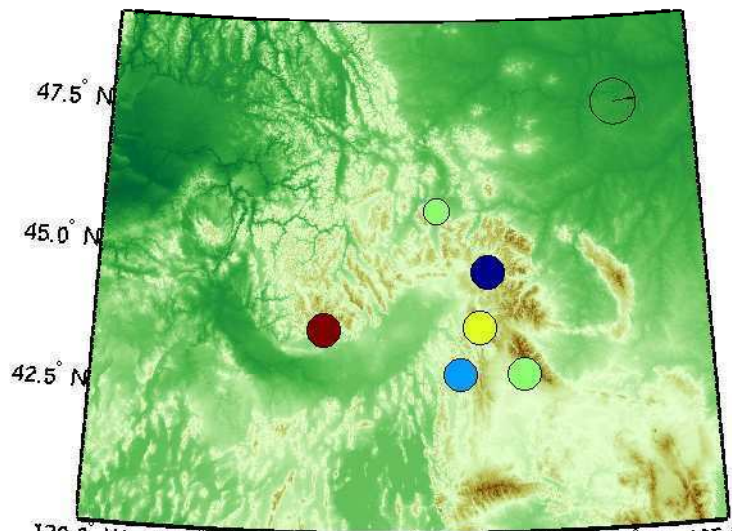
# Event\_2005\_022\_20\_30\_17



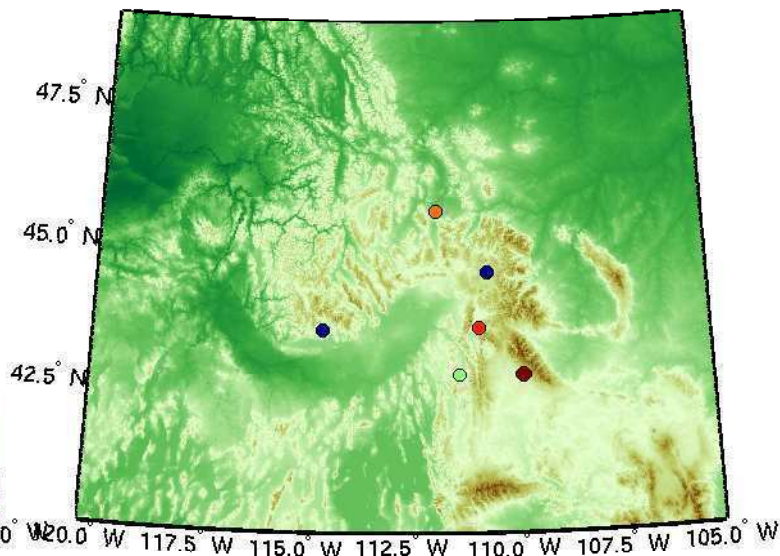
Baz = 263.8125  
 Mean xcor value = 0.71857  
 Range of  $t^*$  values is 1.96  
 Median  $t^*$  err is 0.55695



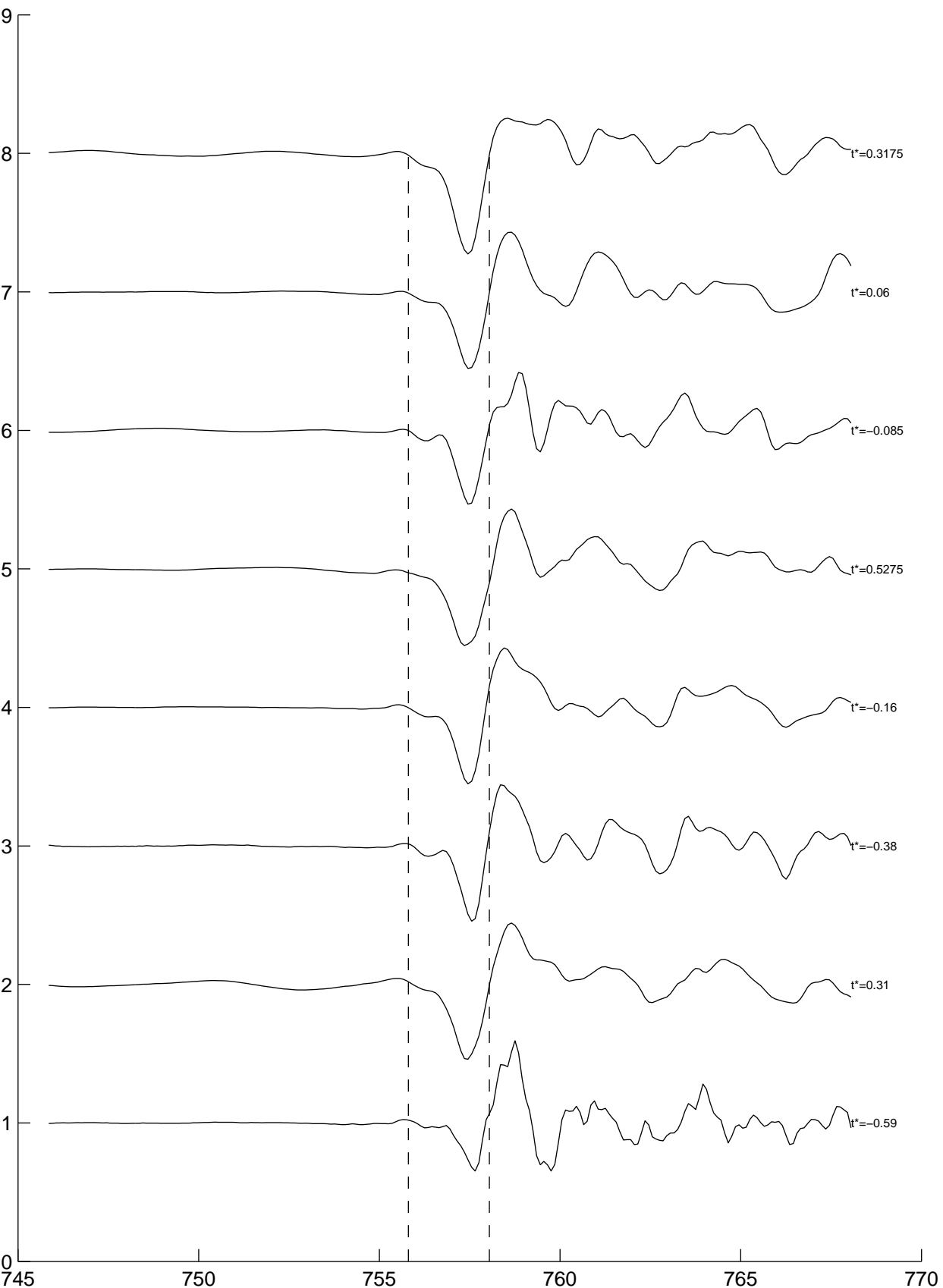
travel time residuals



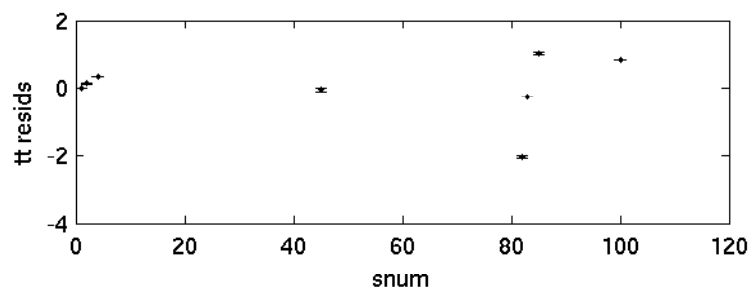
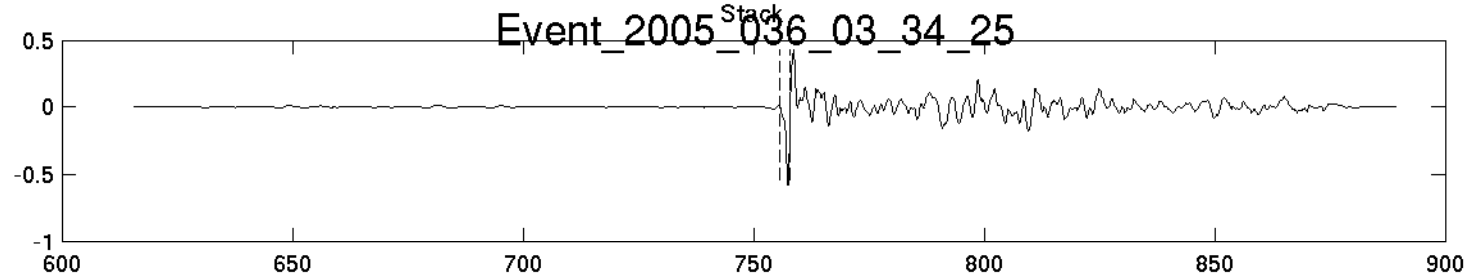
$t^*$  values



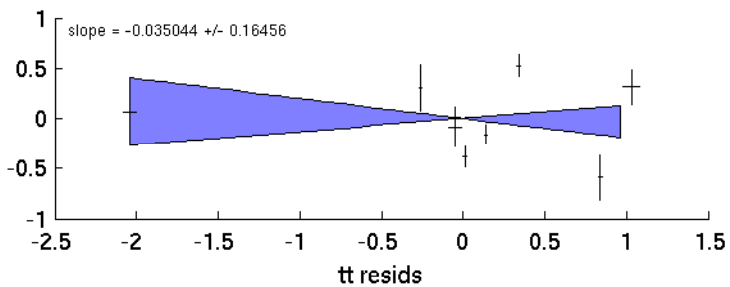
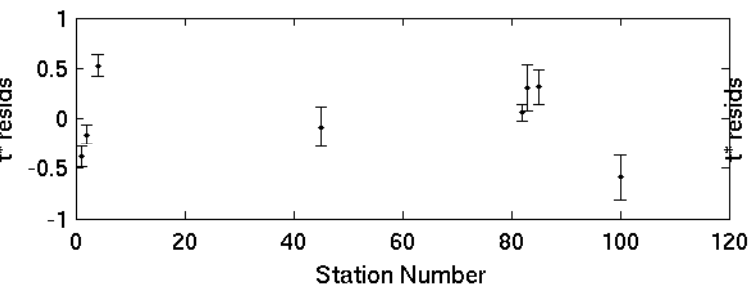
# Event\_2005\_036\_03\_34\_25



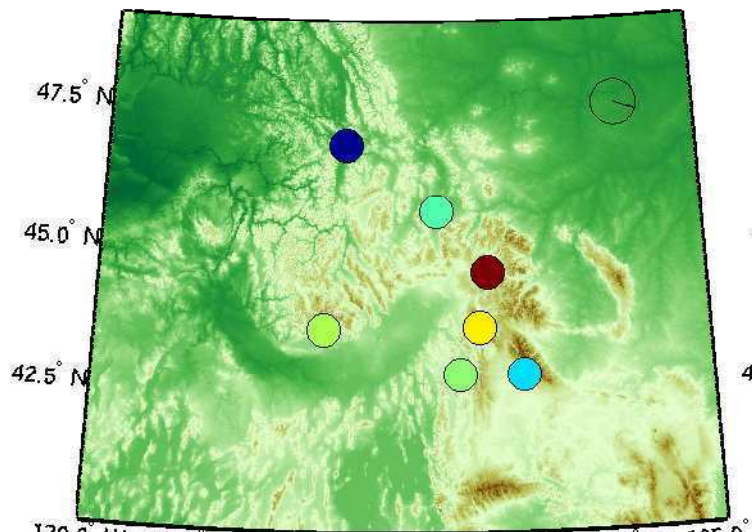
# Event\_2005\_036\_03\_34\_25



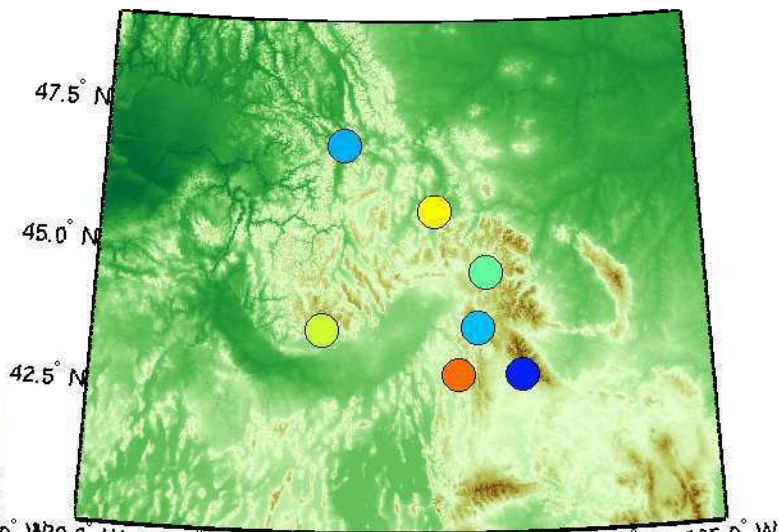
Baz = 290.2135  
 Mean xcor value = 0.74125  
 Range of  $t^*$  values is 1.1175  
 Median  $t^*$  err is 0.14139



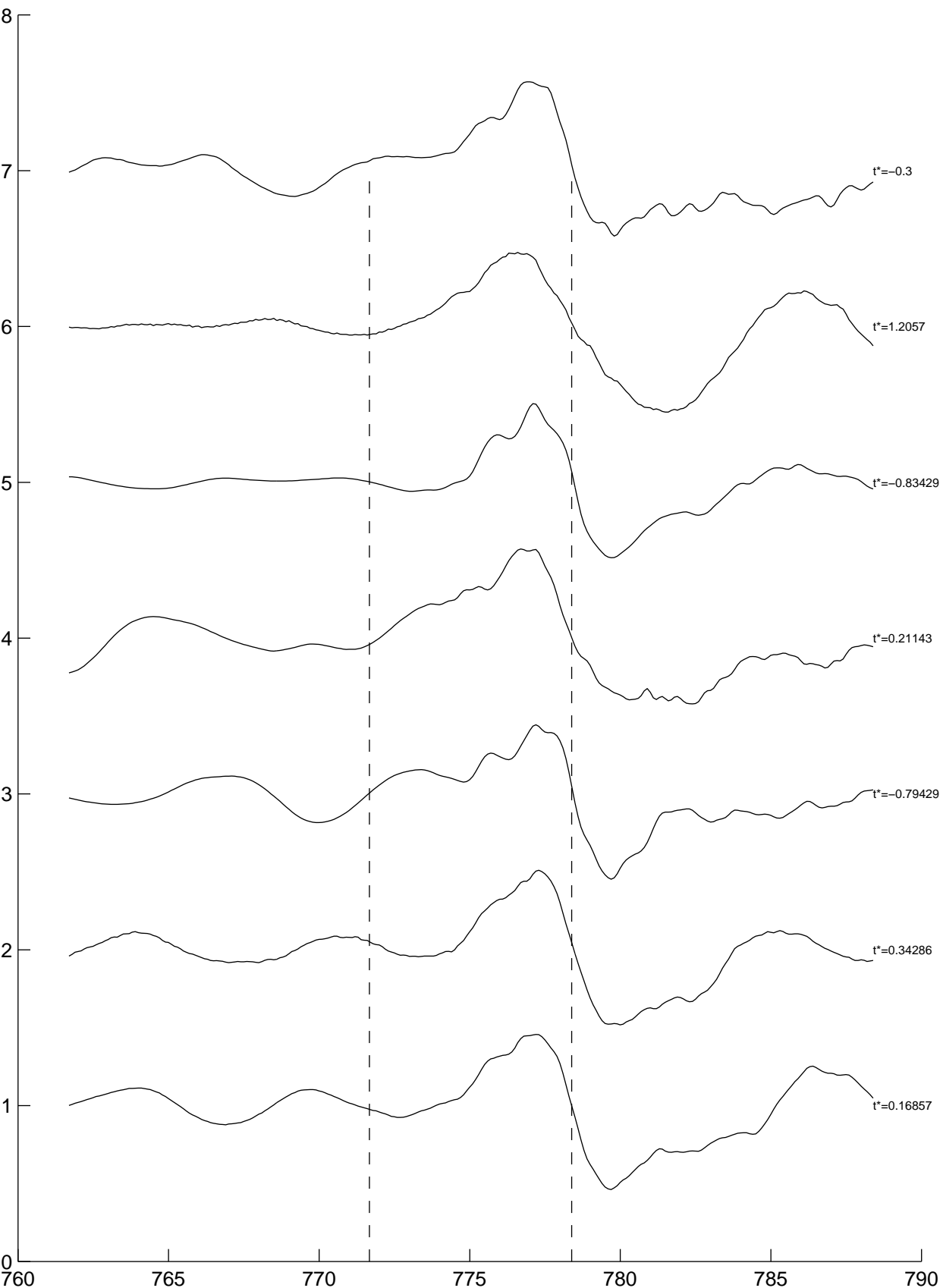
travel time residuals



$t^*$  values

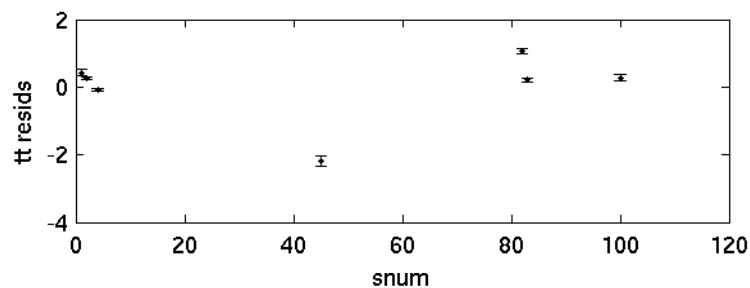
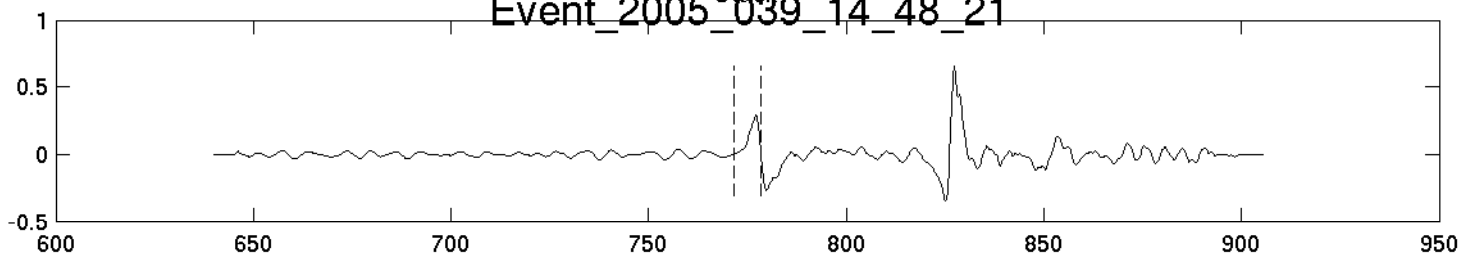


# Event\_2005\_039\_14\_48\_21

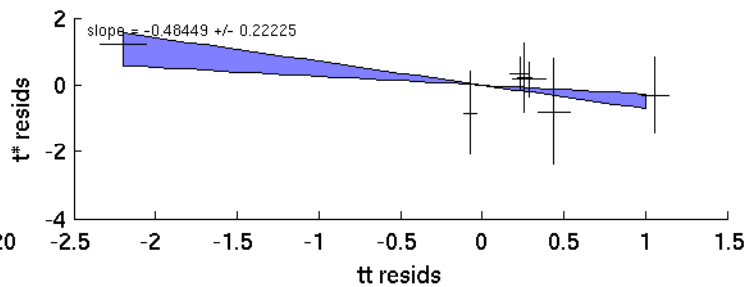
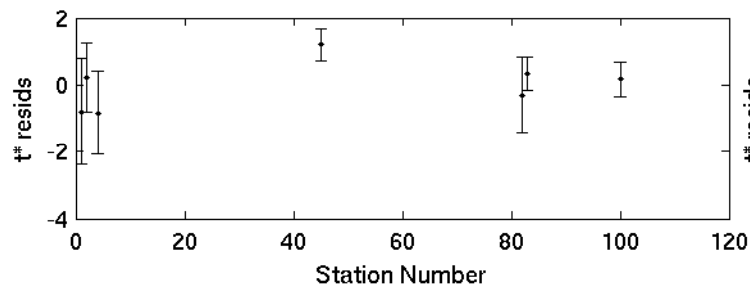


# Event\_2005\_039\_14\_48\_21

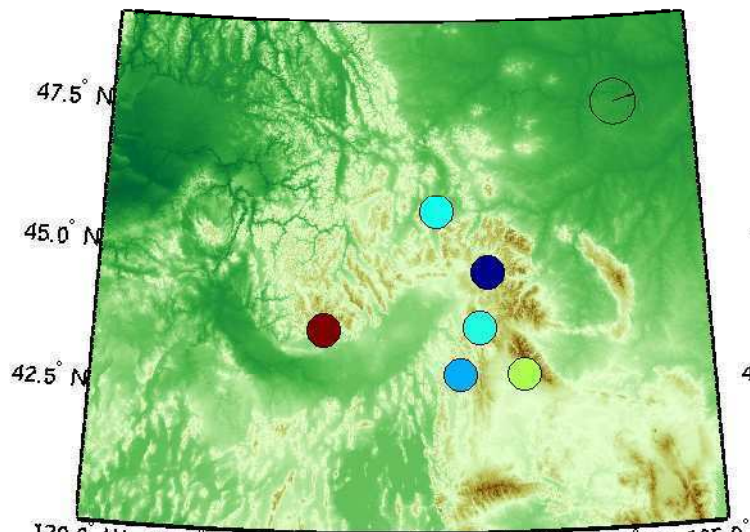
Stack



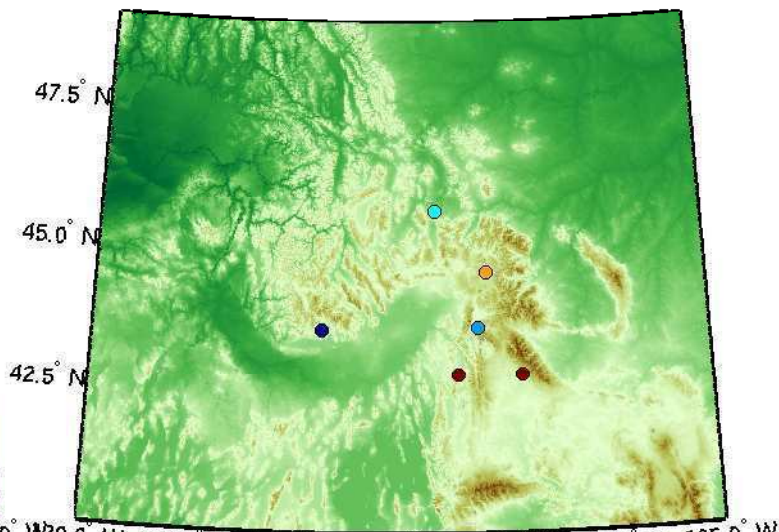
Baz = 253.785  
Mean xcor value = 0.78714  
Range of  $t^*$  values is 2.04  
Median  $t^*$  err is 1.0251



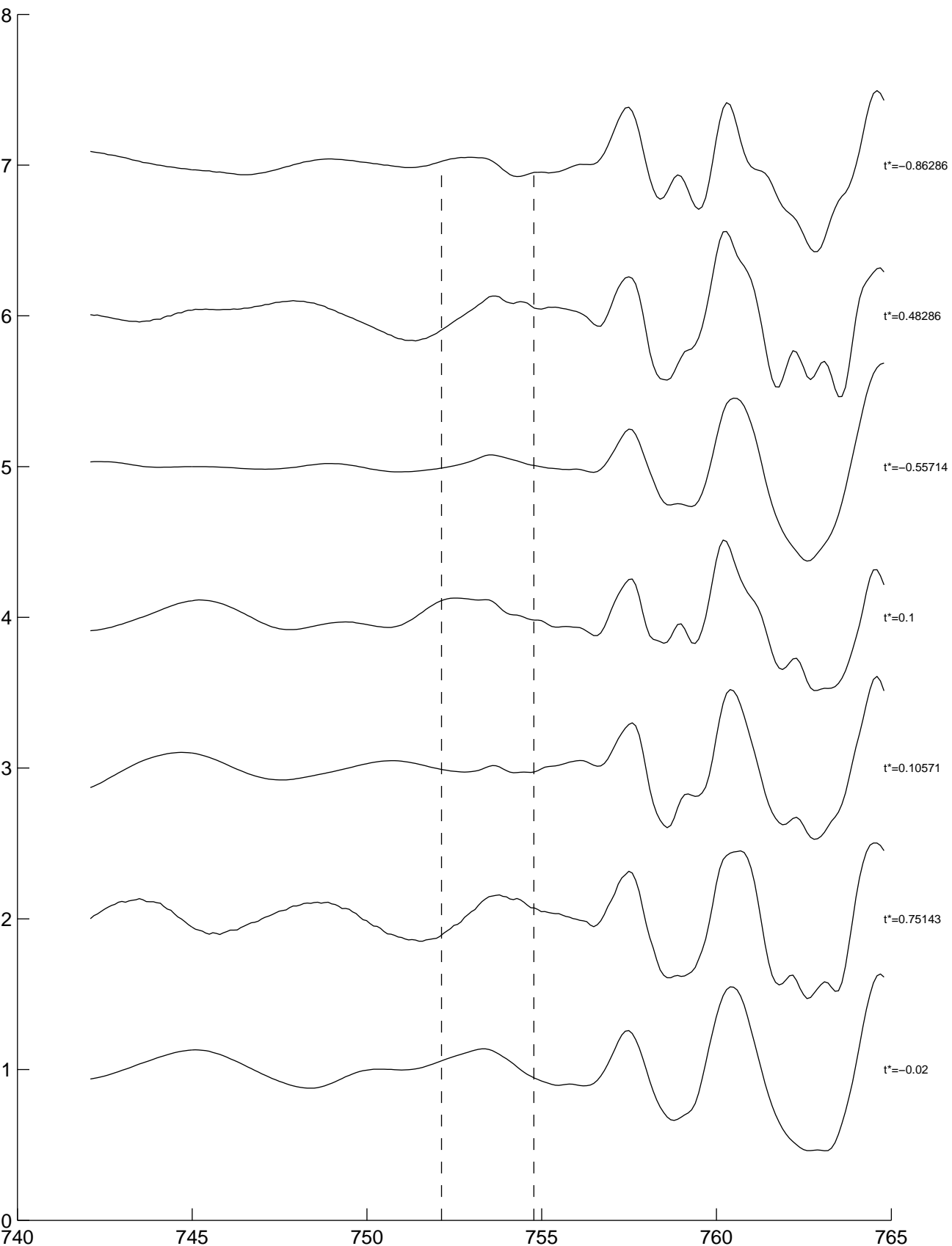
travel time residuals



$t^*$  values

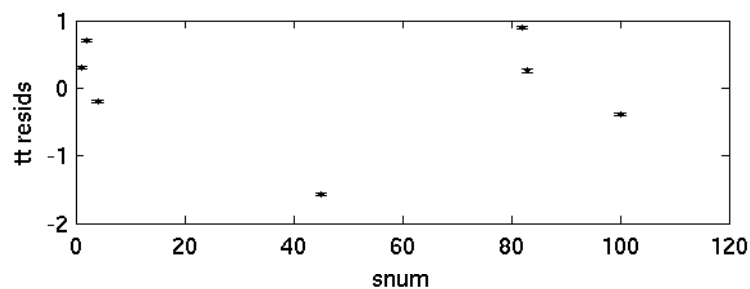
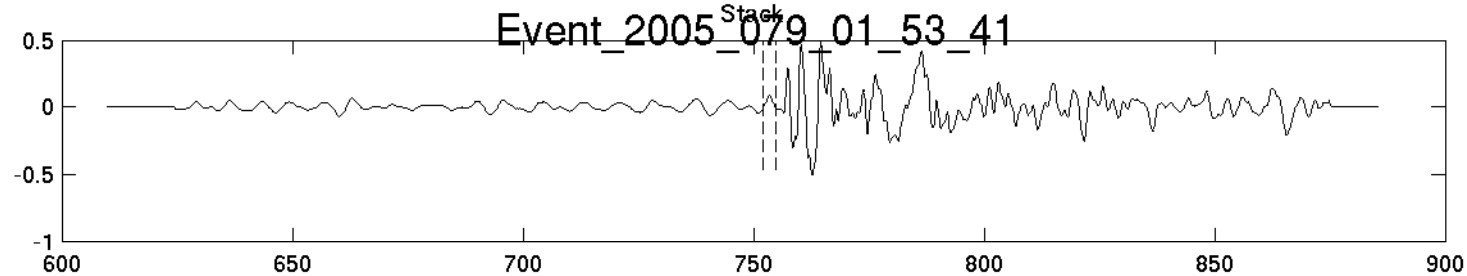


# Event\_2005\_079\_01\_53\_41

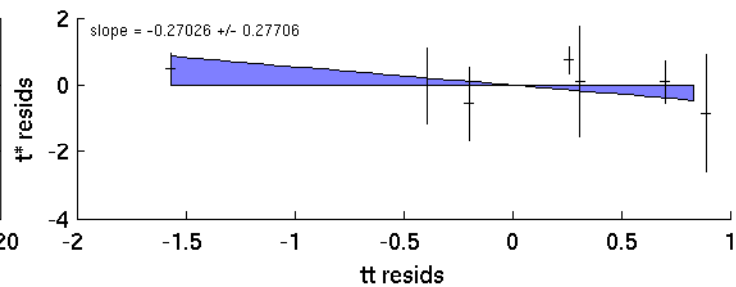
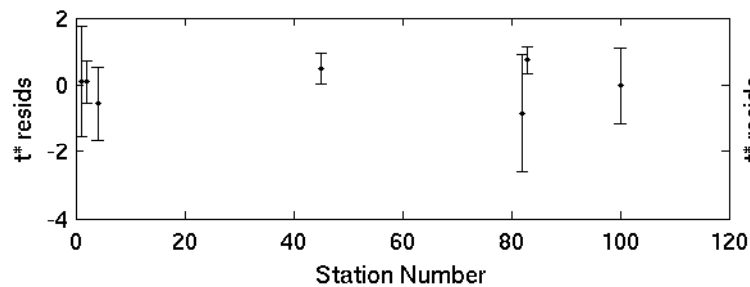




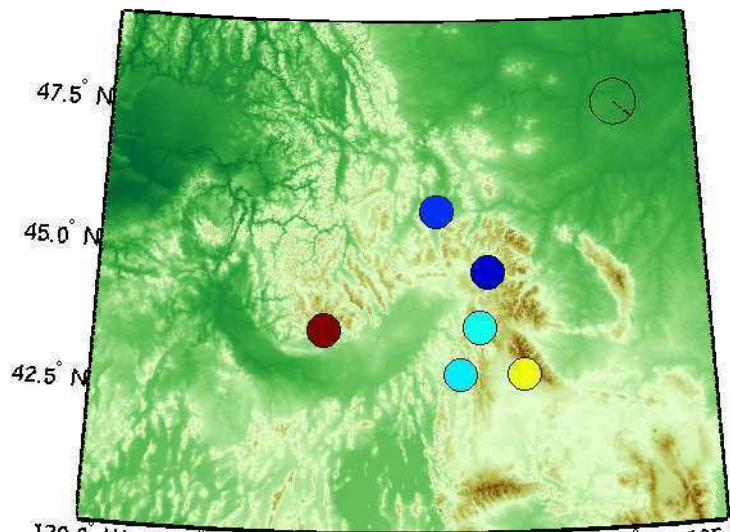
# Event\_2005\_079\_01\_53\_41



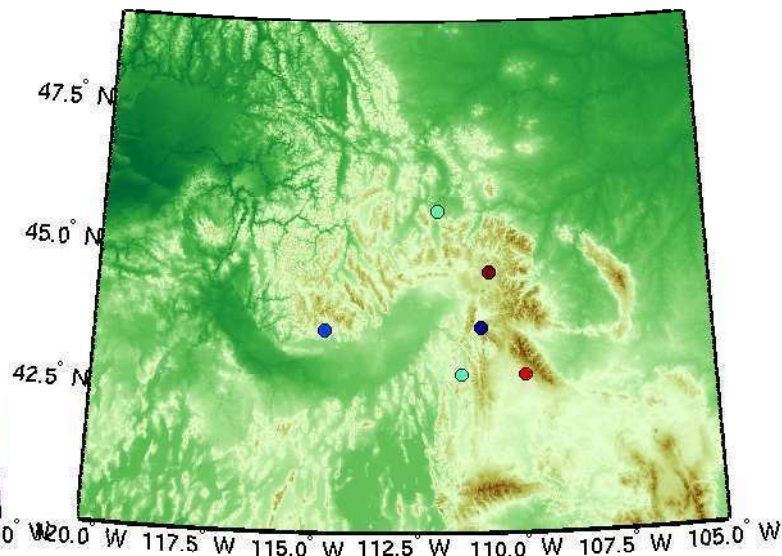
Baz = 312.7386  
Mean xcor value = 0.78429  
Range of  $t^*$  values is 1.6143  
Median  $t^*$  err is 1.0792



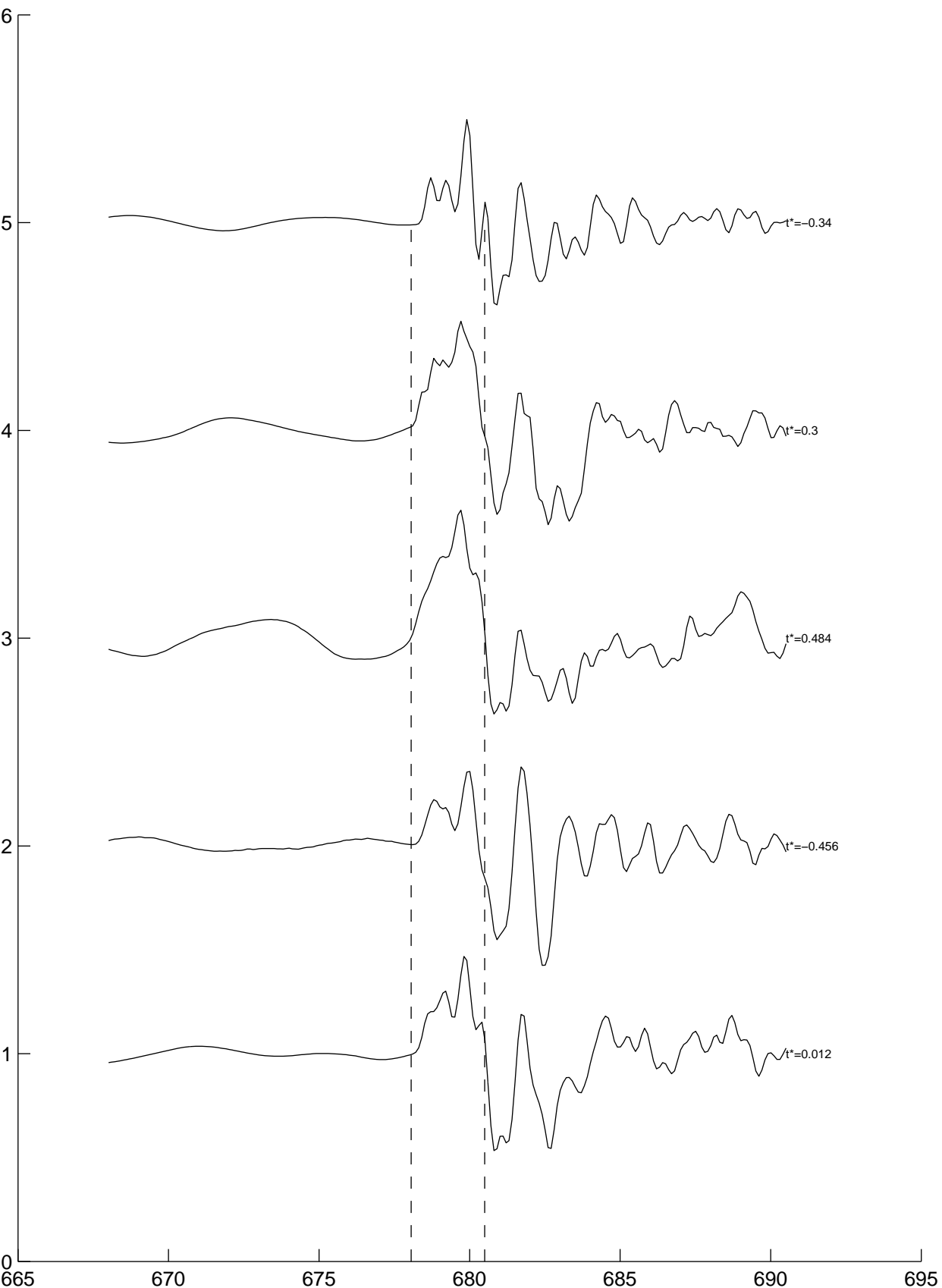
travel time residuals



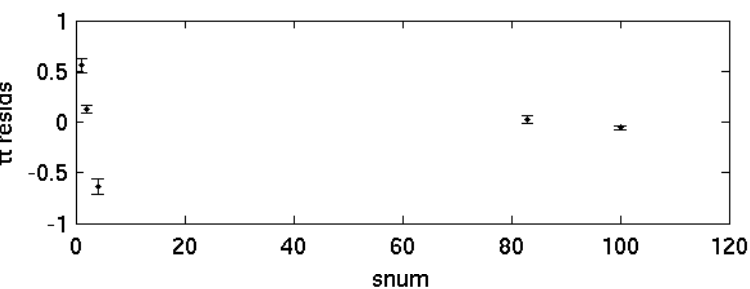
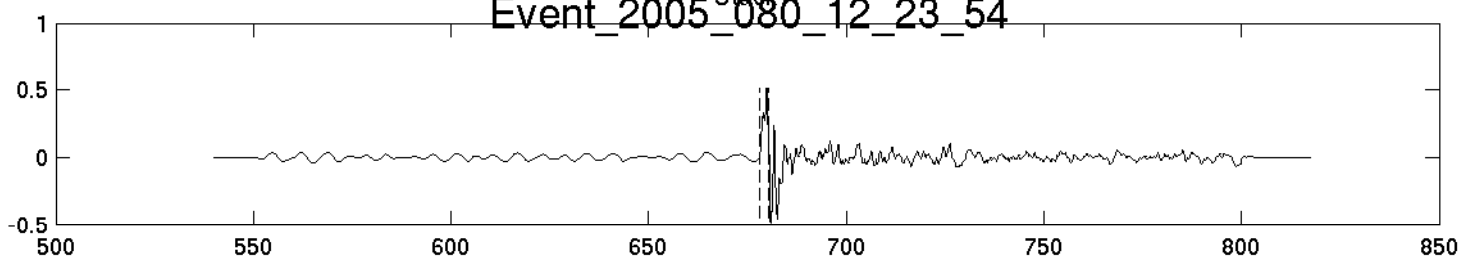
$t^*$  values



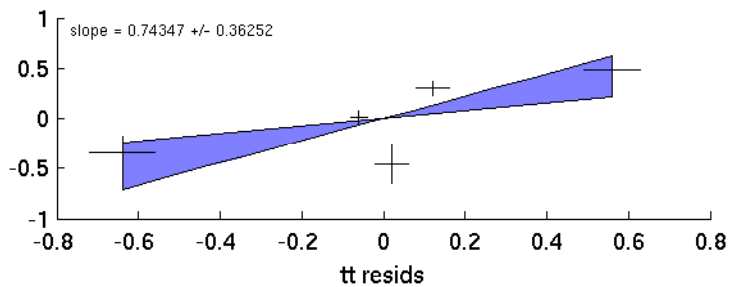
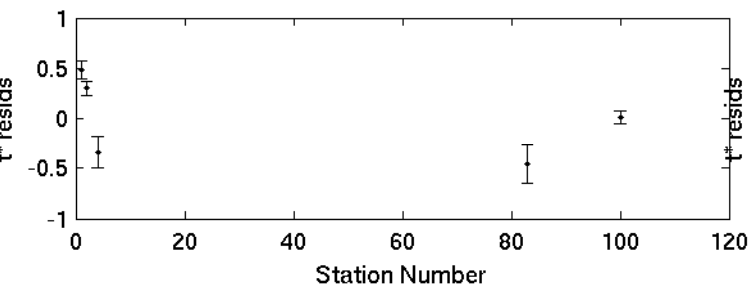
# Event\_2005\_080\_12\_23\_54



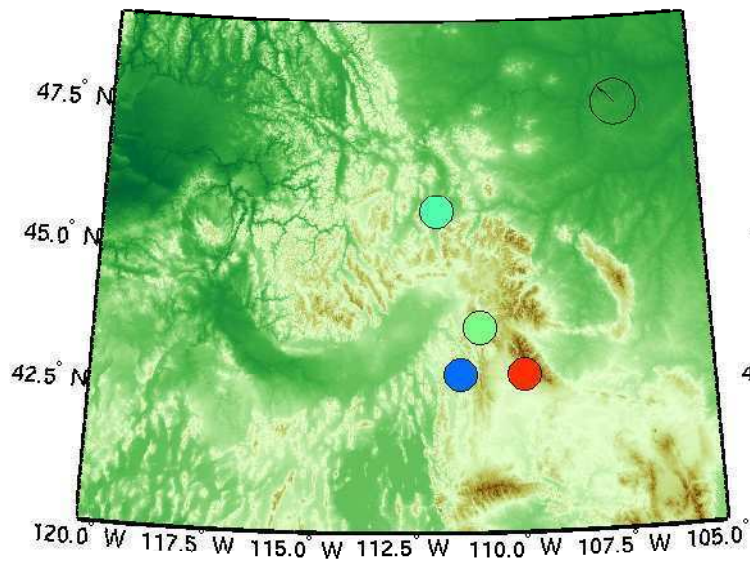
# Event\_2005\_080\_12\_23\_54



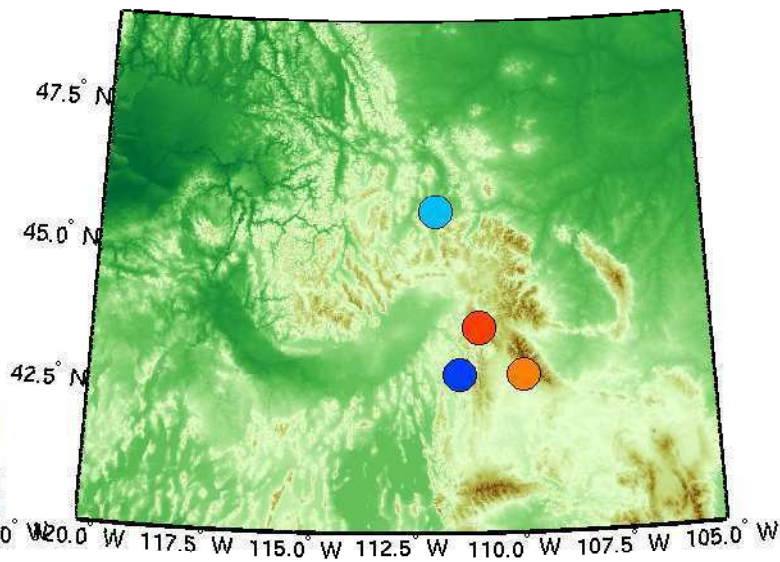
Baz = 137.1627  
Mean xcor value = 0.644  
Range of  $t^*$  values is 0.94  
Median  $t^*$  err is 0.094826



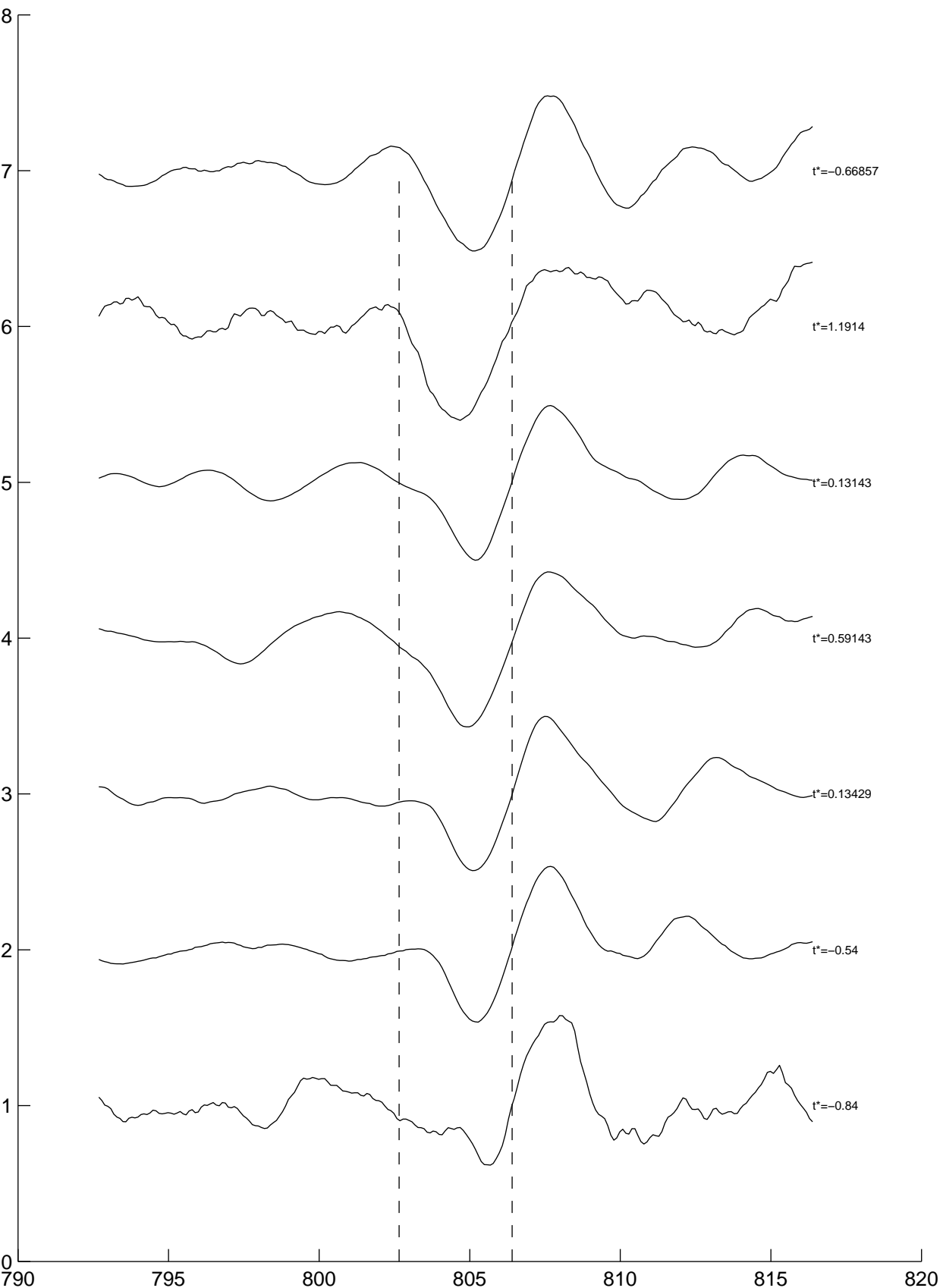
travel time residuals



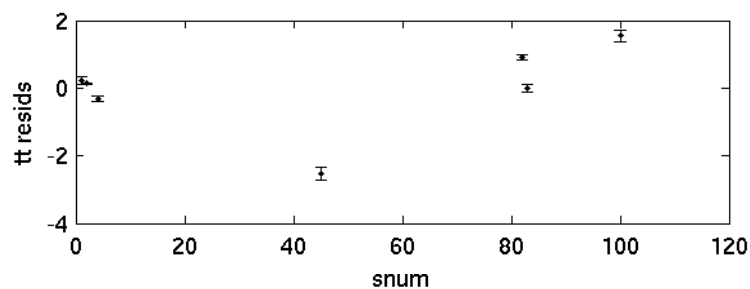
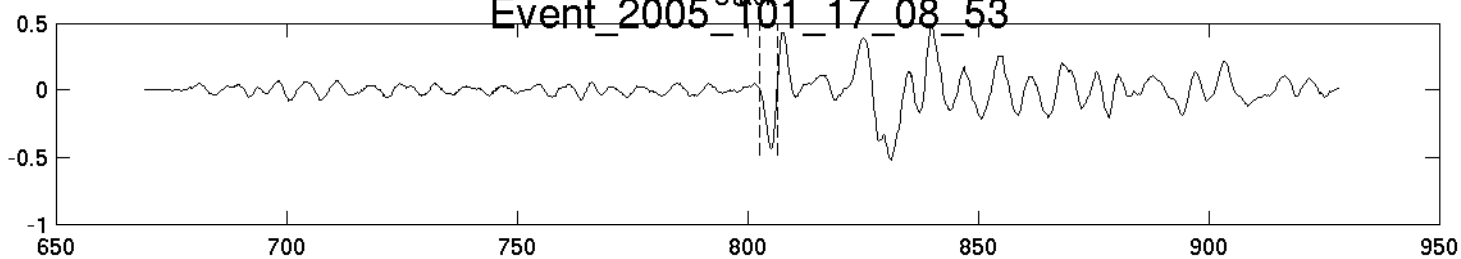
$t^*$  values



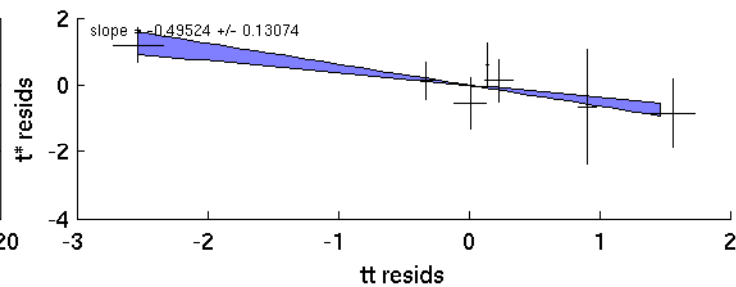
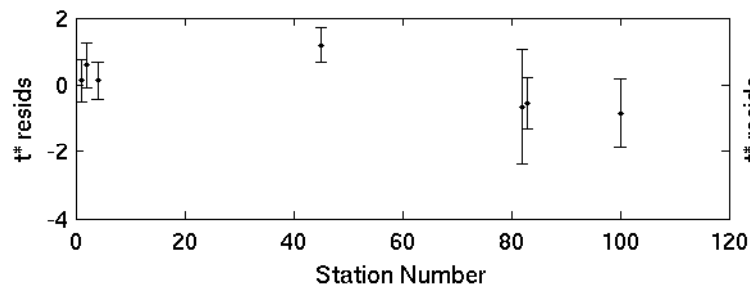
# Event\_2005\_101\_17\_08\_53



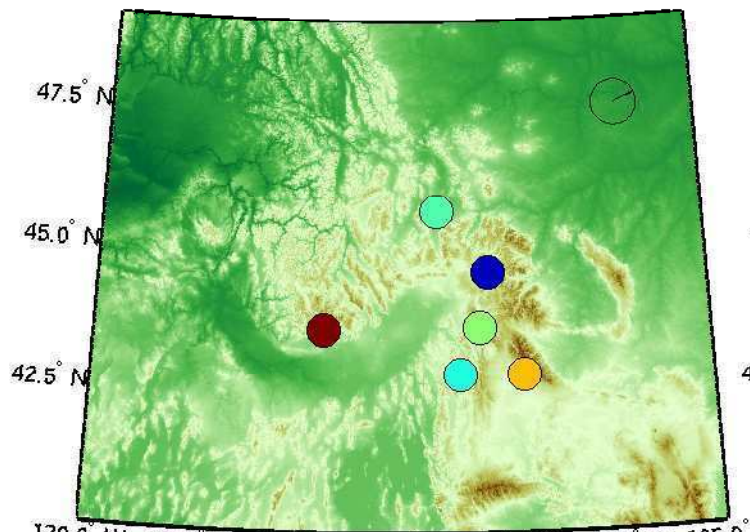
# Event\_2005\_101\_17\_08\_53



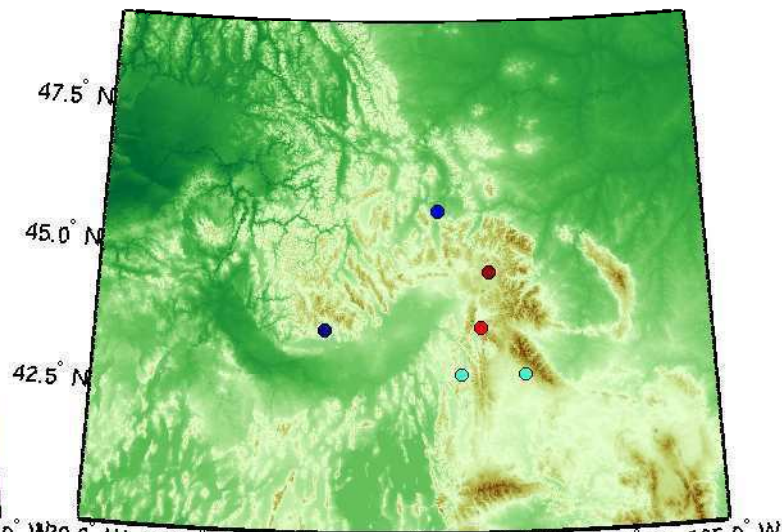
Baz = 246.026  
Mean xcor value = 0.70286  
Range of  $t^*$  values is 2.0314  
Median  $t^*$  err is 0.68011



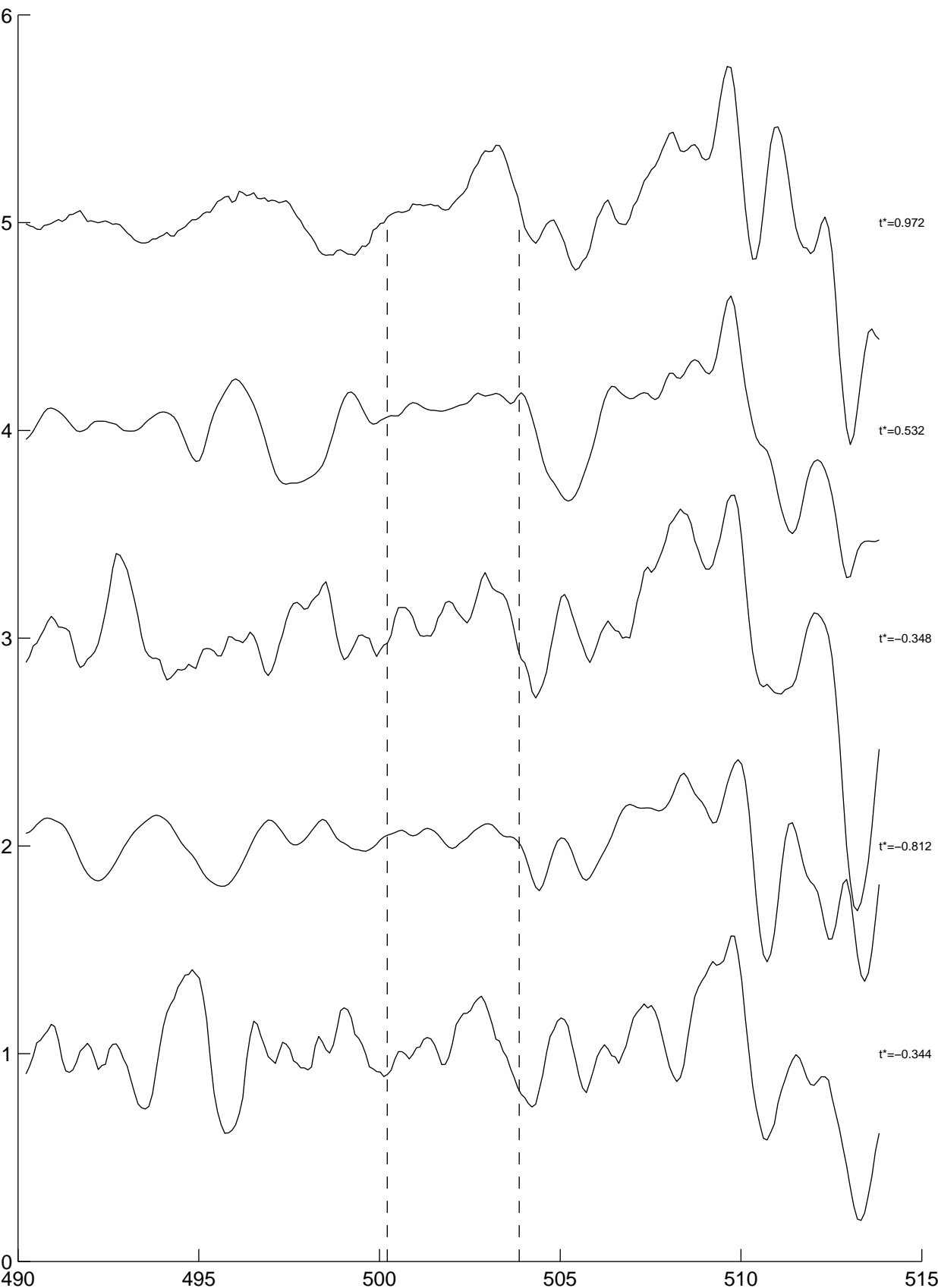
travel time residuals



$t^*$  values

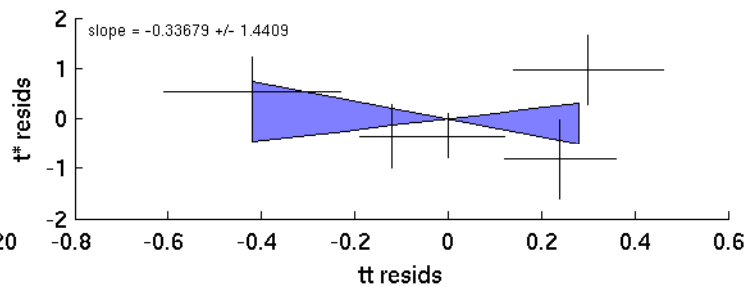
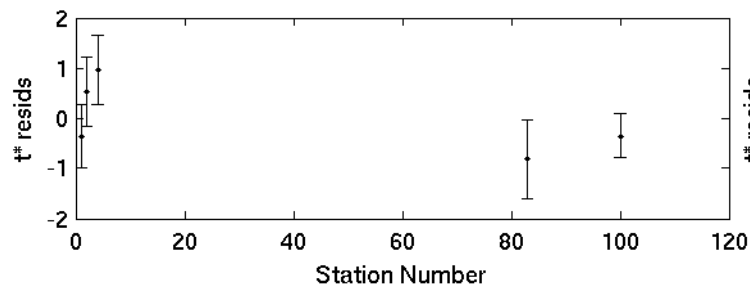
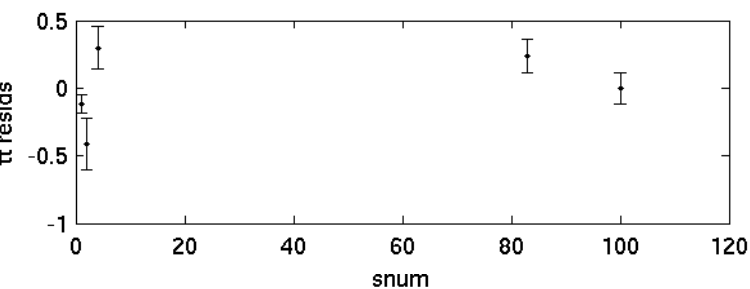
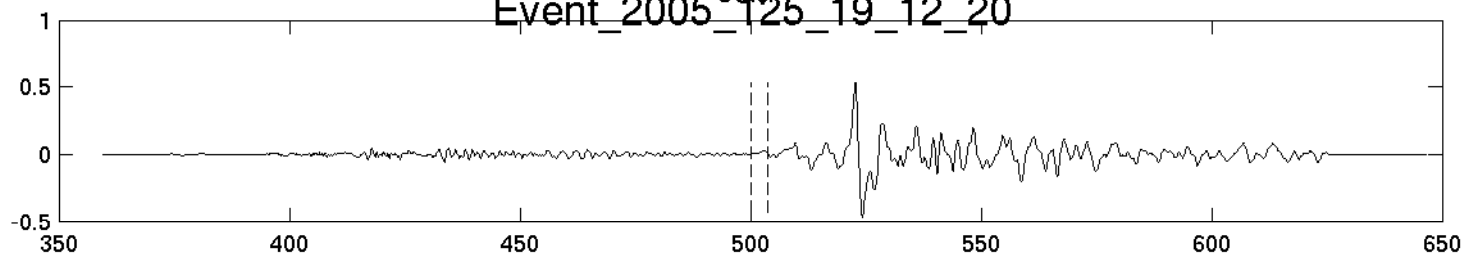


# Event\_2005\_125\_19\_12\_20

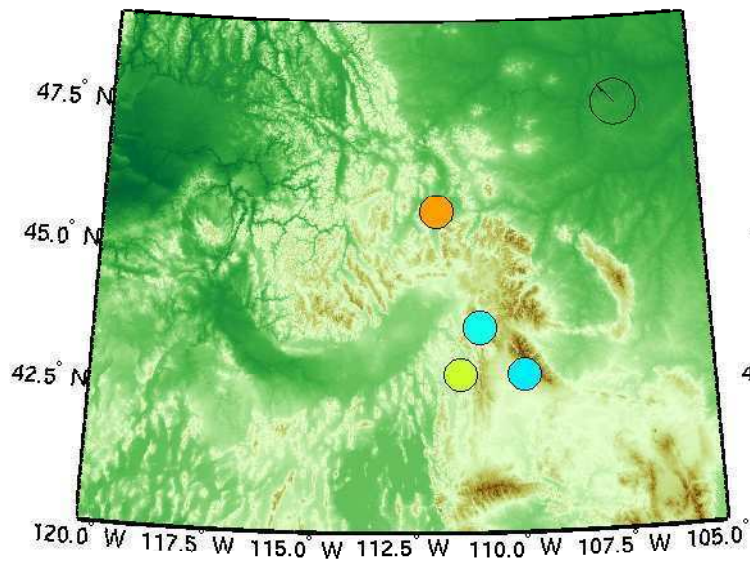




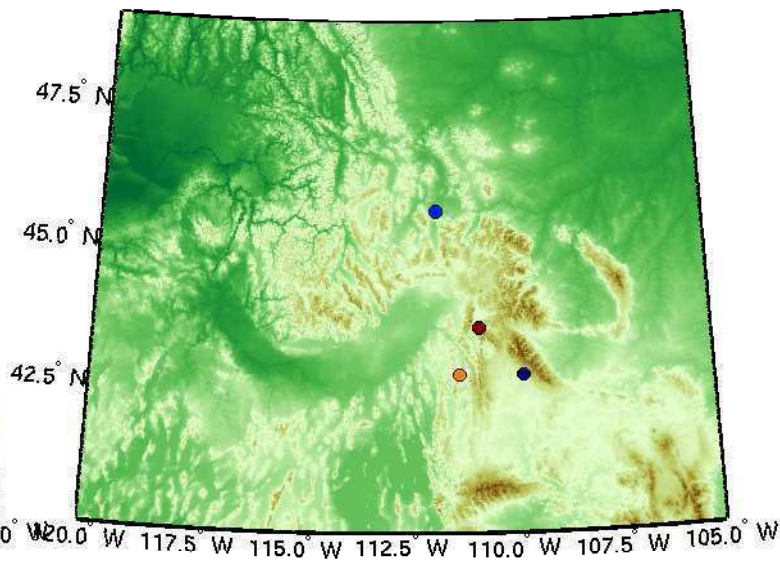
# Event\_2005\_12\_19\_12\_20<sup>Stack</sup>



travel time residuals

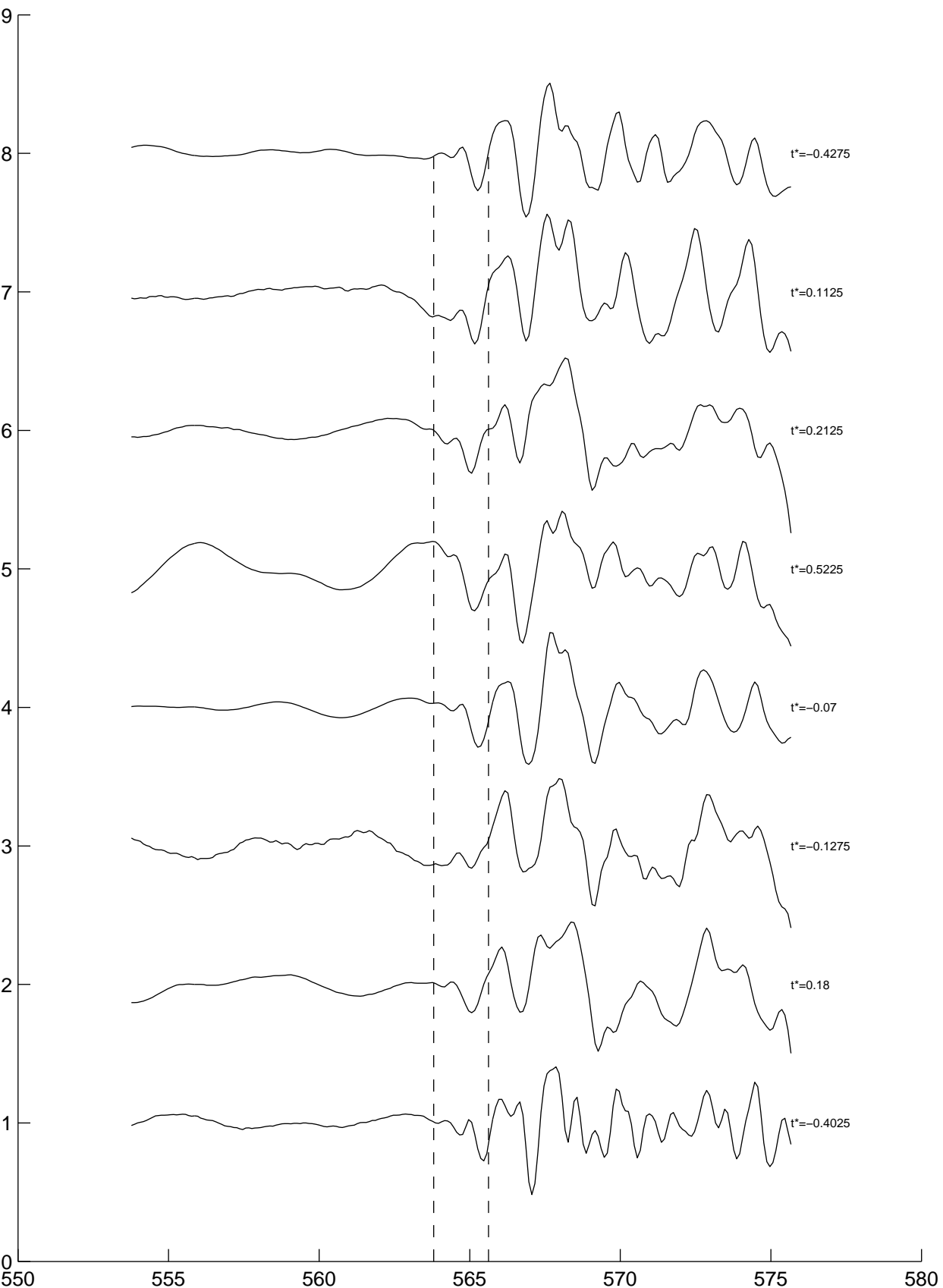


$t^*$  values

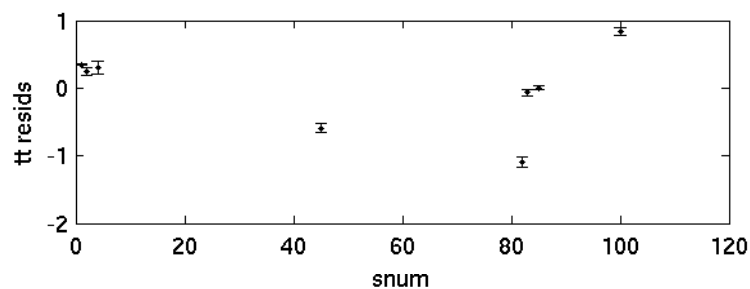
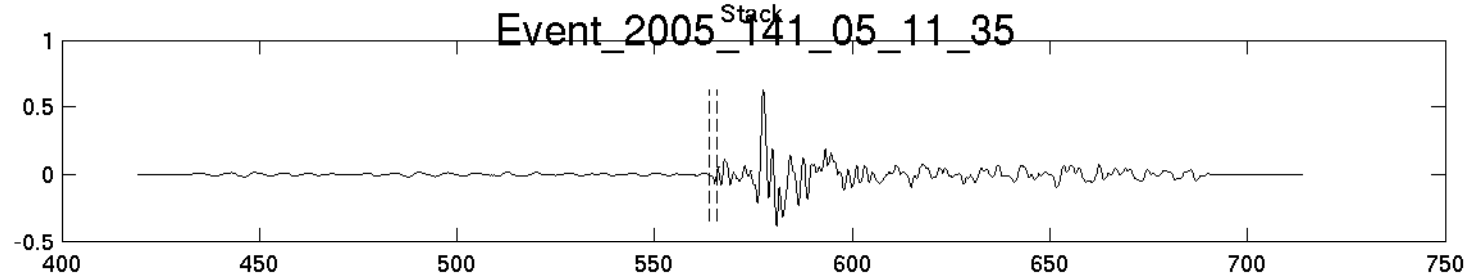




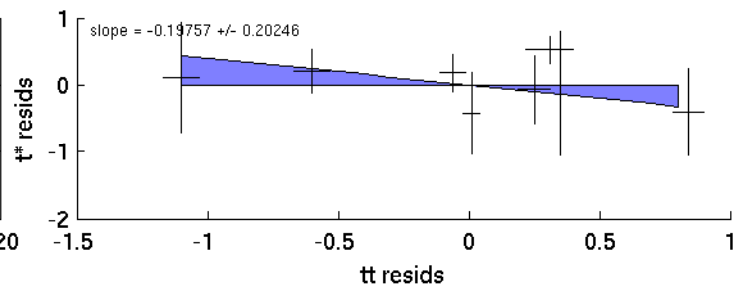
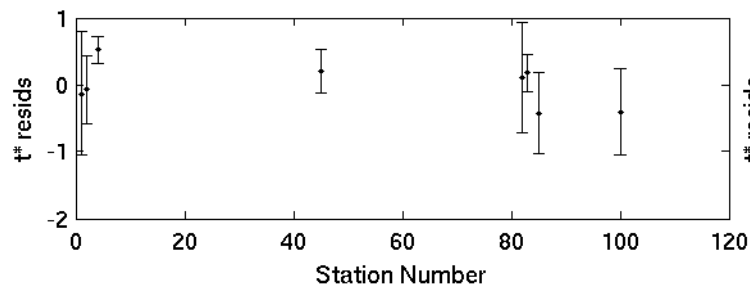
# Event\_2005\_141\_05\_11\_35



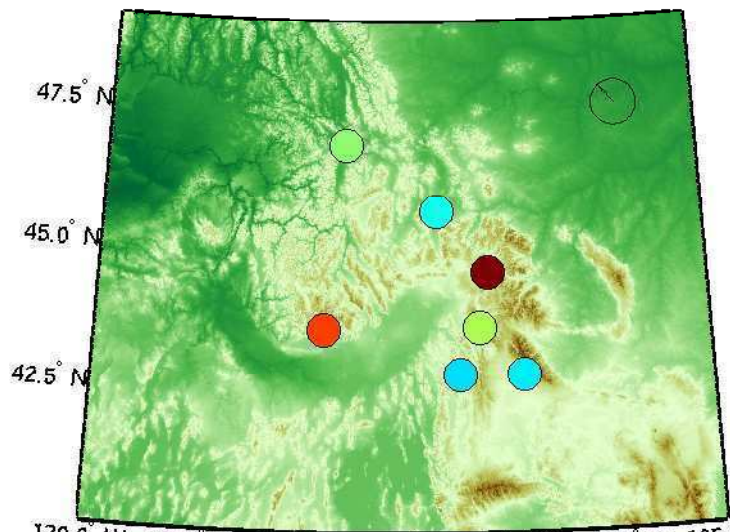
# Event\_2005\_141\_05\_11\_35



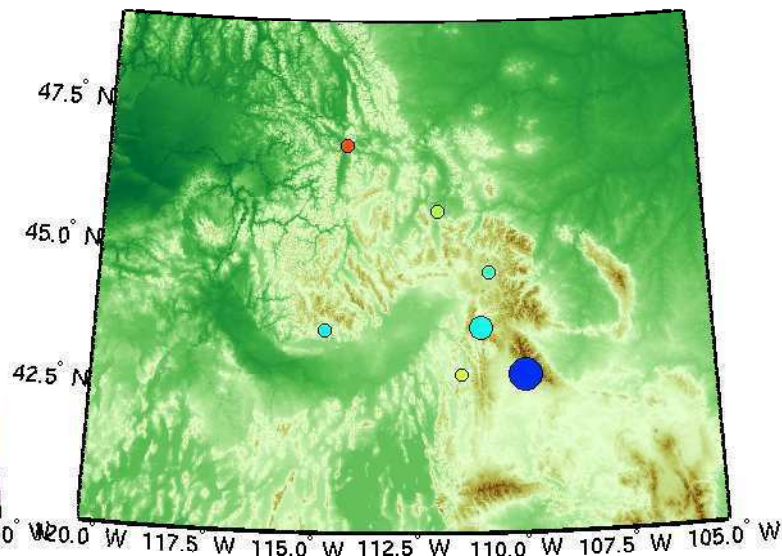
Baz = 141.7074  
Mean xcor value = 0.77375  
Range of  $t^*$  values is 0.95  
Median  $t^*$  err is 0.56094



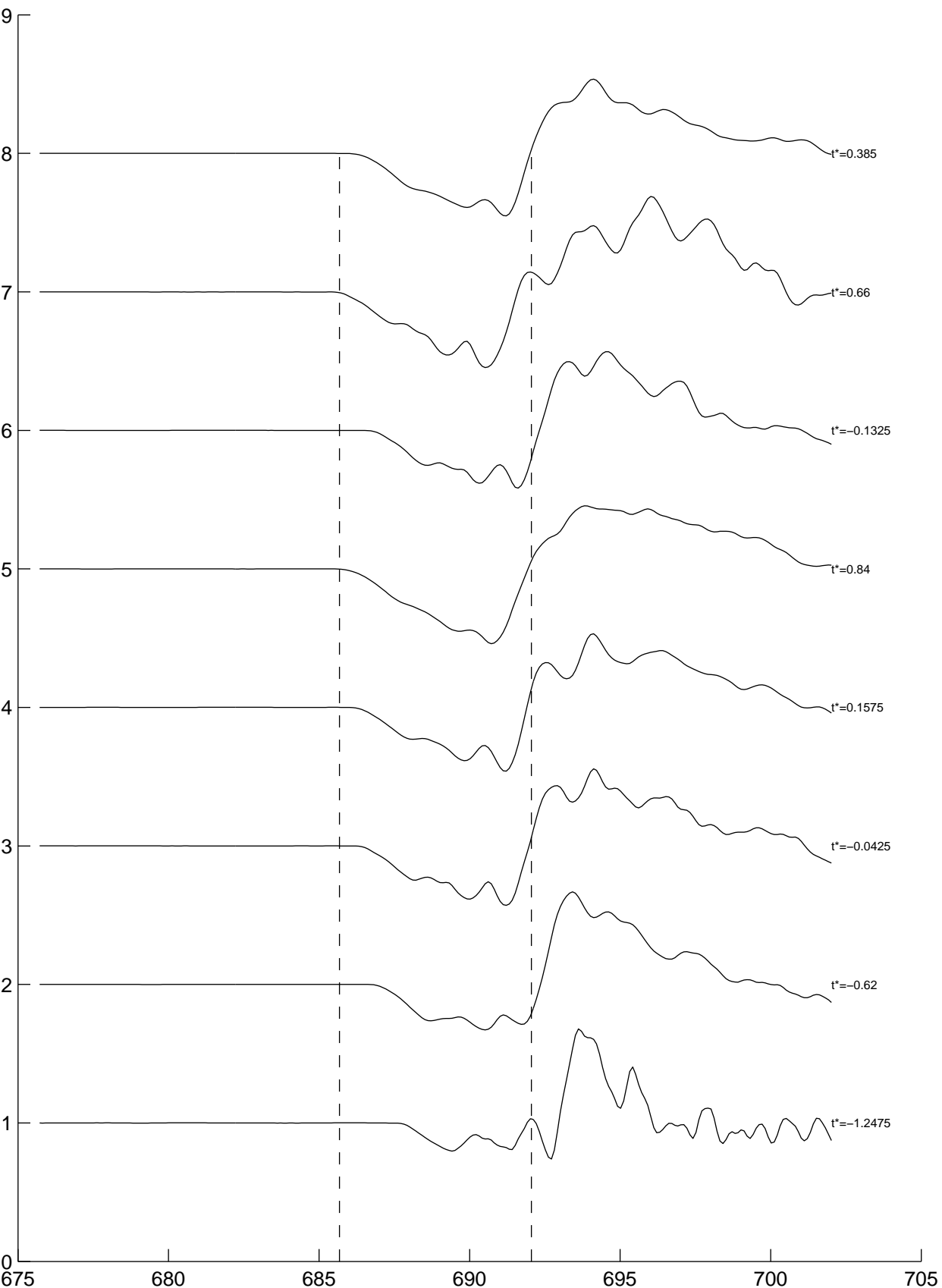
travel time residuals



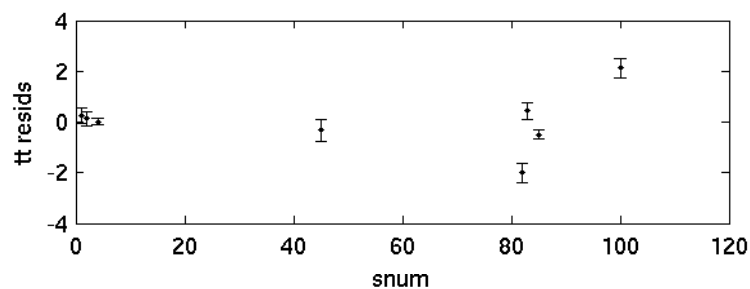
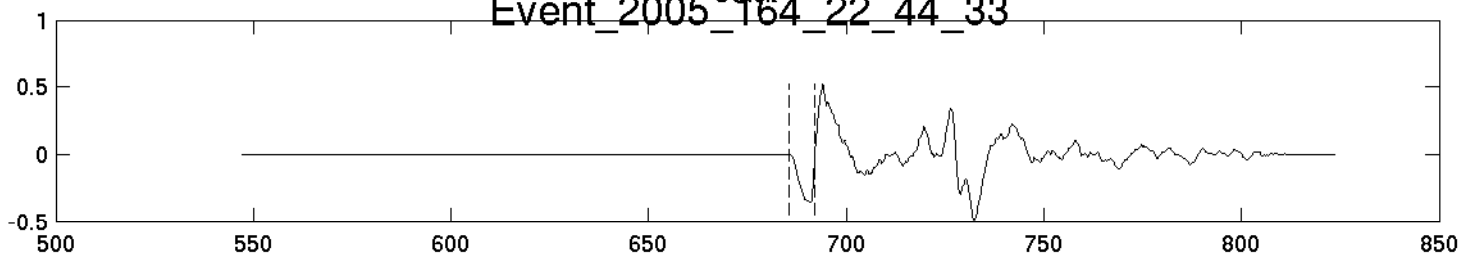
$t^*$  values



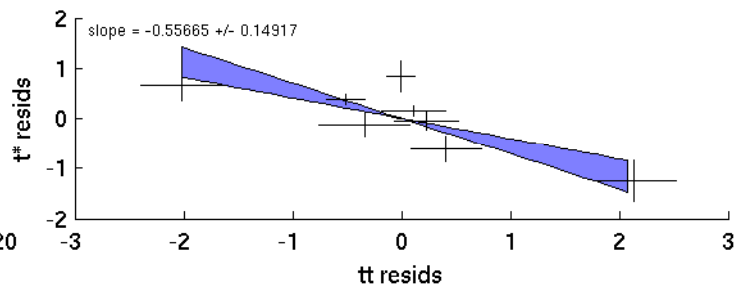
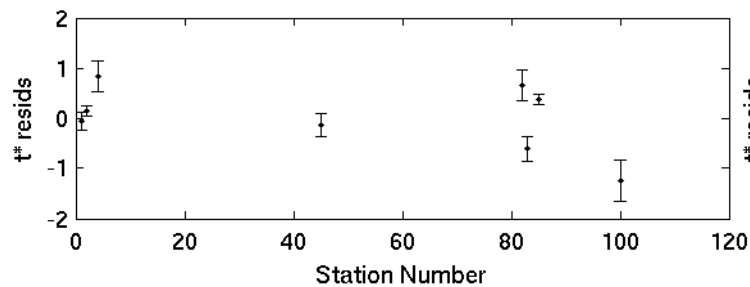
# Event\_2005\_164\_22\_44\_33



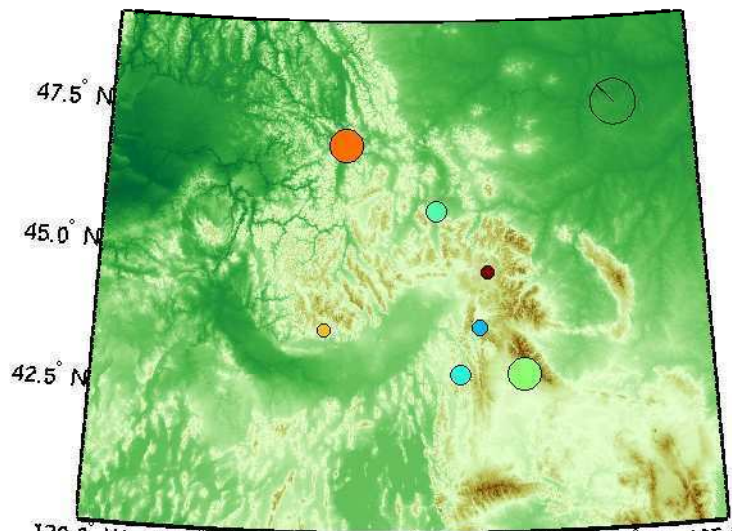
# Event\_2005\_164\_22\_44\_33



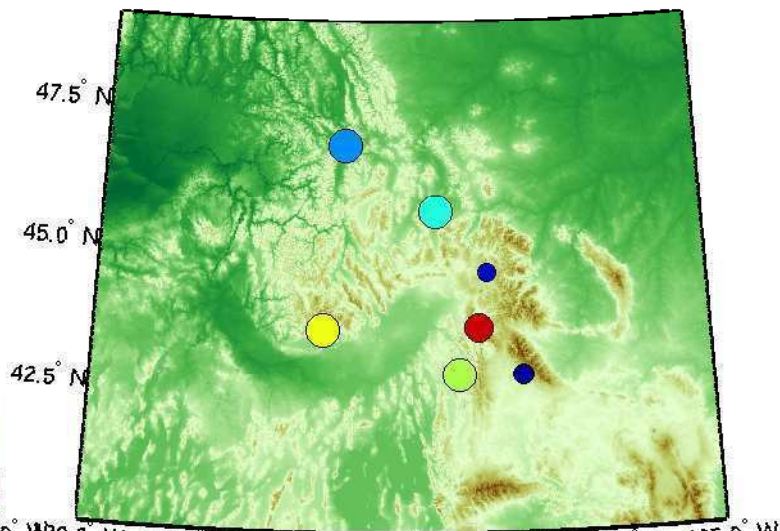
Baz = 139.1336  
 Mean xcor value = 0.84375  
 Range of  $t^*$  values is 2.0875  
 Median  $t^*$  err is 0.24206



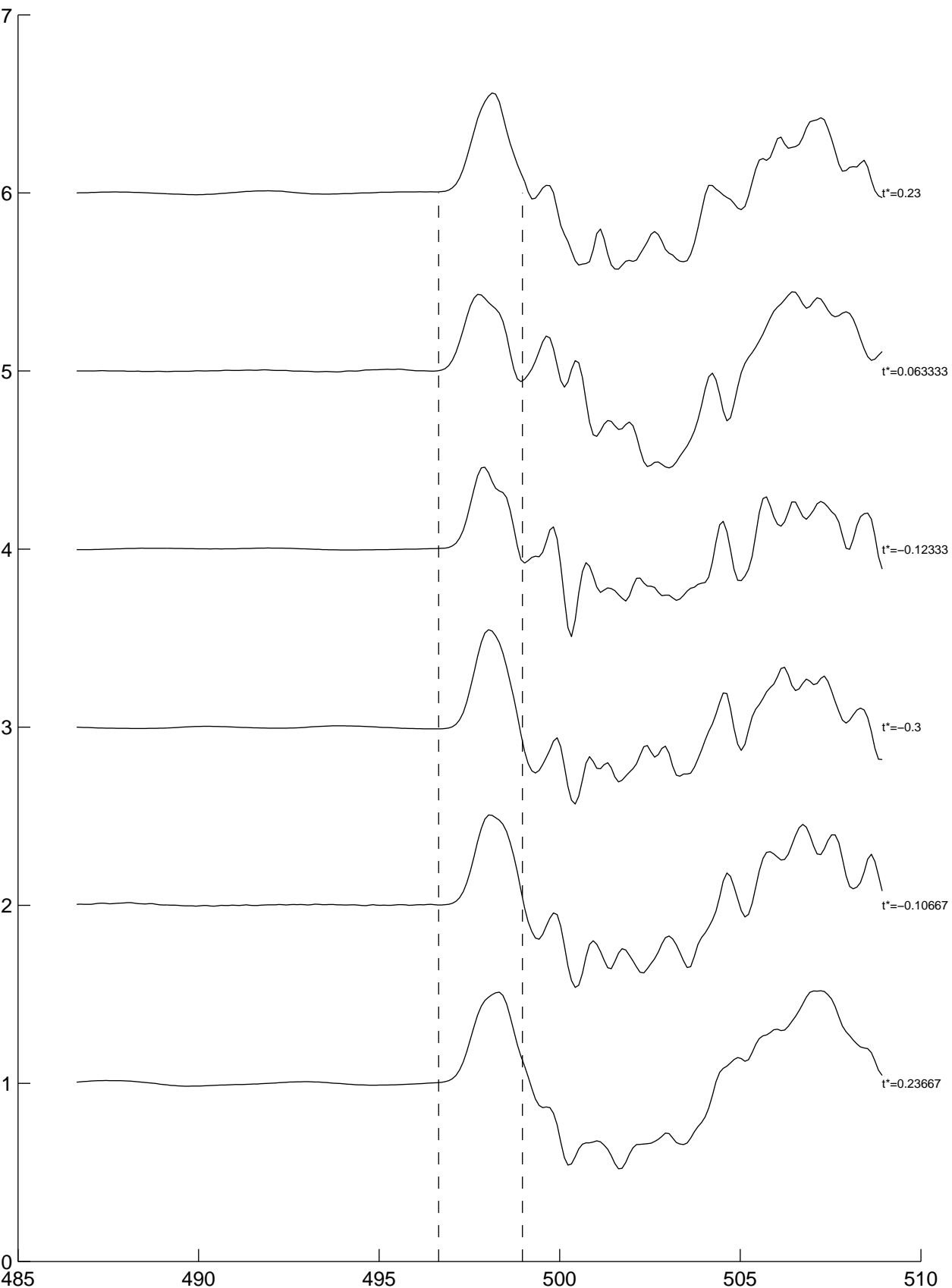
travel time residuals



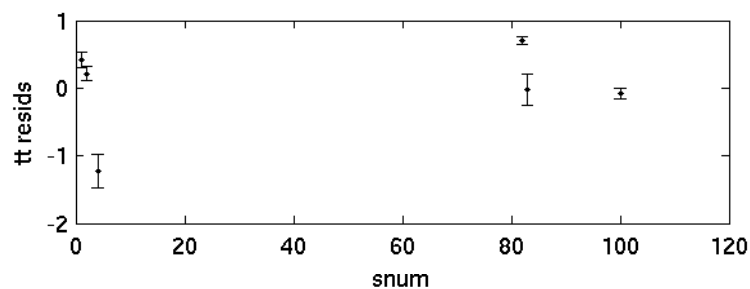
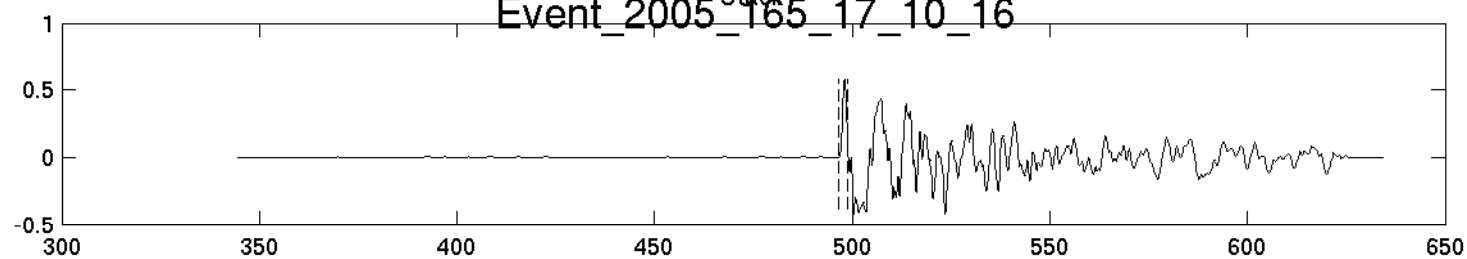
$t^*$  values



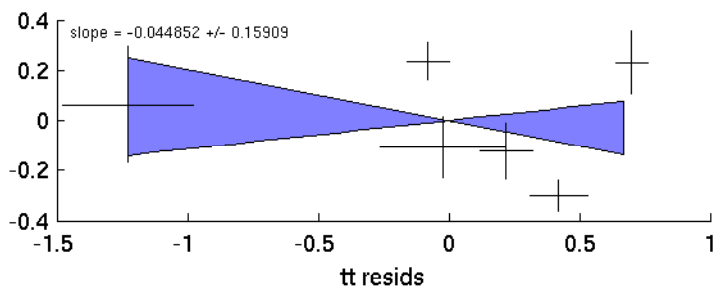
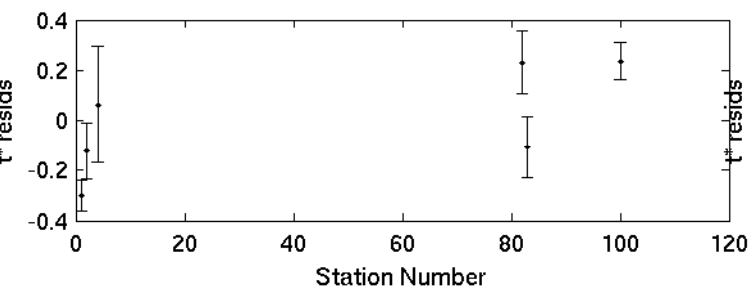
# Event\_2005\_165\_17\_10\_16



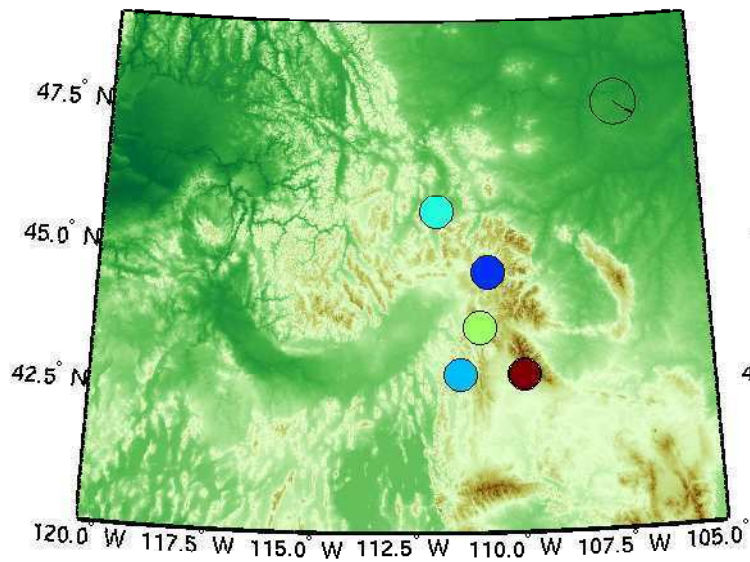
# Event\_2005\_165\_17\_10\_16



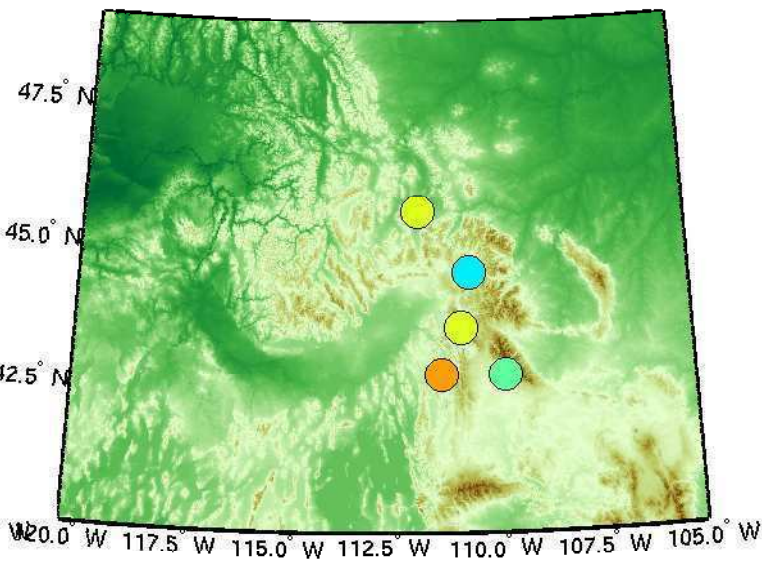
Baz = 304.7278  
Mean xcor value = 0.75333  
Range of  $t^*$  values is 0.53667  
Median  $t^*$  err is 0.11696



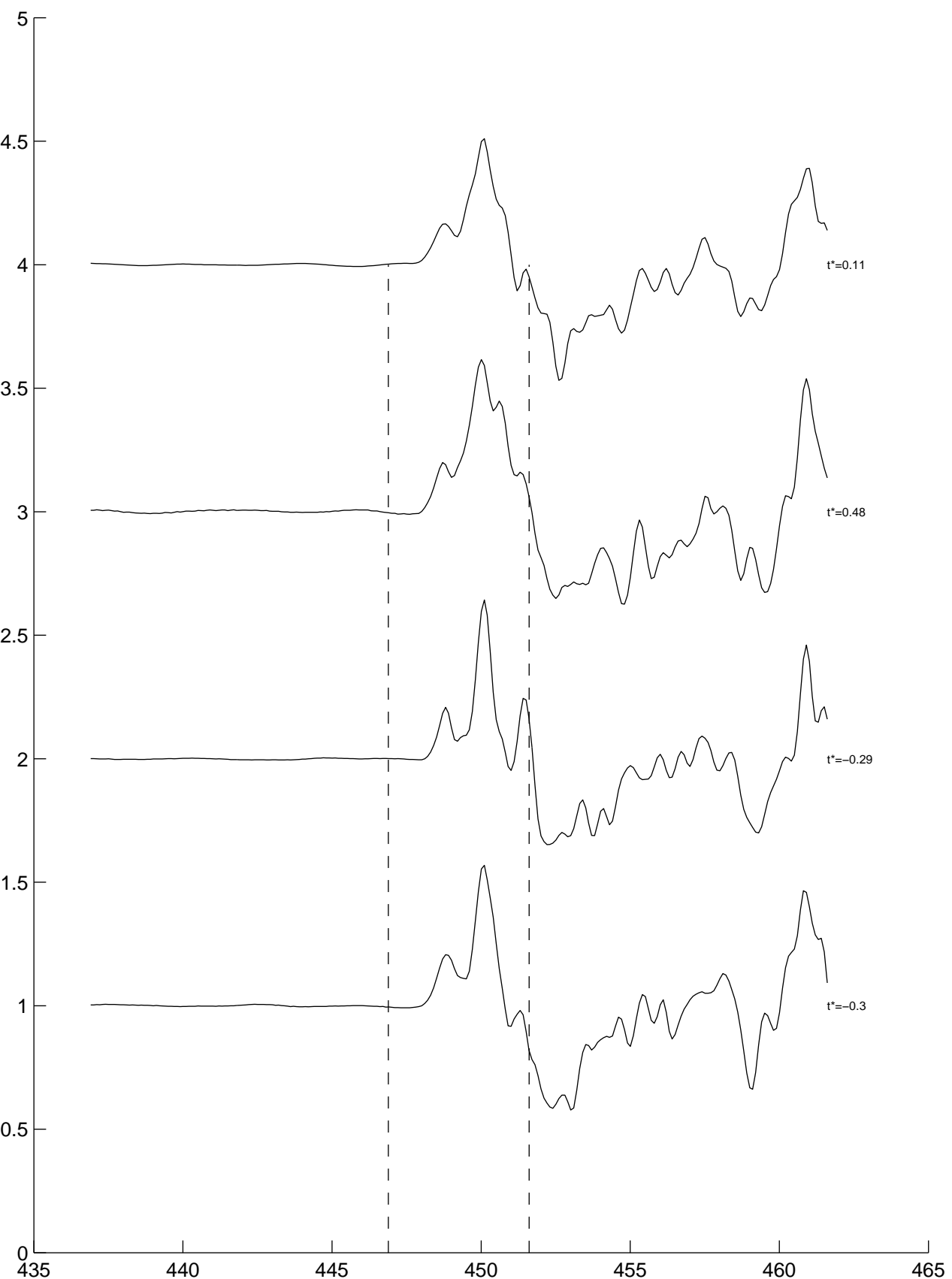
travel time residuals



$t^*$  values

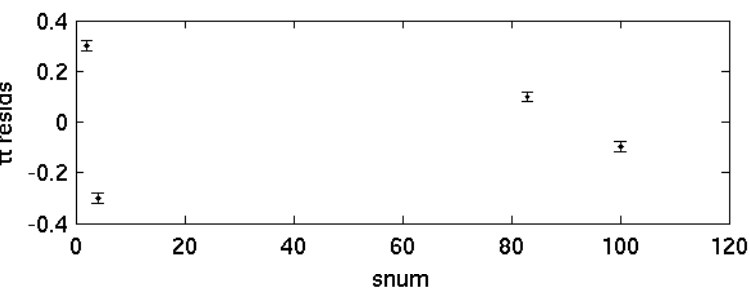
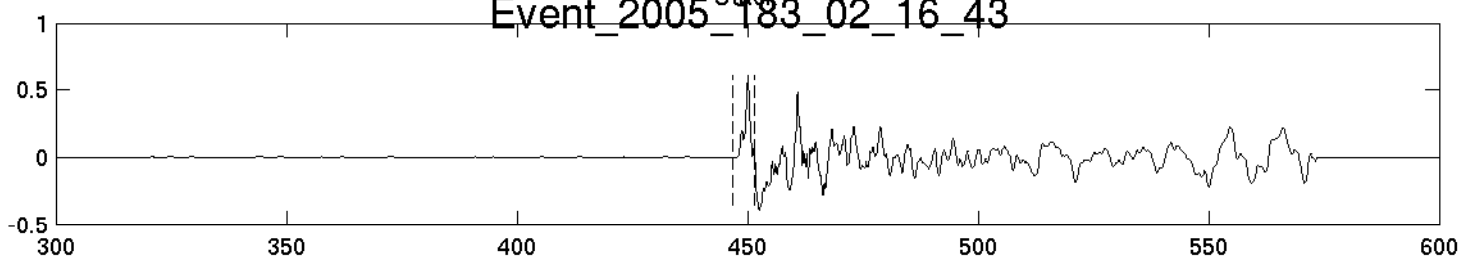


Event\_2005\_183\_02\_16\_43

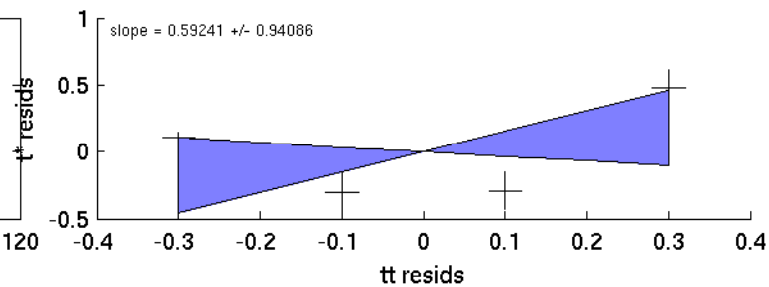
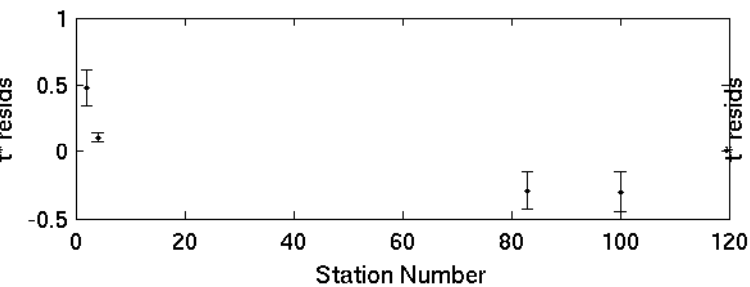




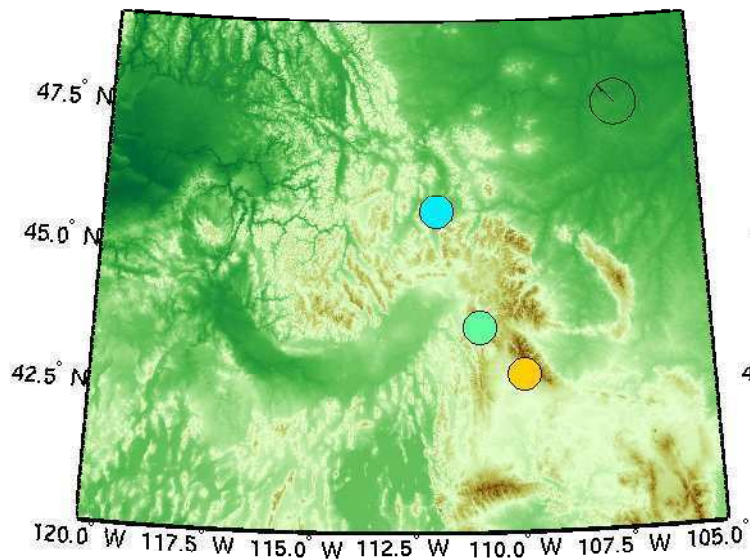
# Event\_2005\_183\_02\_16\_43



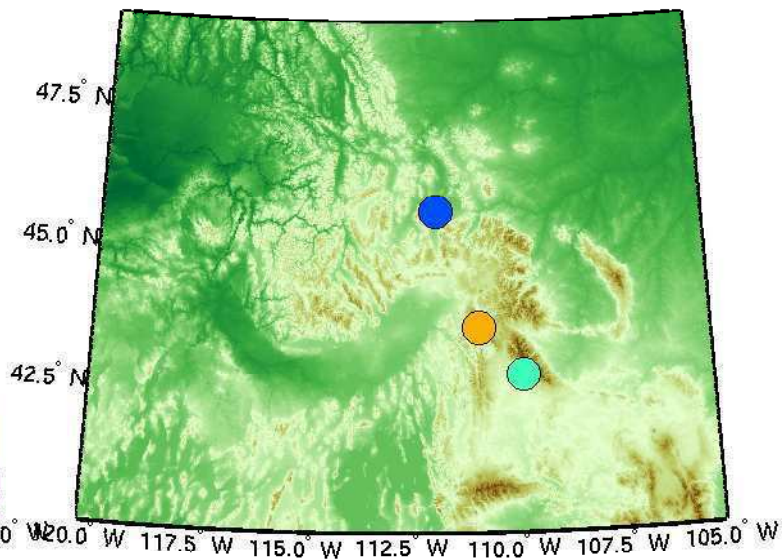
Baz = 138.8756  
Mean xcor value = 0.6275  
Range of  $t^*$  values is 0.78  
Median  $t^*$  err is 0.13564



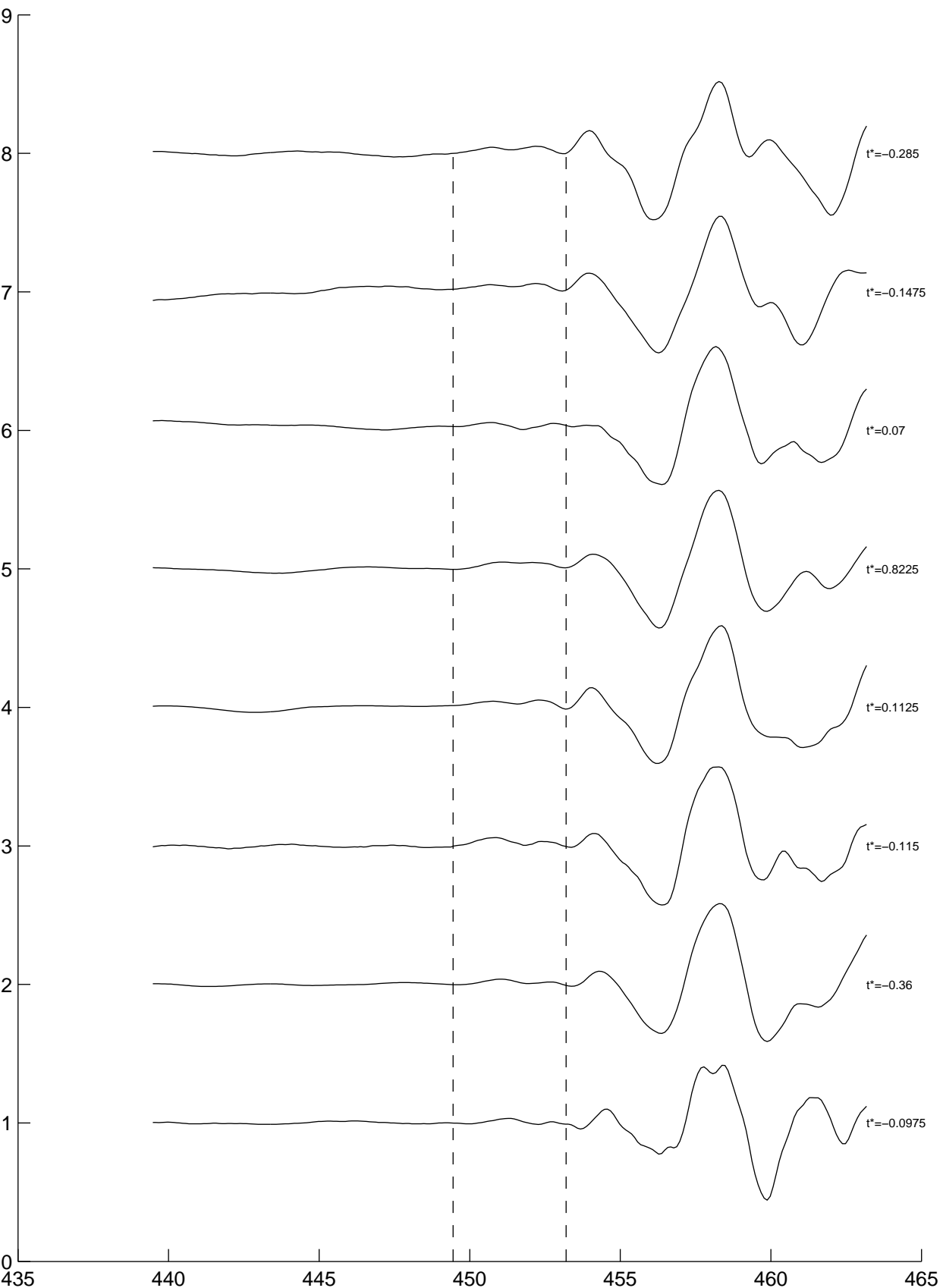
travel time residuals



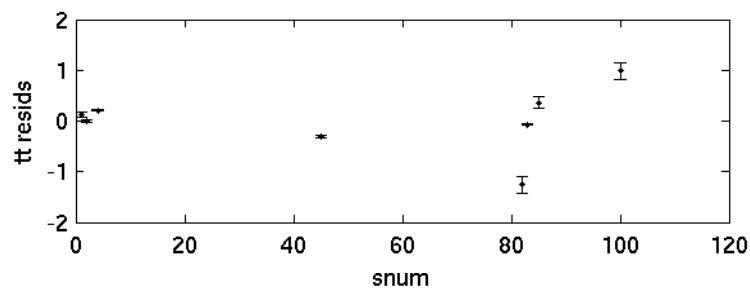
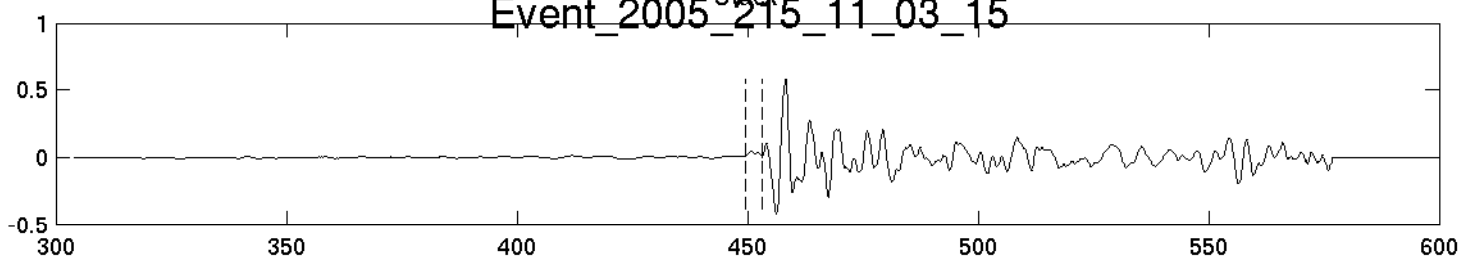
$t^*$  values



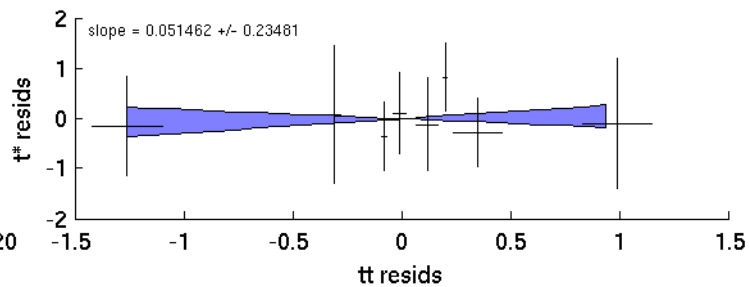
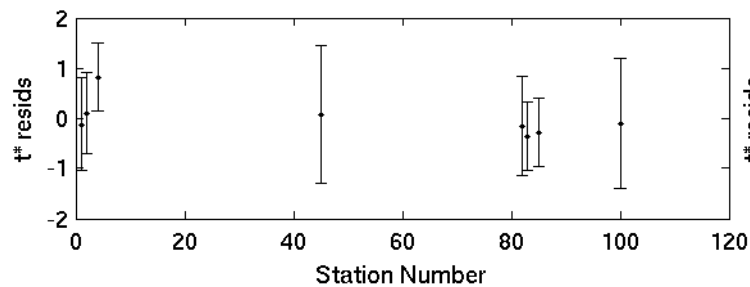
# Event\_2005\_215\_11\_03\_15



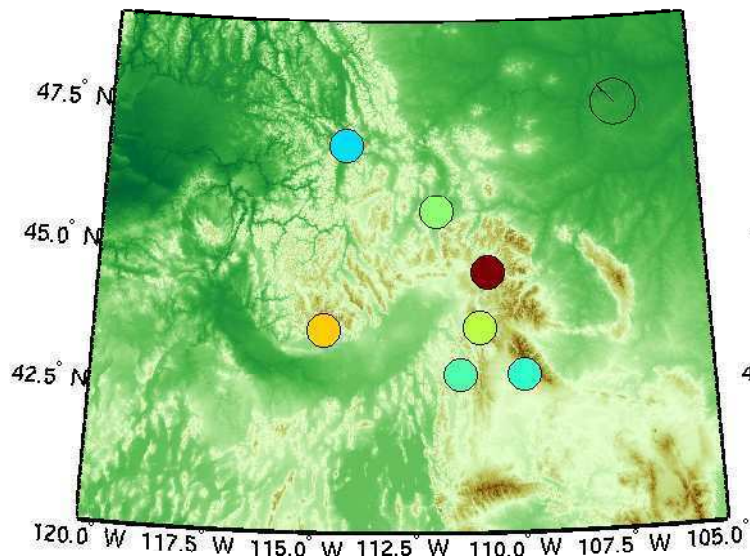
# Event\_2005\_215\_11\_03\_15



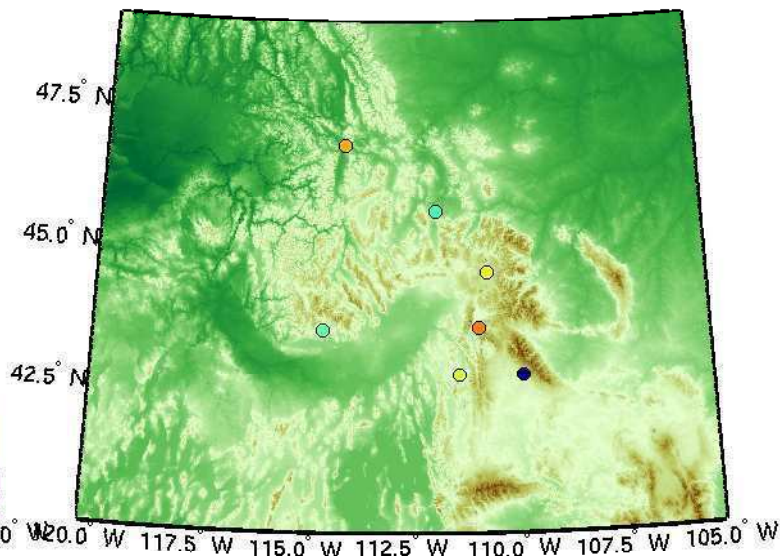
Baz = 137.9264  
Mean xcor value = 0.8175  
Range of  $t^*$  values is 1.1825  
Median  $t^*$  err is 0.67141



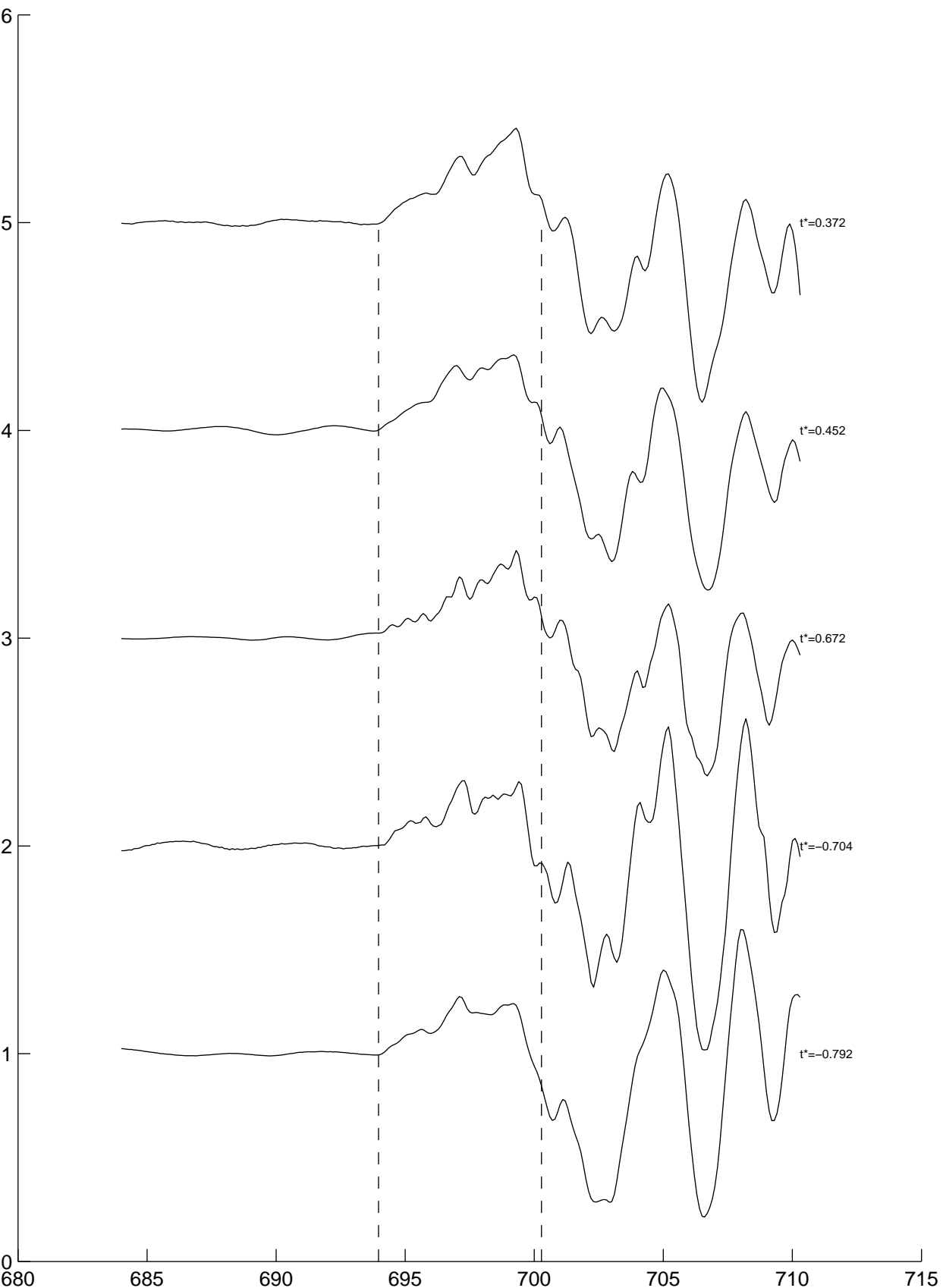
travel time residuals



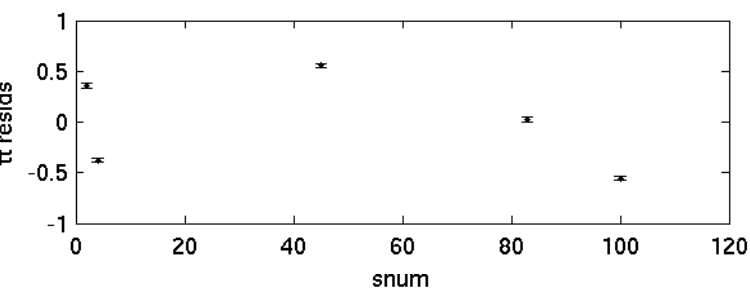
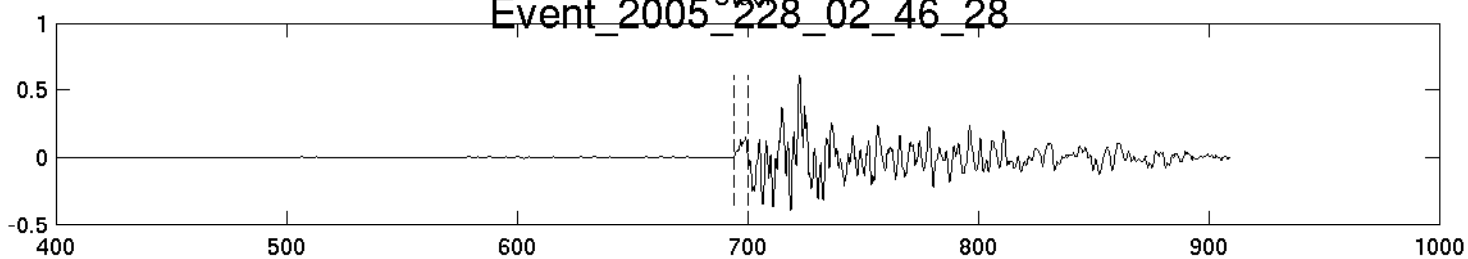
$t^*$  values



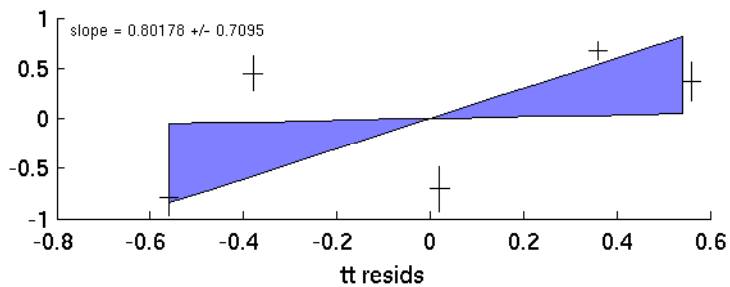
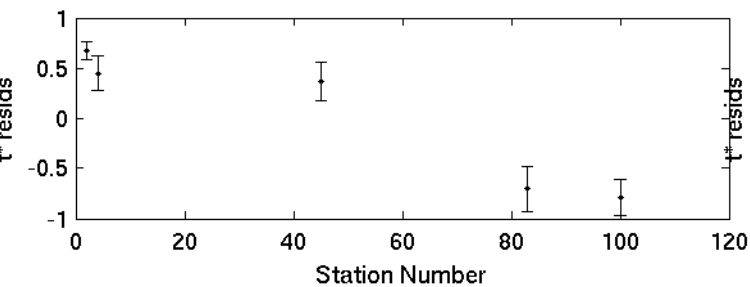
# Event\_2005\_228\_02\_46\_28



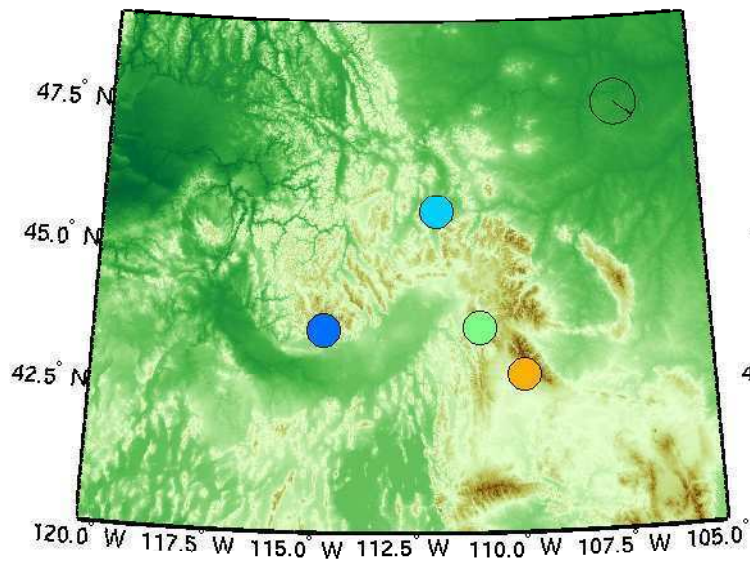
# Event\_2005\_228\_02\_46\_28



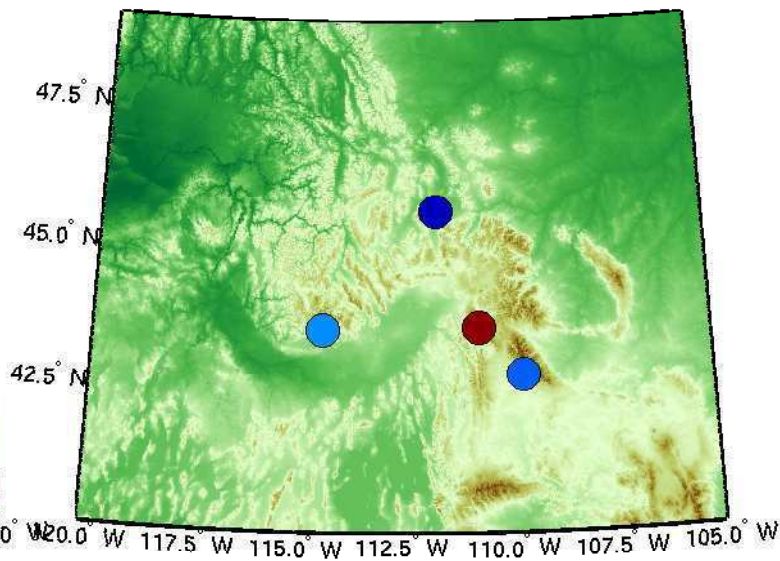
Baz = 308.425  
 Mean xcor value = 0.778  
 Range of  $t^*$  values is 1.464  
 Median  $t^*$  err is 0.17651



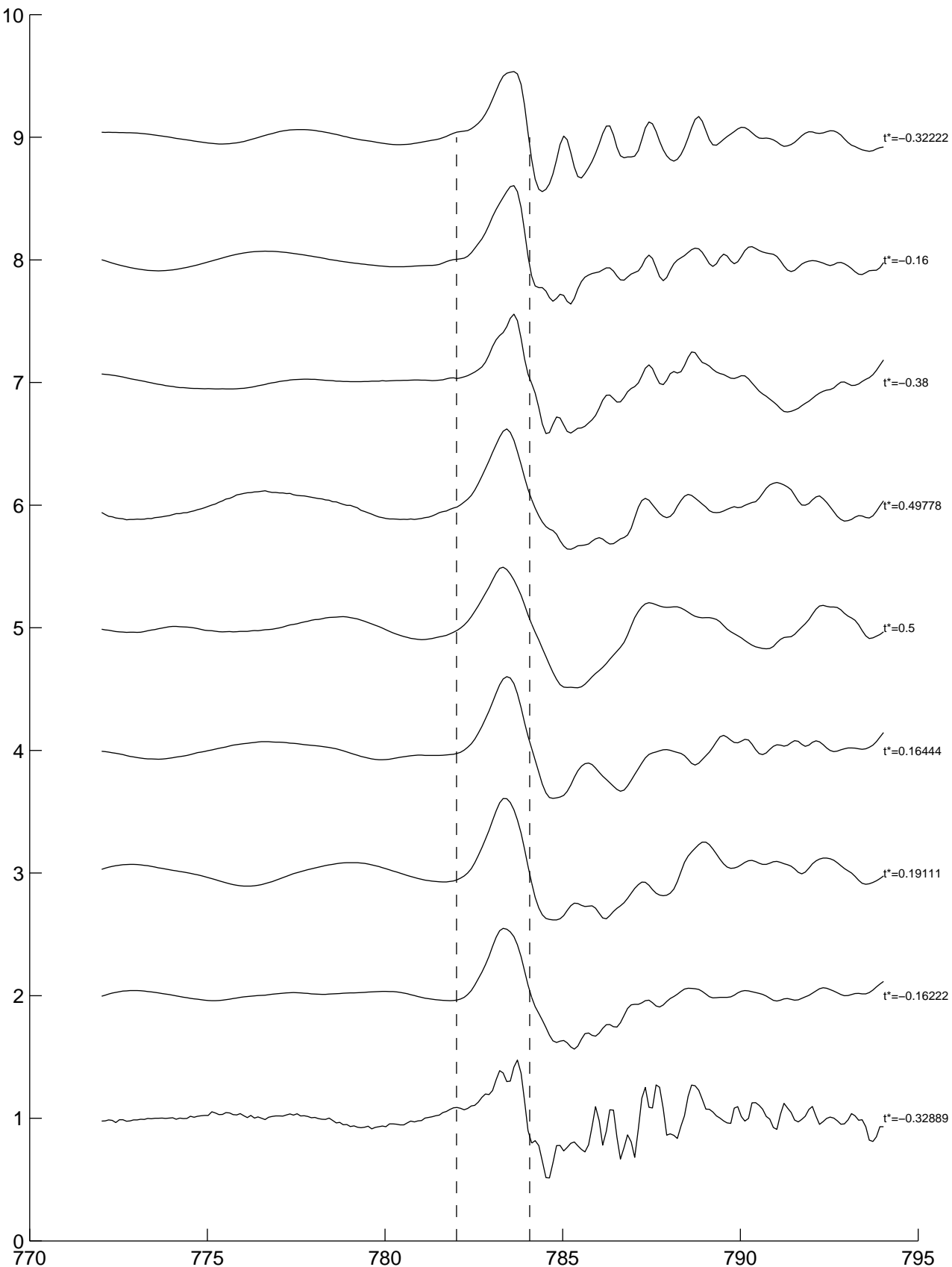
travel time residuals



$t^*$  values

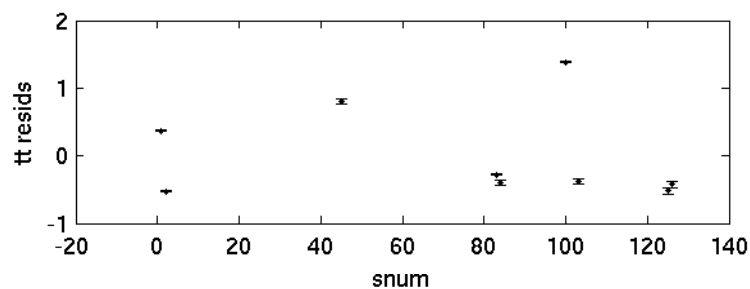
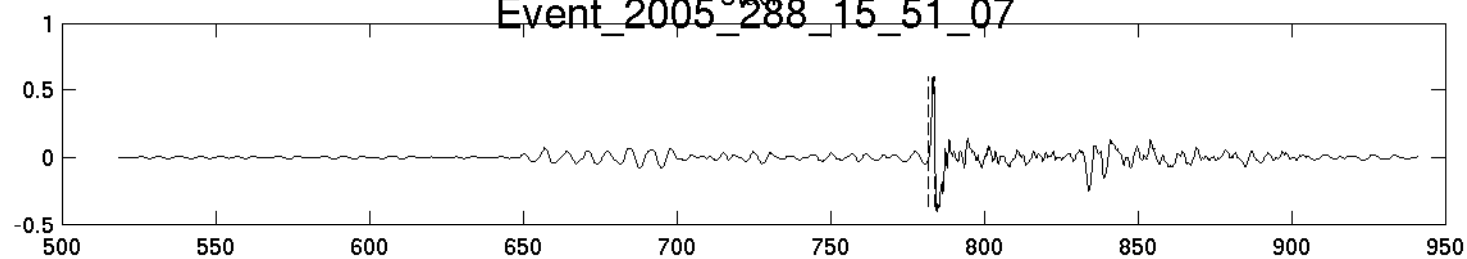


# Event\_2005\_288\_15\_51\_07

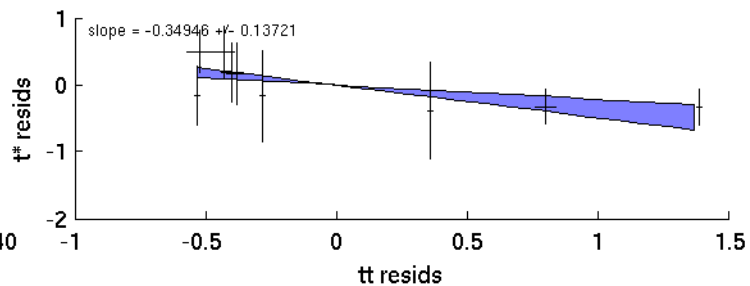
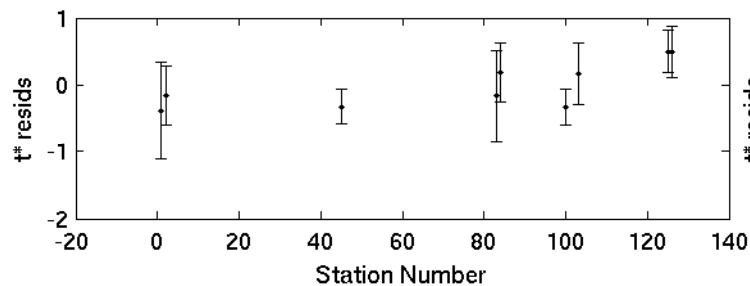




# Event\_2005\_288\_15\_51\_07

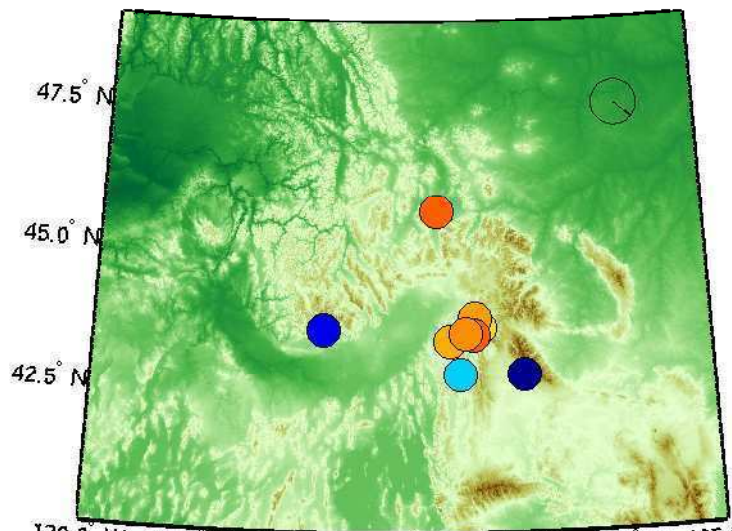


Baz = 312.217  
Mean xcor value = 0.70111  
Range of  $t^*$  values is 0.88  
Median  $t^*$  err is 0.43935

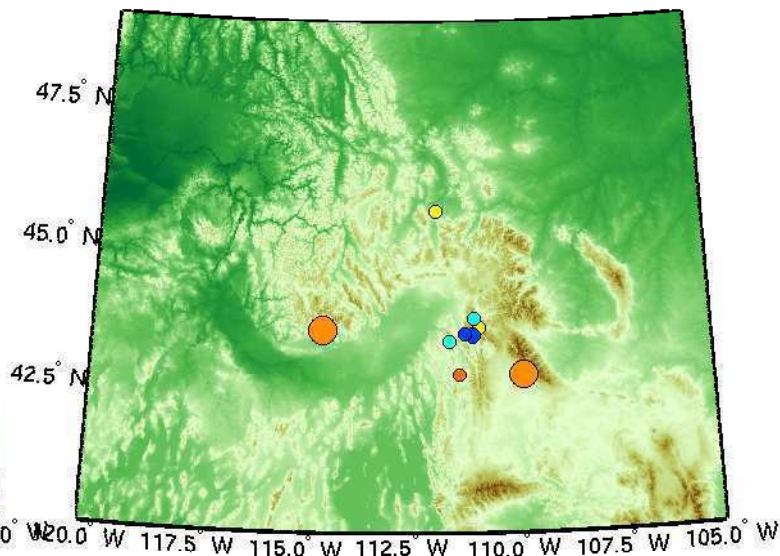


slope = -0.34946 +/- 0.13721

travel time residuals

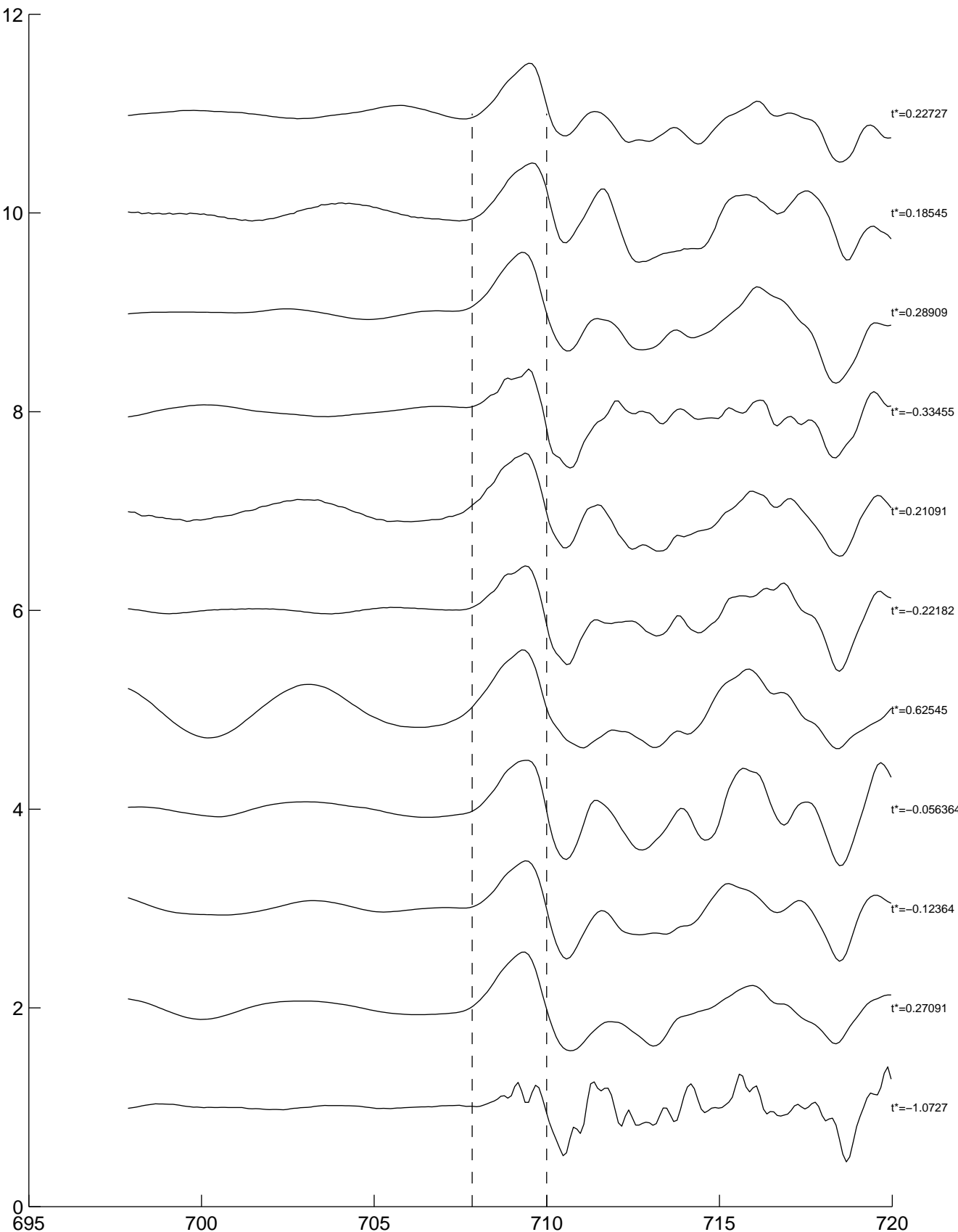


$t^*$  values

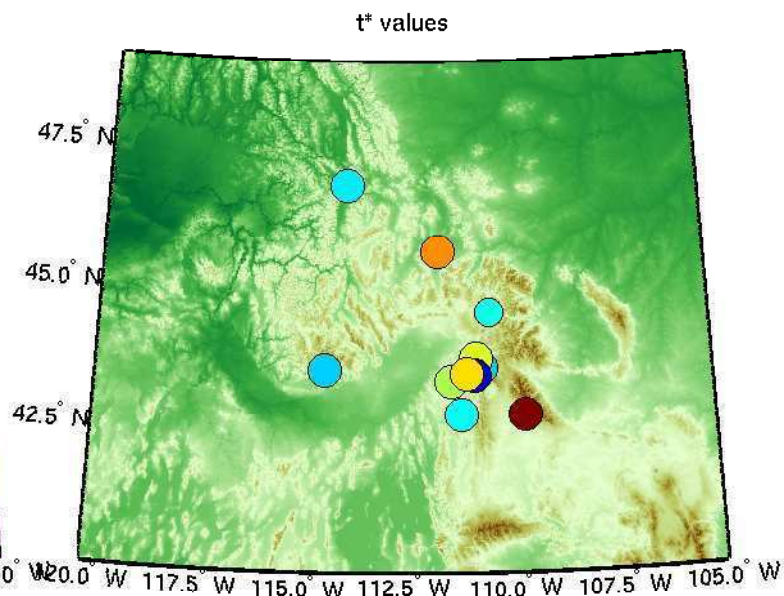
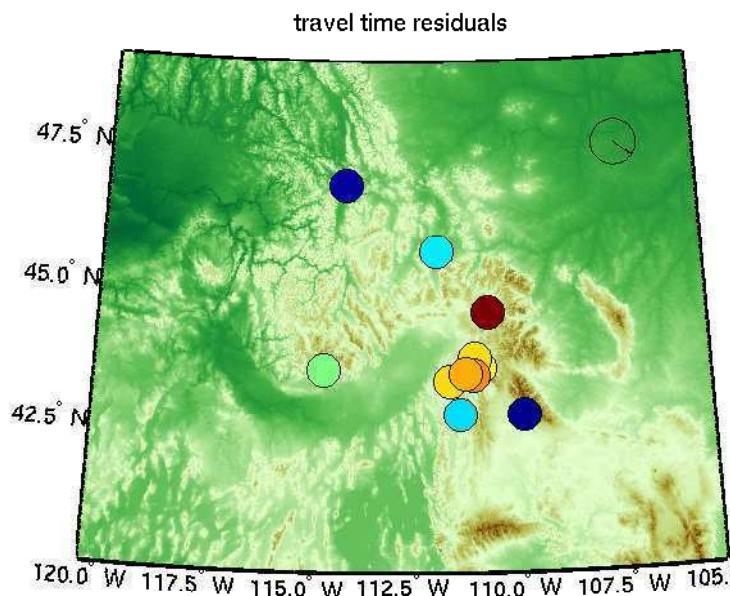
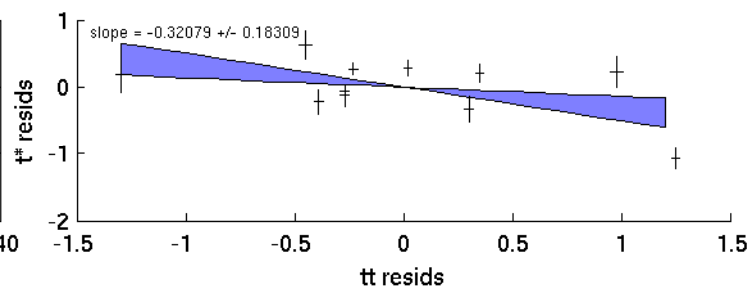
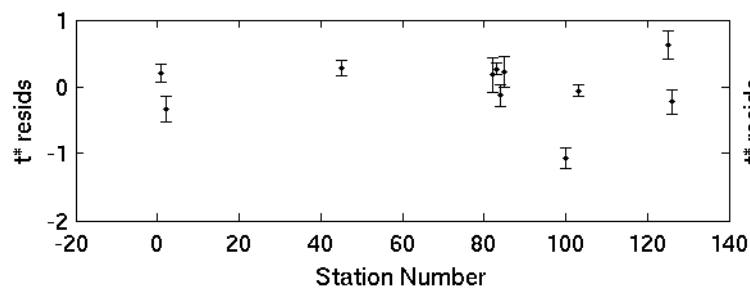
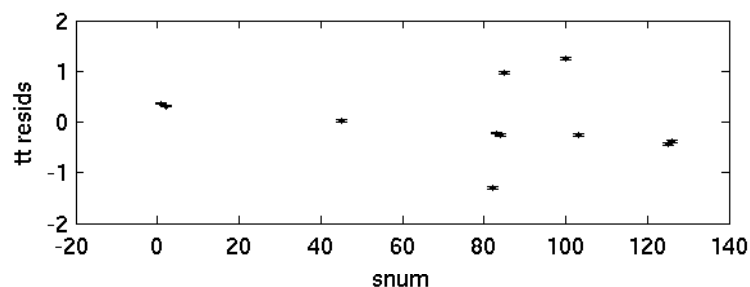
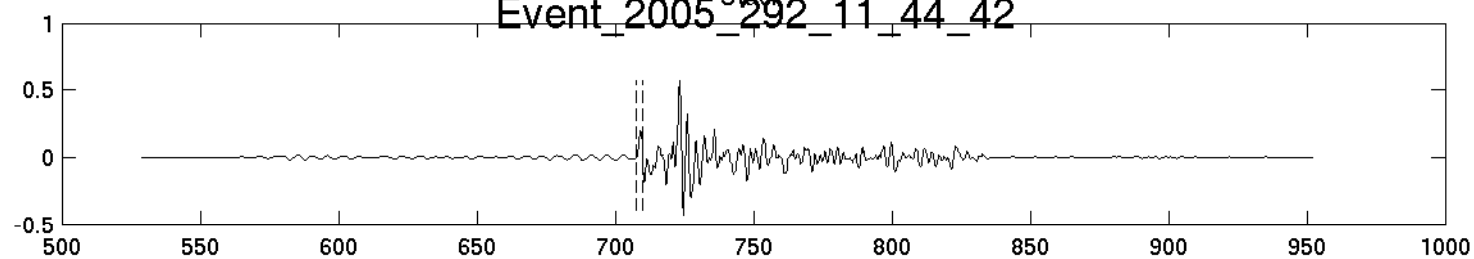




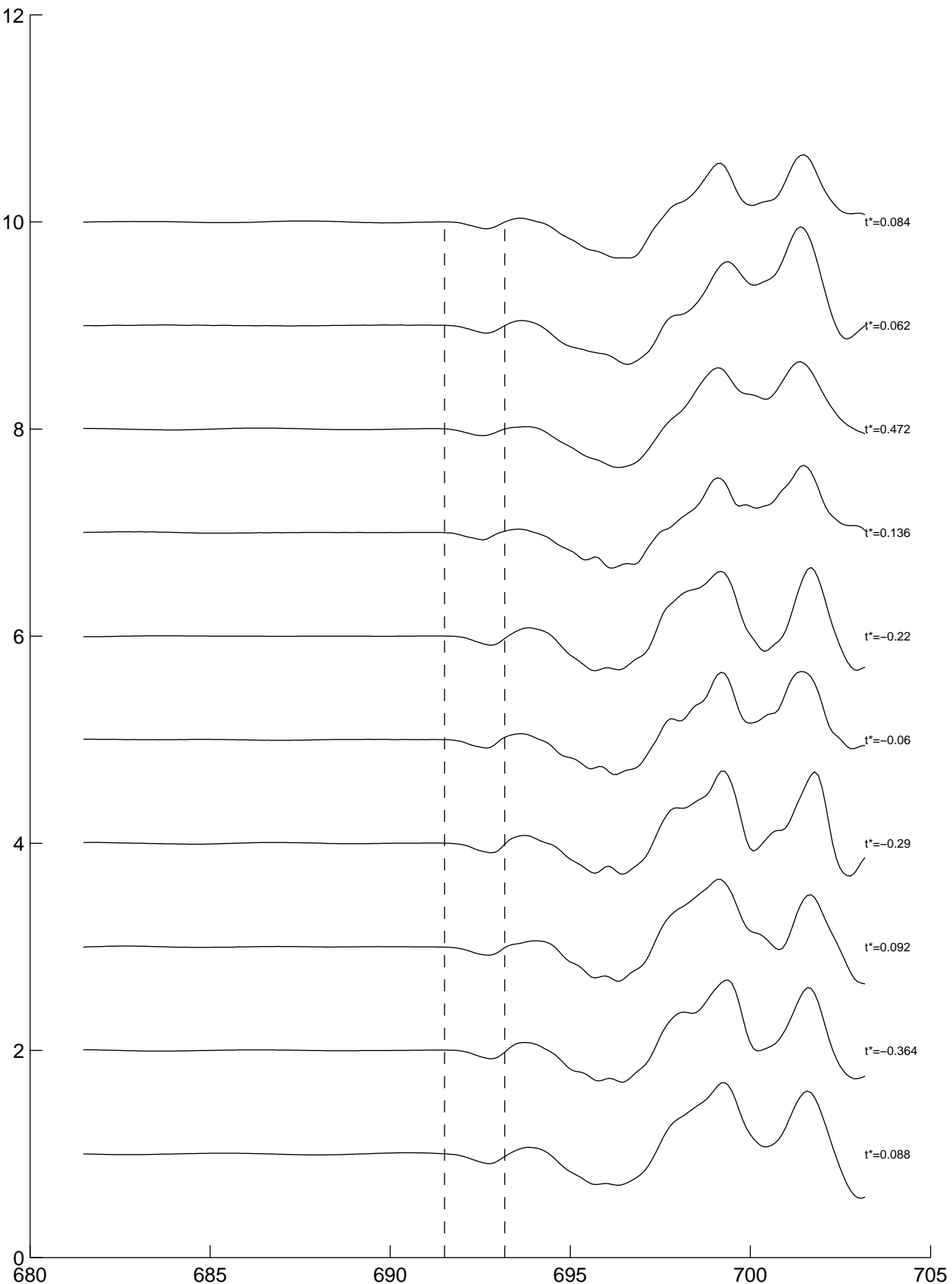
# Event\_2005\_292\_11\_44\_42



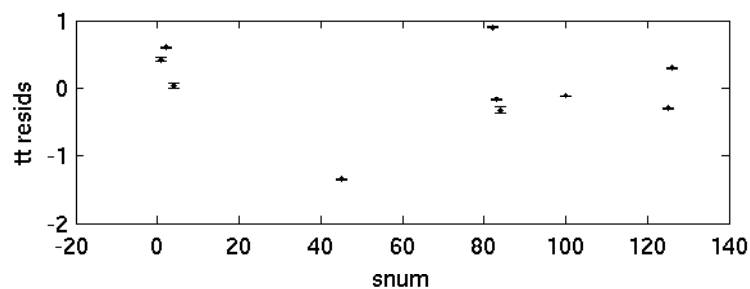
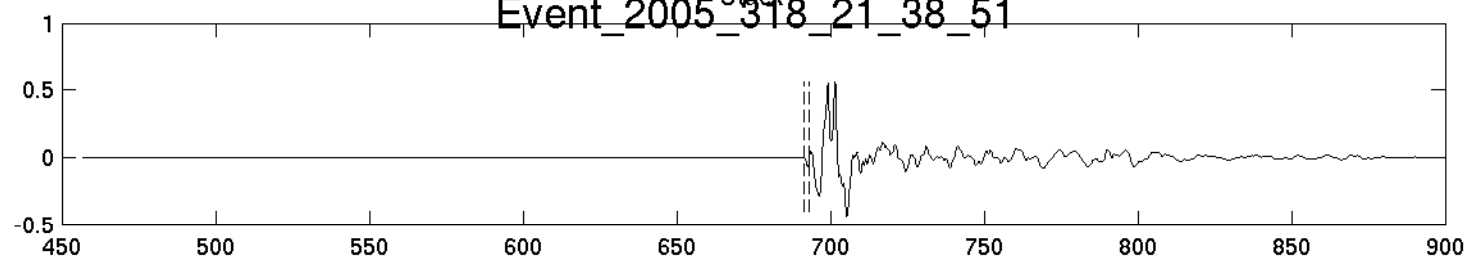
# Event\_2005\_292\_11\_44\_42



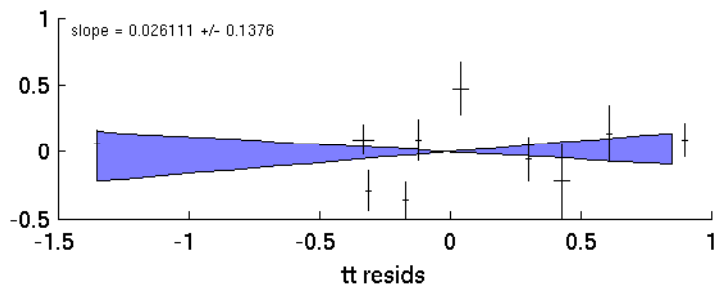
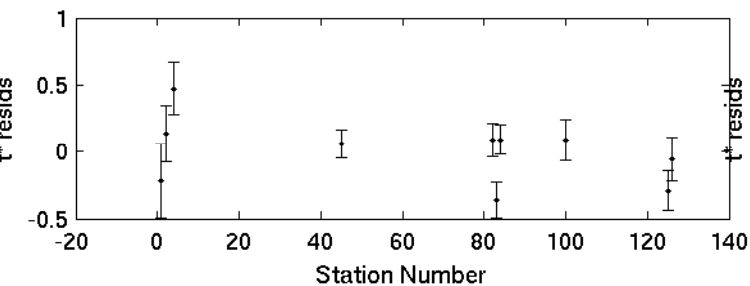
# Event\_2005\_318\_21\_38\_51



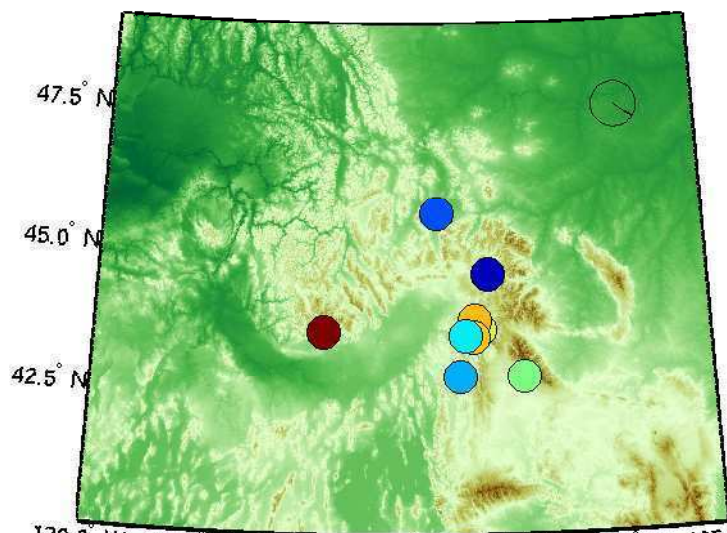
# Event\_2005\_318\_21\_38\_51



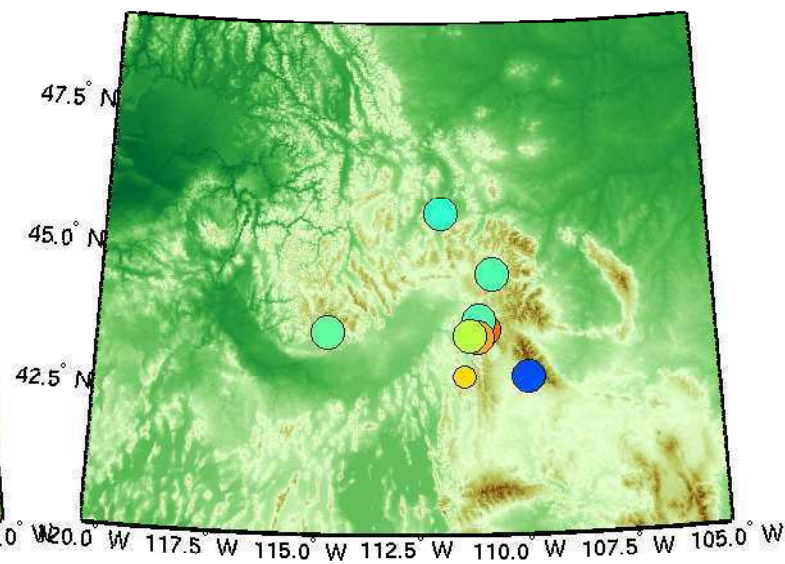
Baz = 306.9647  
 Mean xcor value = 0.849  
 Range of  $t^*$  values is 0.836  
 Median  $t^*$  err is 0.15026



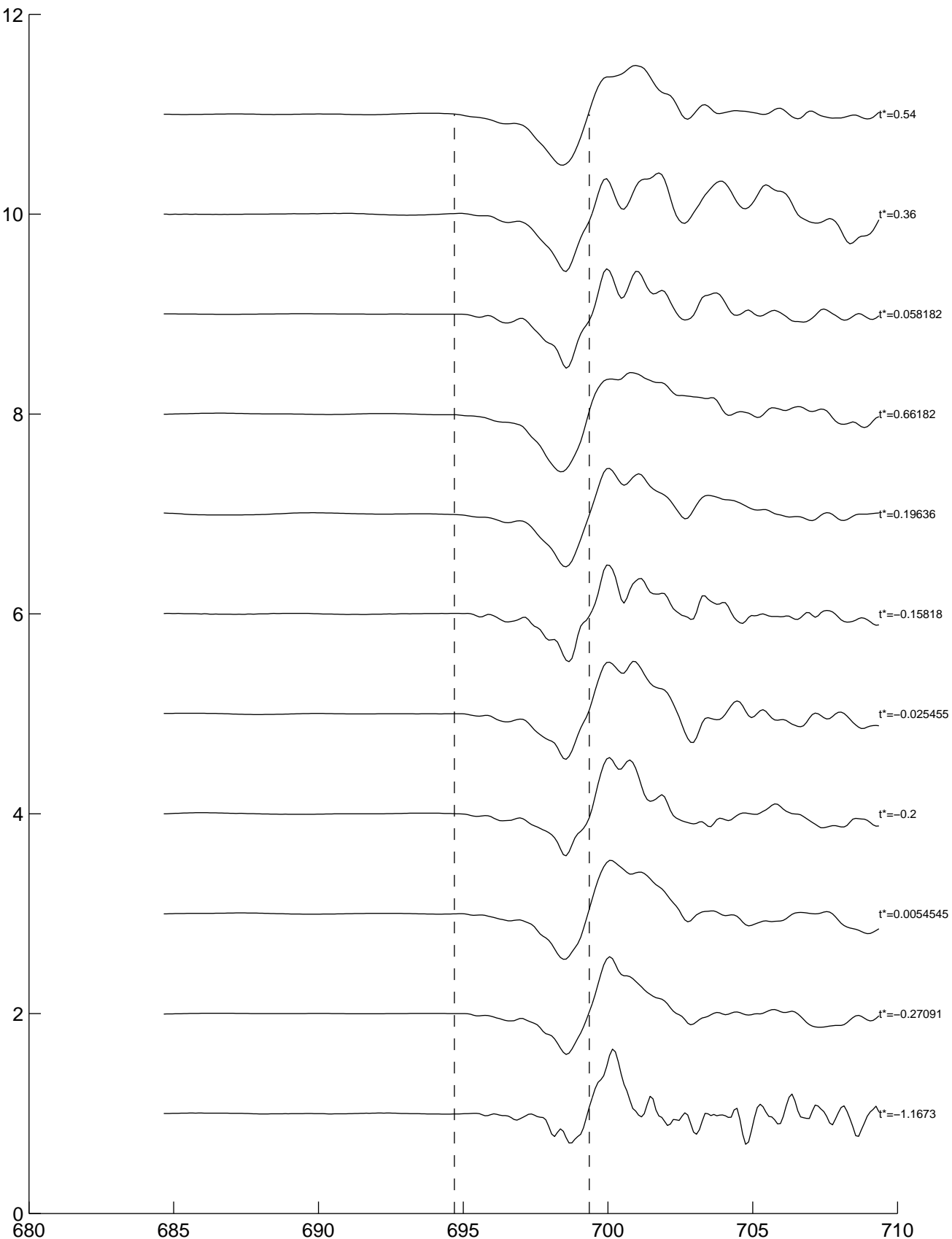
travel time residuals



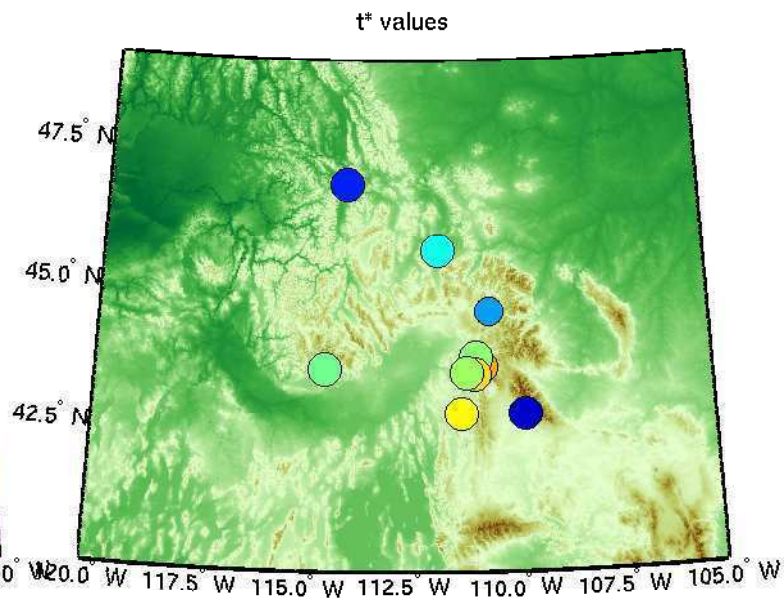
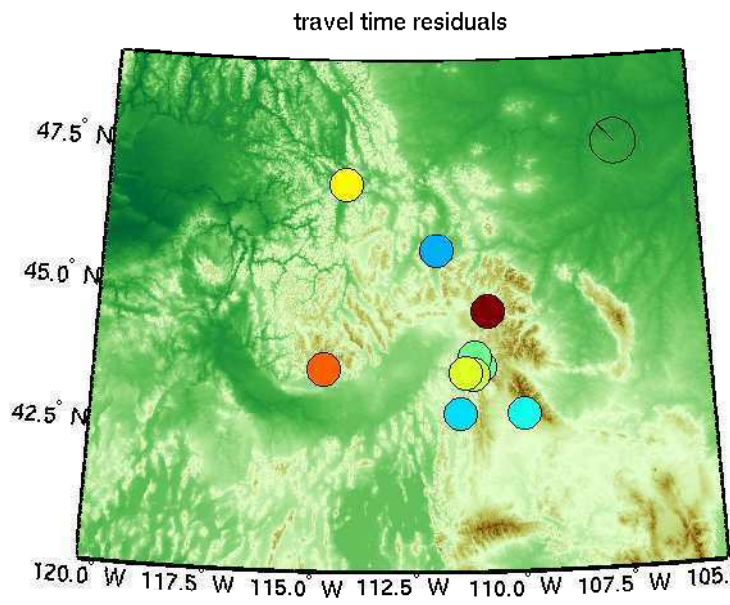
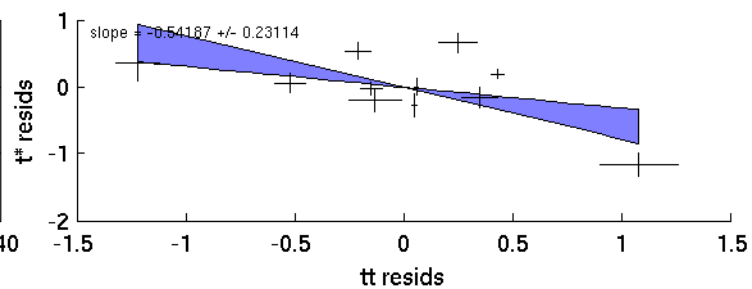
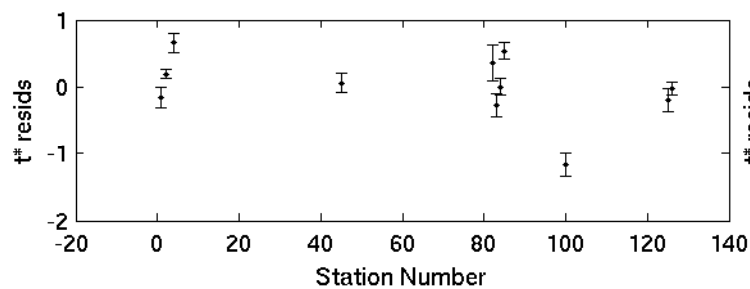
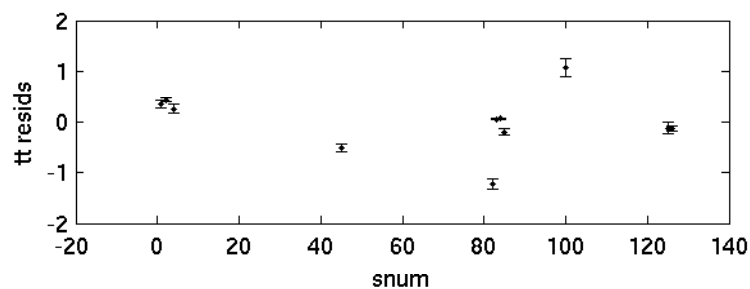
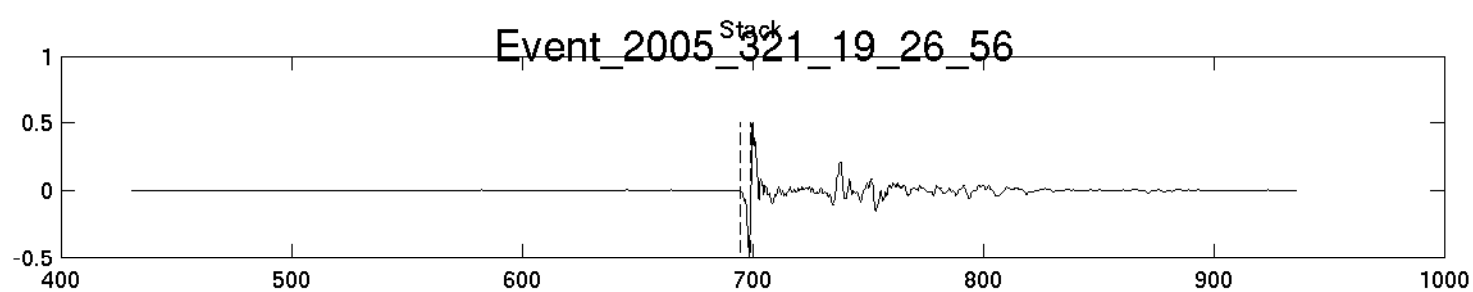
$t^*$  values



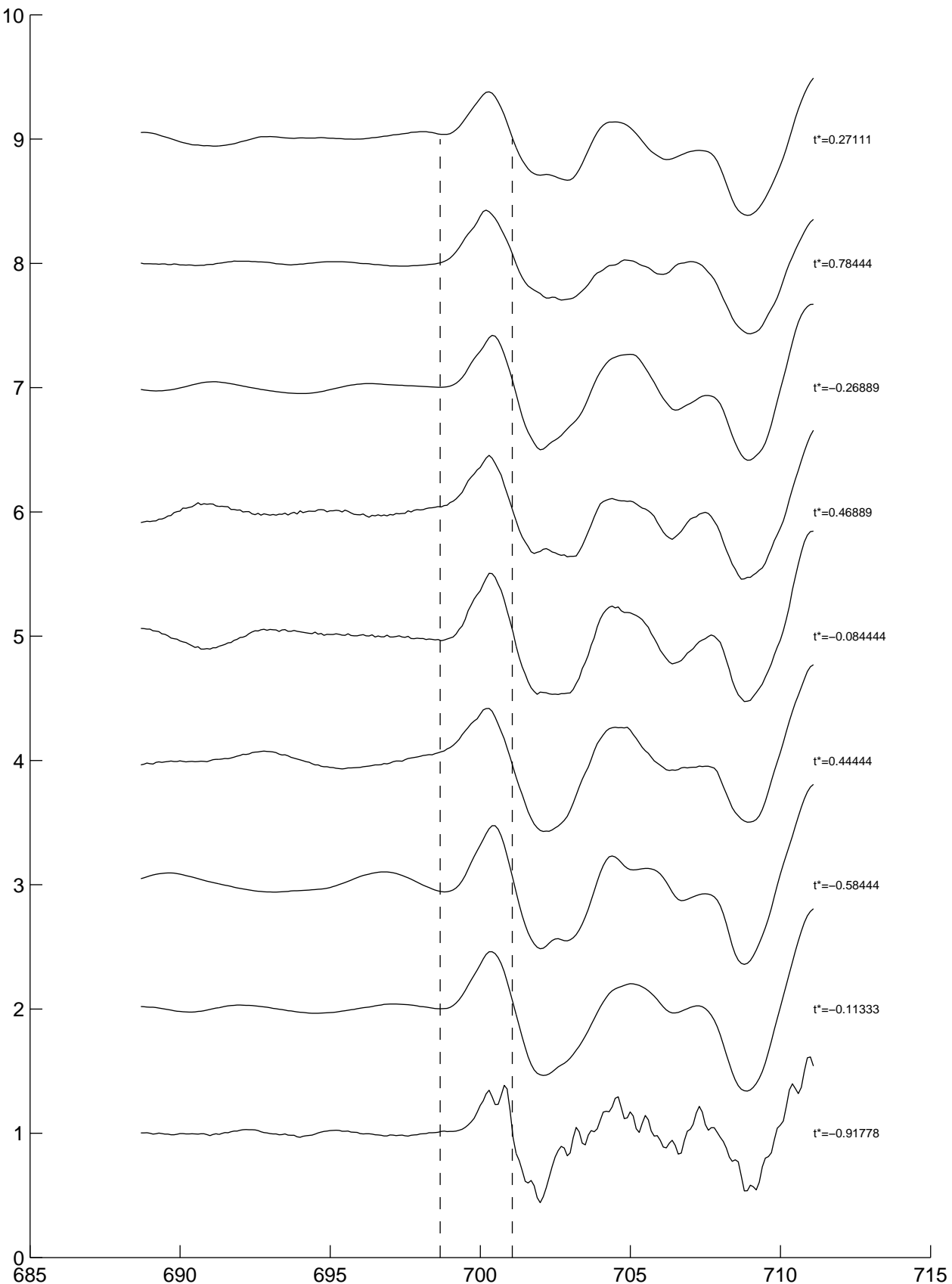
# Event\_2005\_321\_19\_26\_56



# Event\_2005\_321\_19\_26\_56

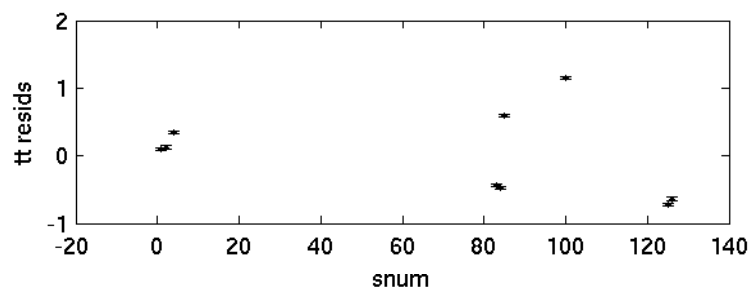
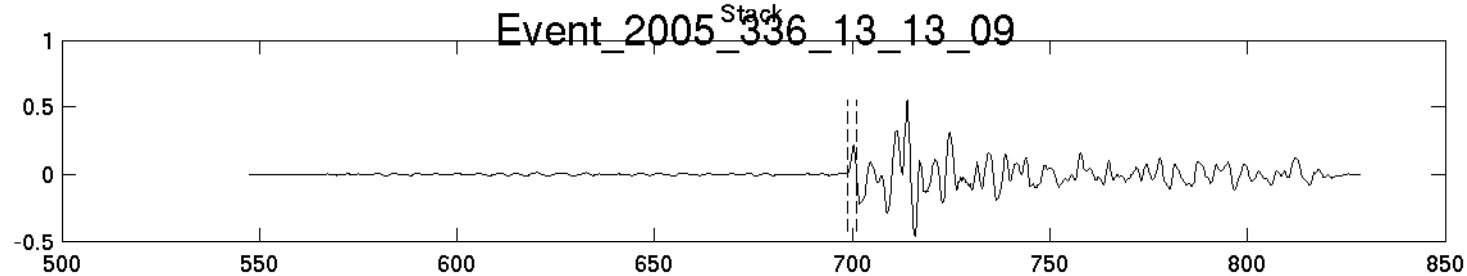


# Event\_2005\_336\_13\_13\_09

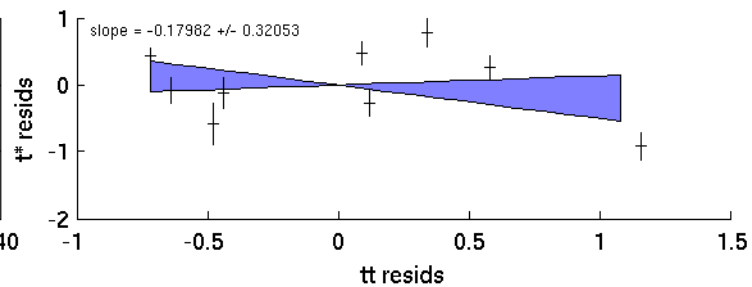
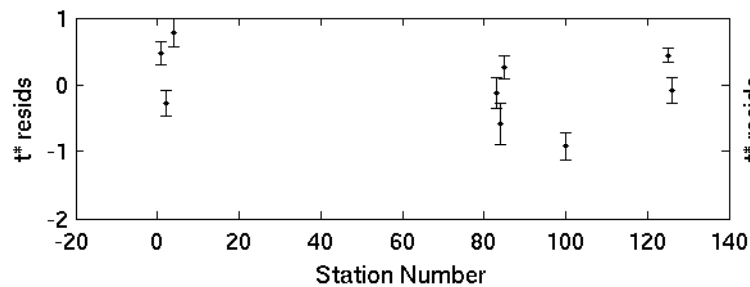




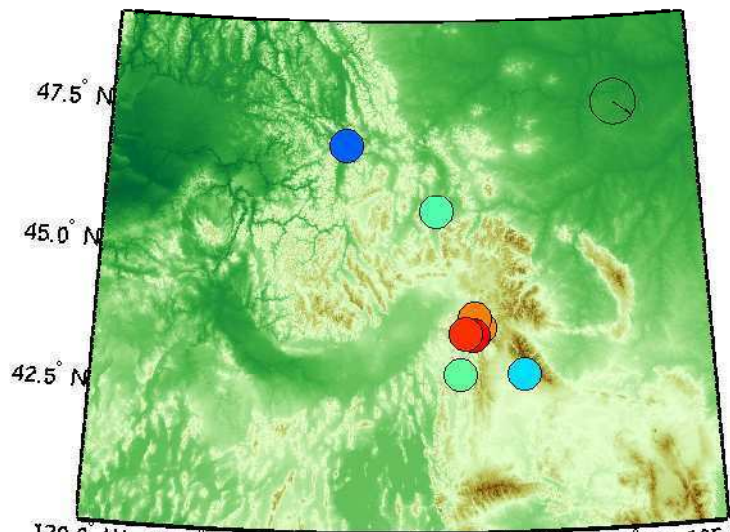
# Event\_2005\_336\_13\_13\_09



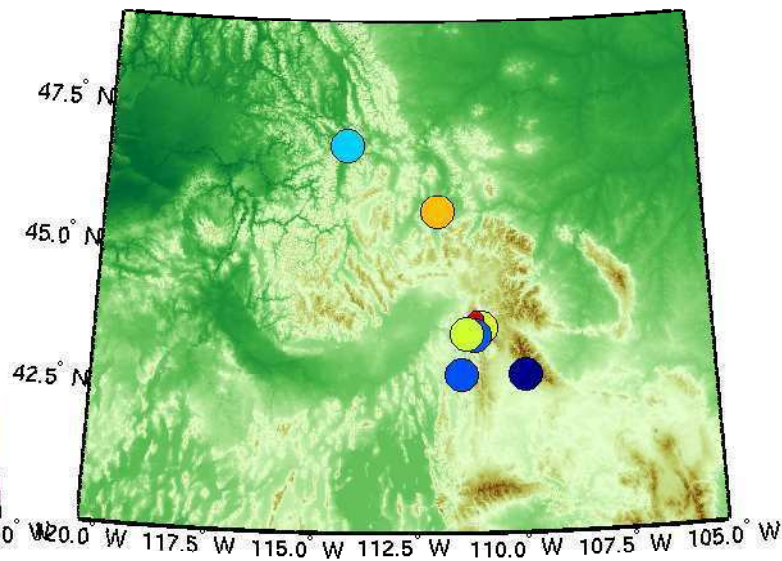
Baz = 308.6687  
Mean xcor value = 0.87333  
Range of  $t^*$  values is 1.7022  
Median  $t^*$  err is 0.18823



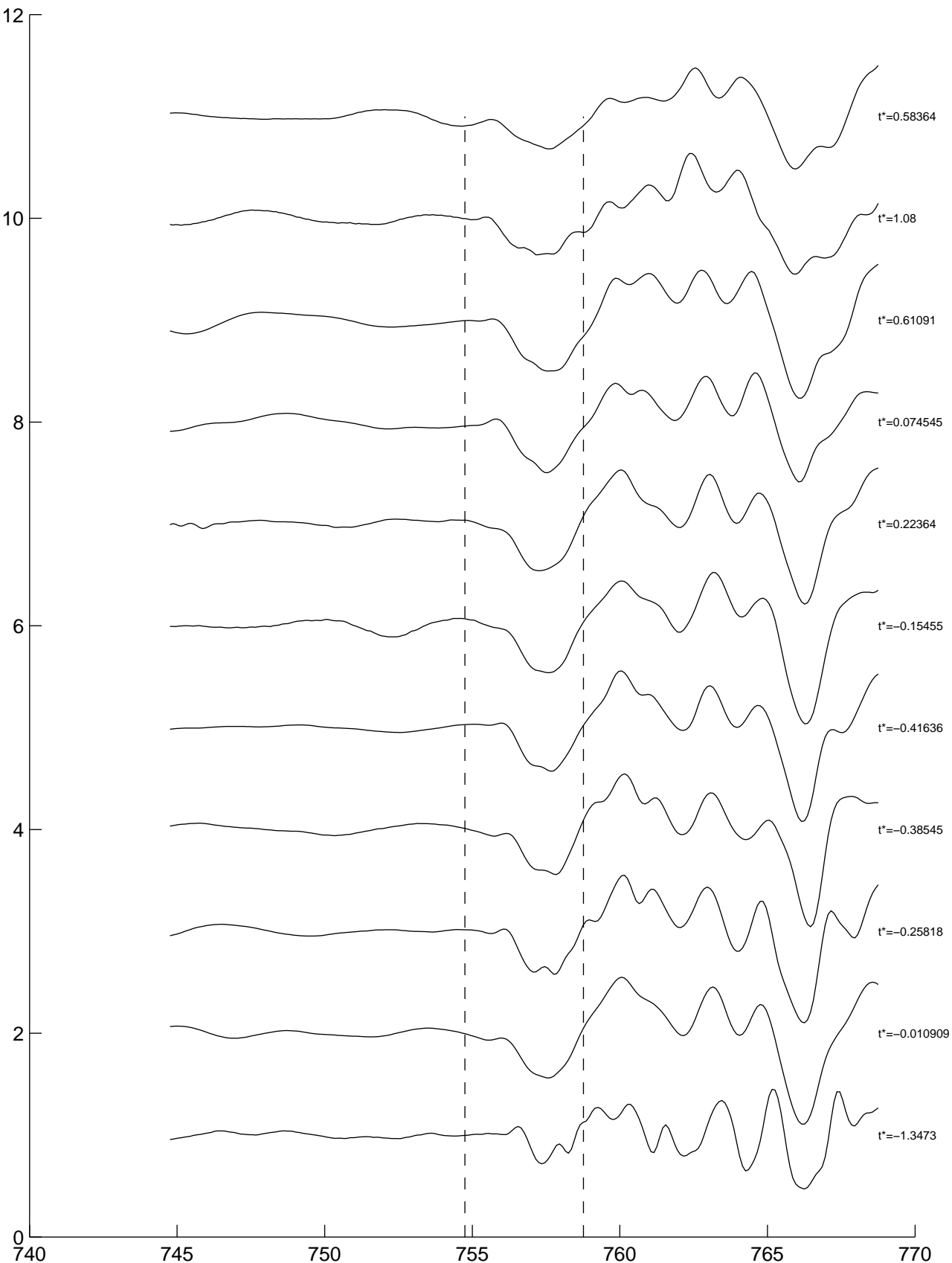
travel time residuals



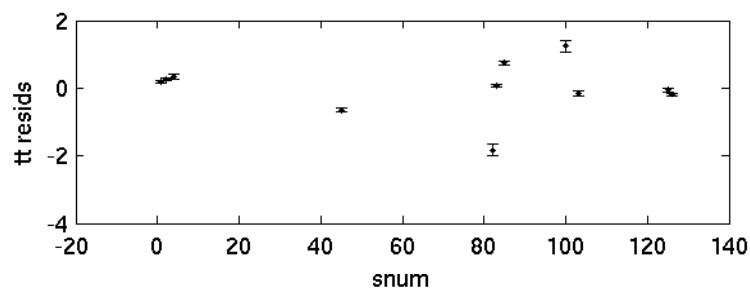
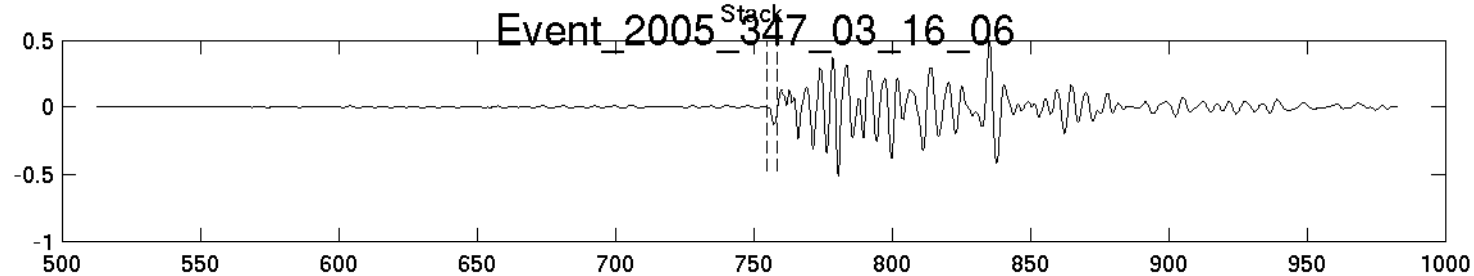
$t^*$  values



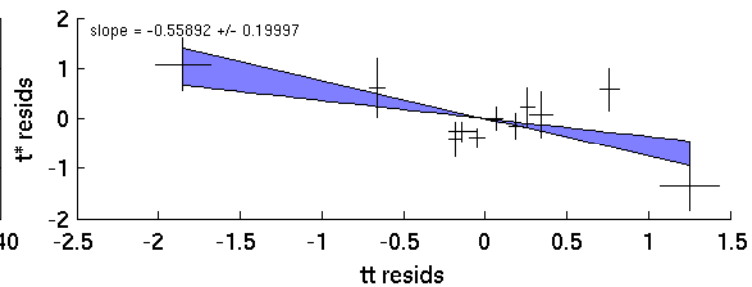
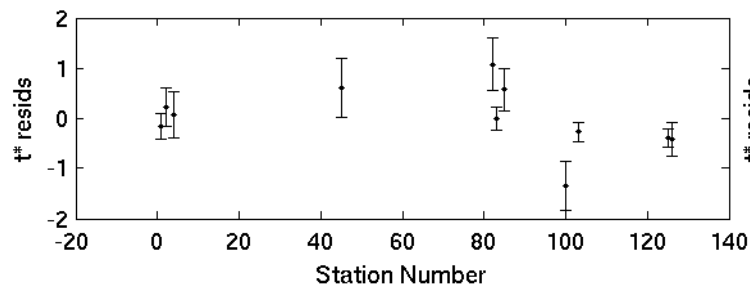
# Event\_2005\_347\_03\_16\_06



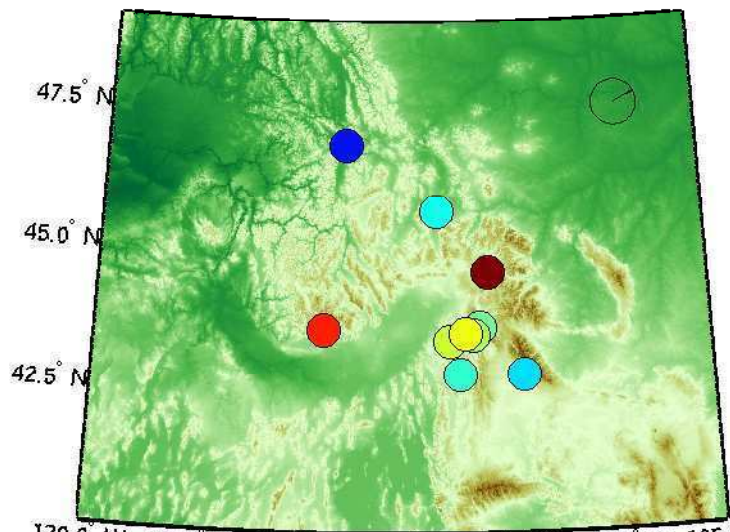
# Event\_2005\_347\_03\_16\_06



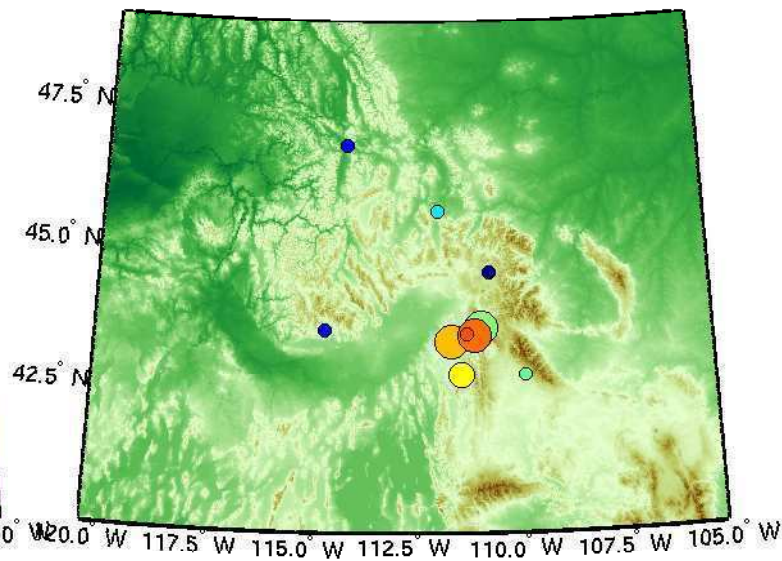
Baz = 243.2627  
 Mean xcor value = 0.83727  
 Range of  $t^*$  values is 2.4273  
 Median  $t^*$  err is 0.3813



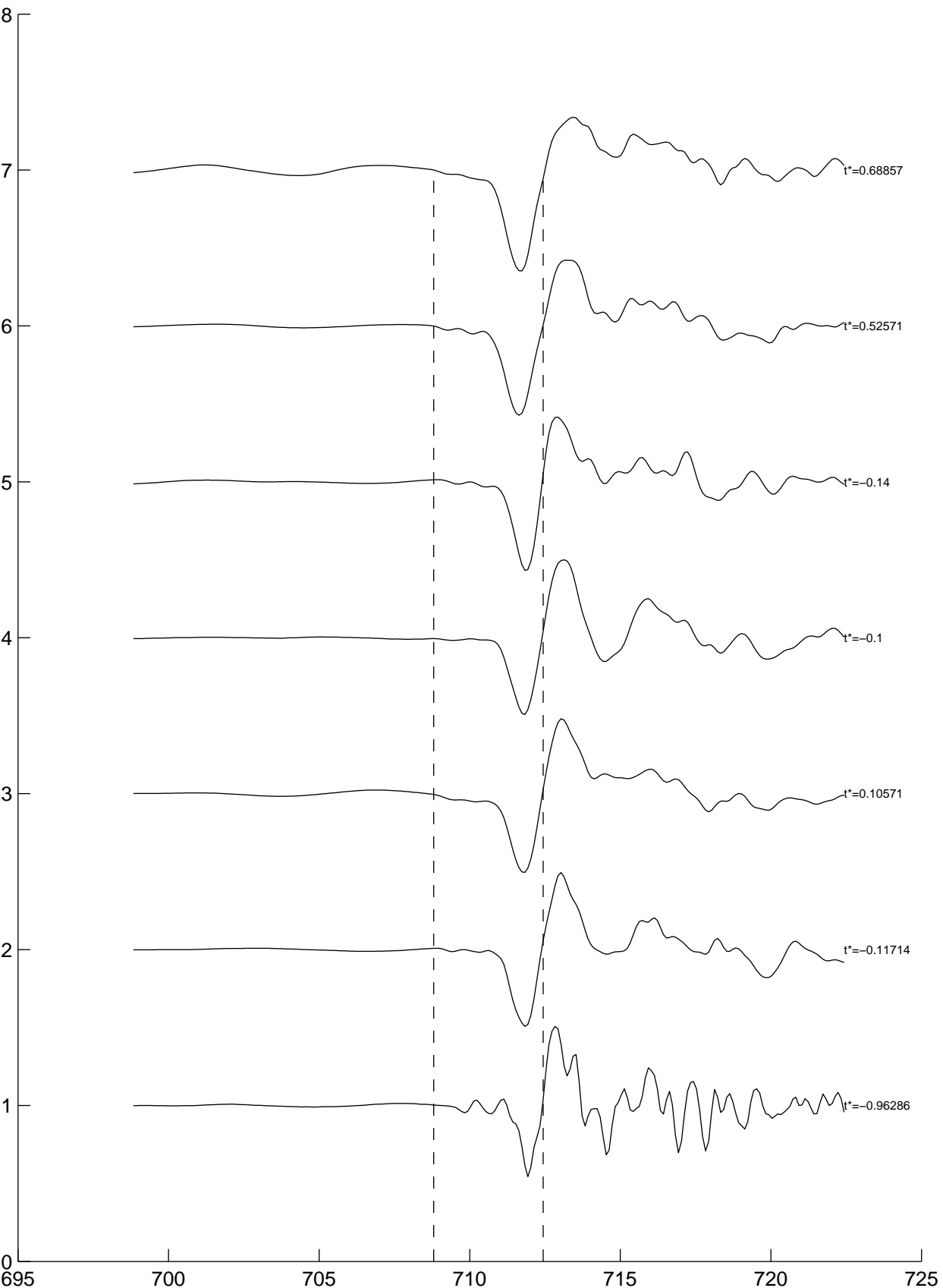
travel time residuals



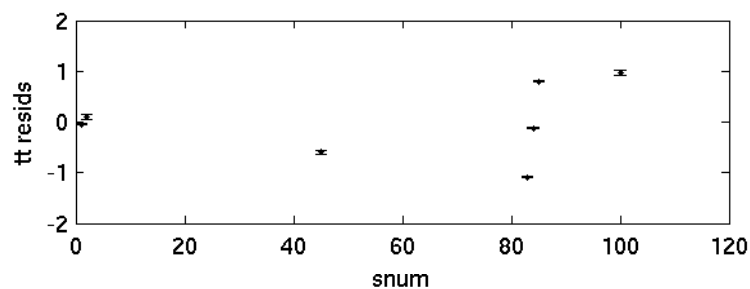
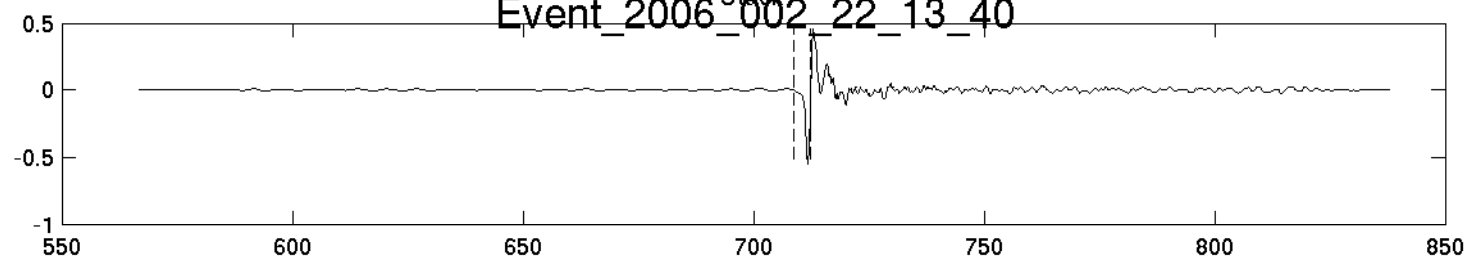
$t^*$  values



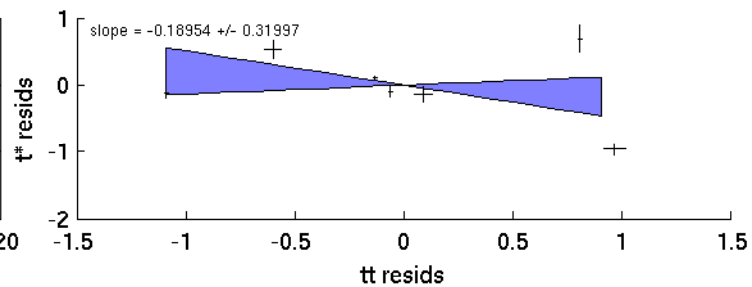
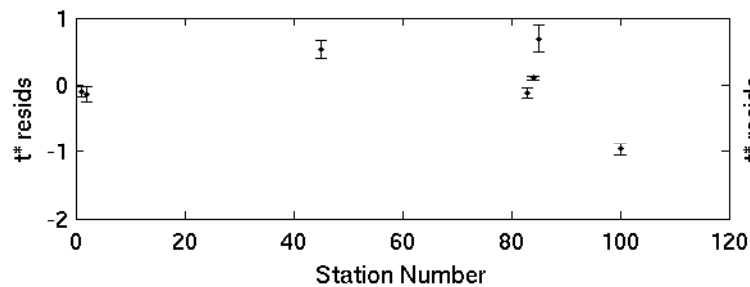
# Event\_2006\_002\_22\_13\_40



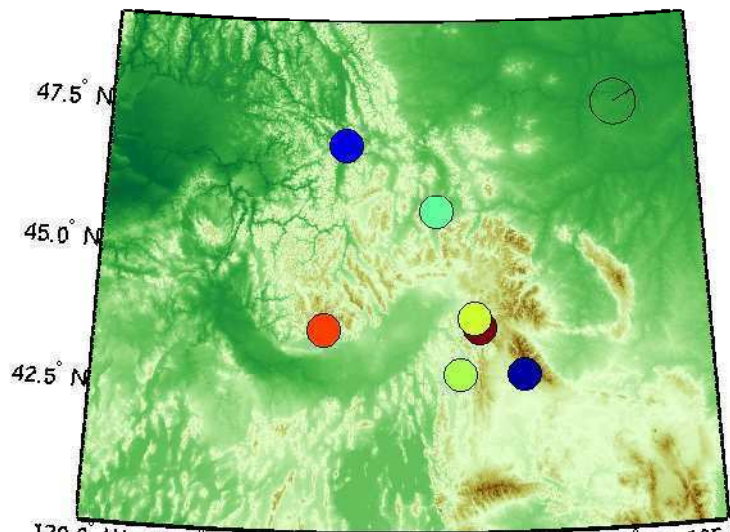
# Event\_2006\_002\_22\_13\_40



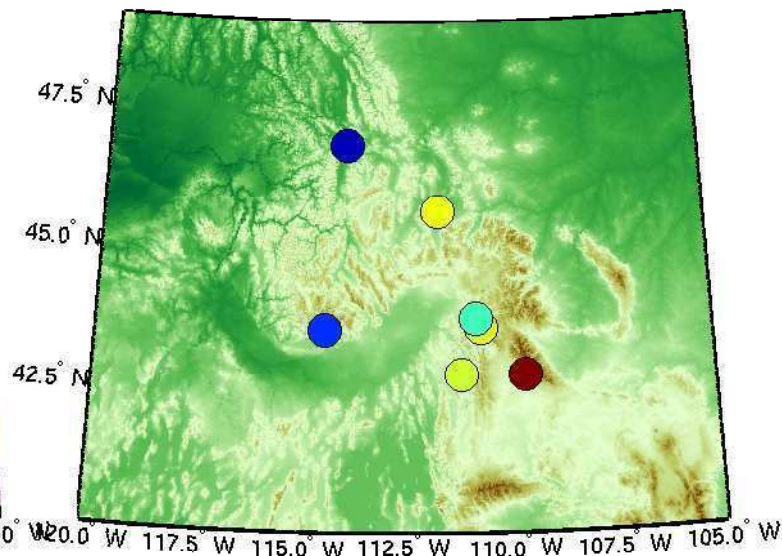
Baz = 239.5744  
 Mean xcor value = 0.80571  
 Range of  $t^*$  values is 1.6514  
 Median  $t^*$  err is 0.084293



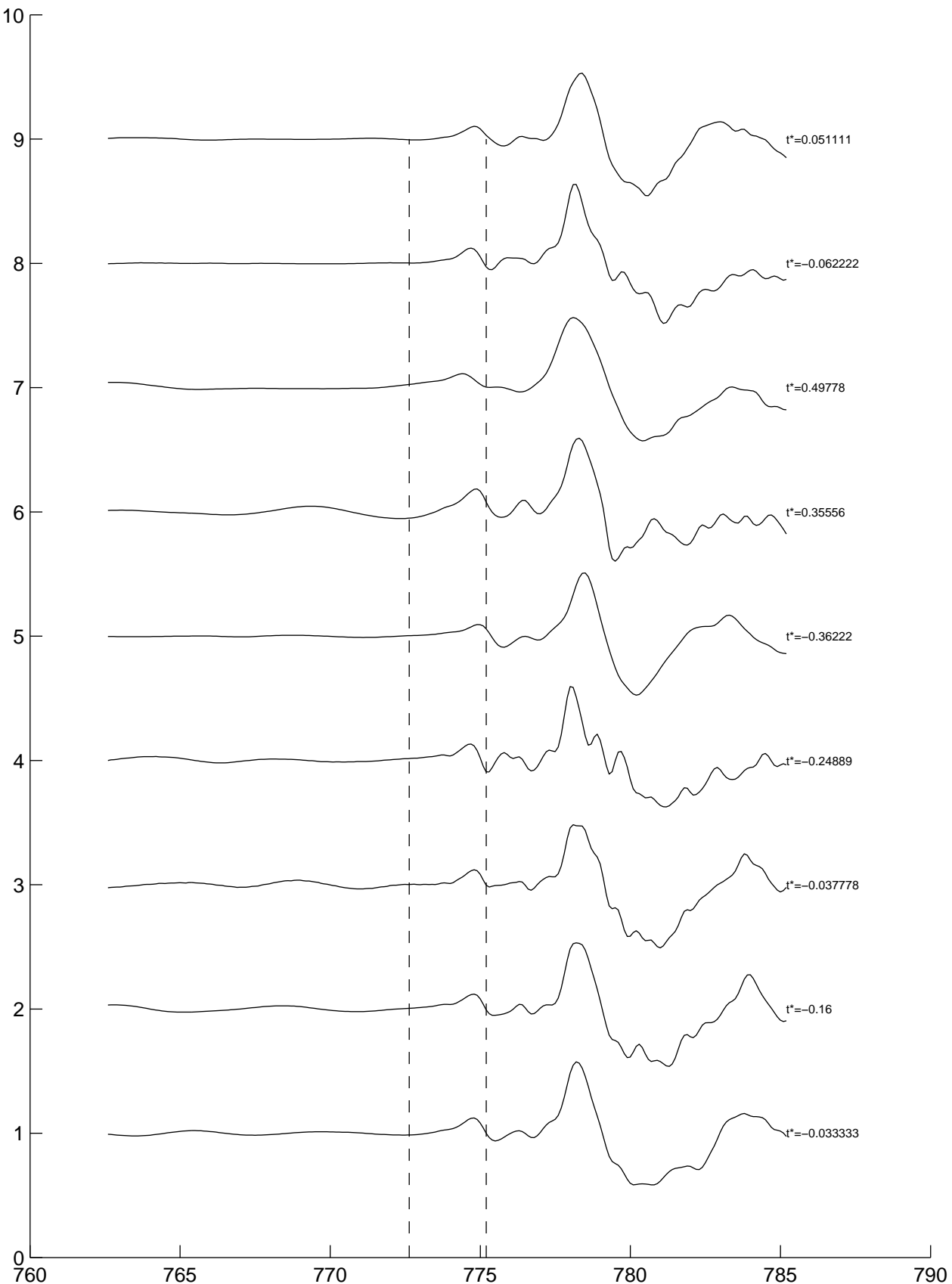
travel time residuals



$t^*$  values

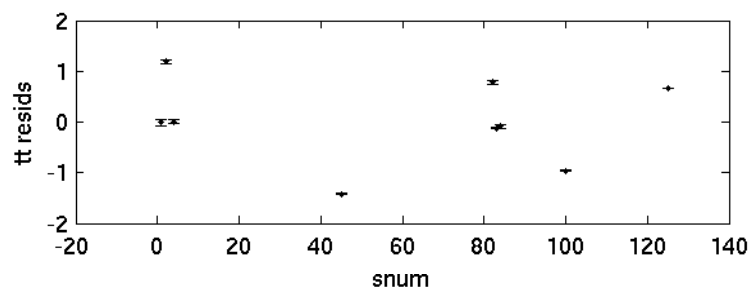
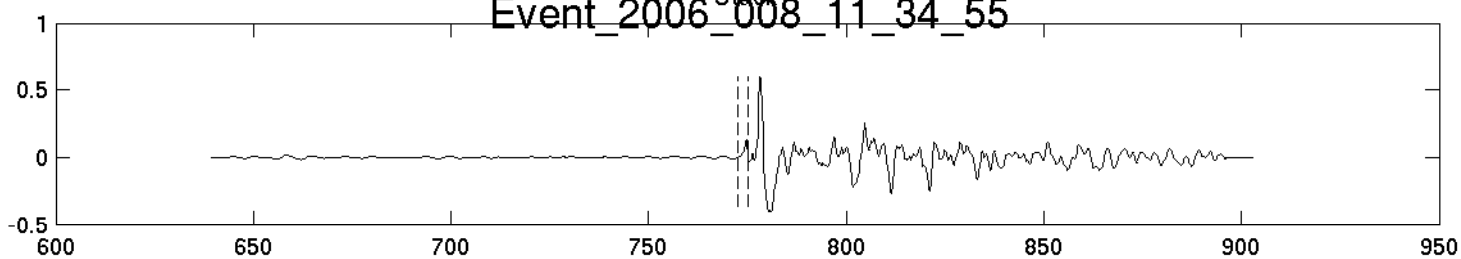


# Event\_2006\_008\_11\_34\_55

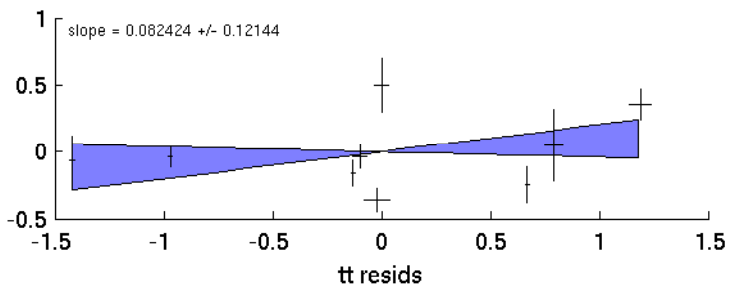
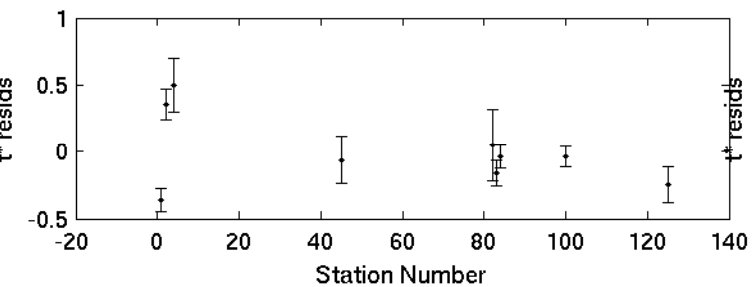




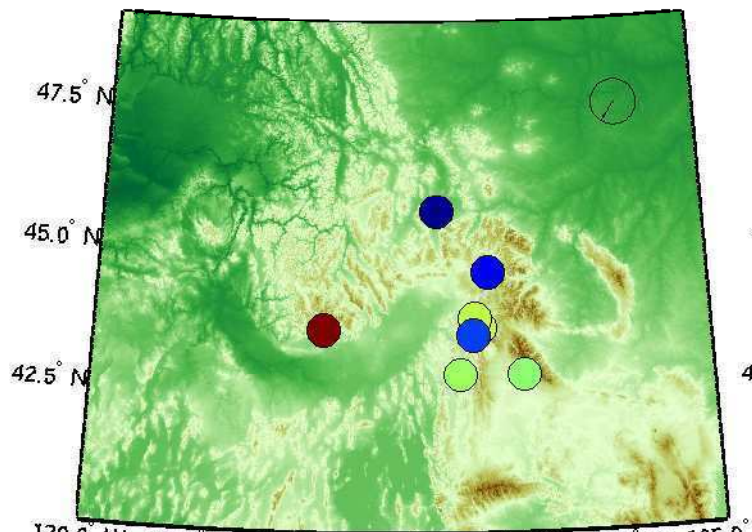
# Event\_2006\_008\_11\_34\_55



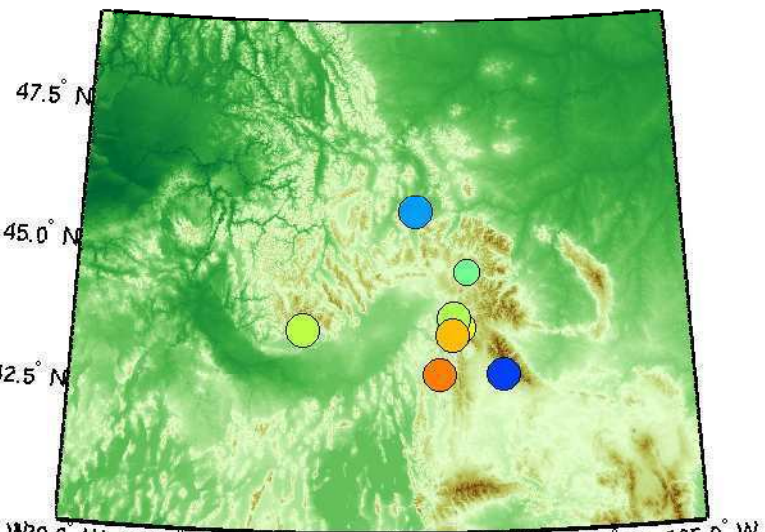
Baz = 35.0912  
 Mean xcor value = 0.76444  
 Range of  $t^*$  values is 0.86  
 Median  $t^*$  err is 0.11504



travel time residuals

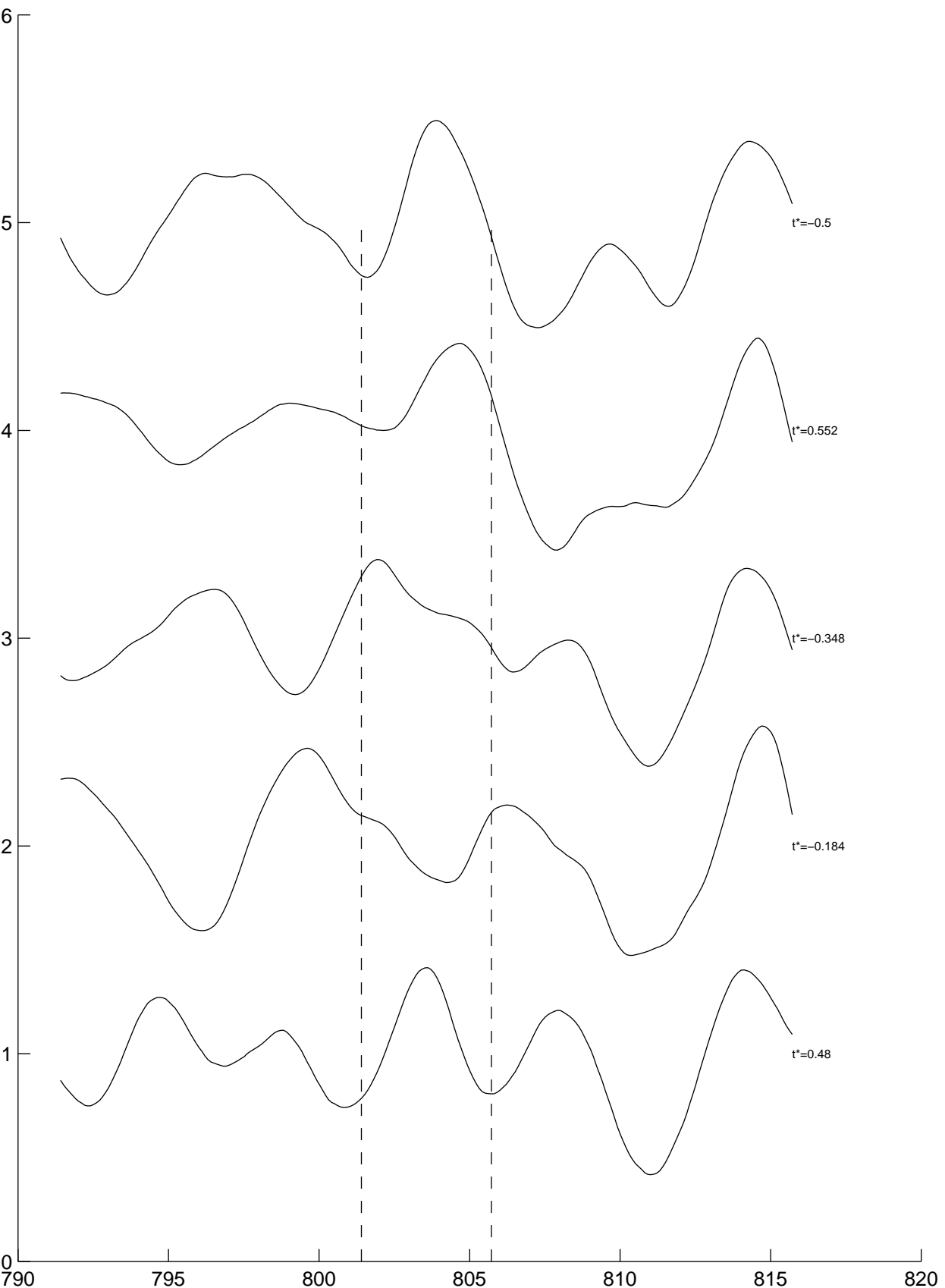


$t^*$  values

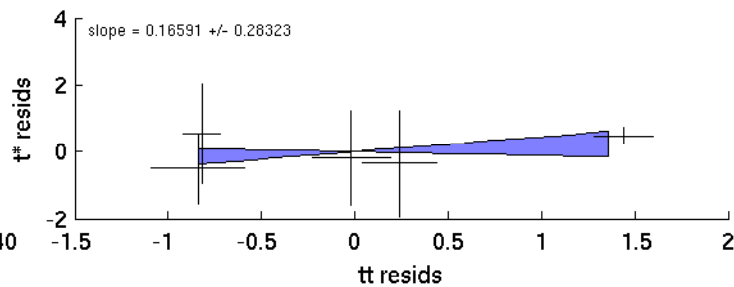
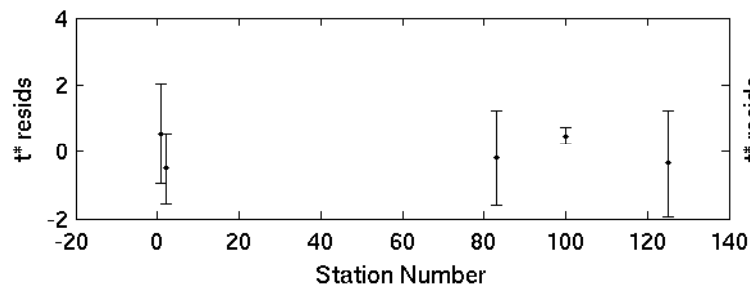
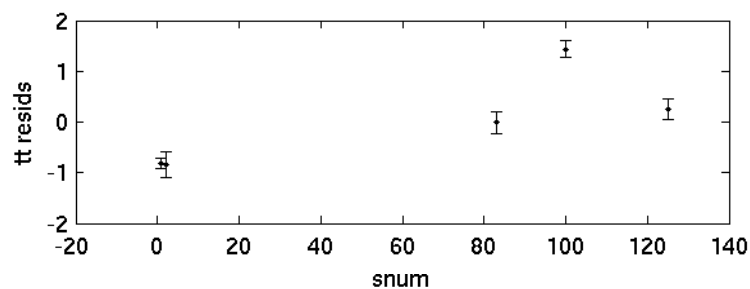
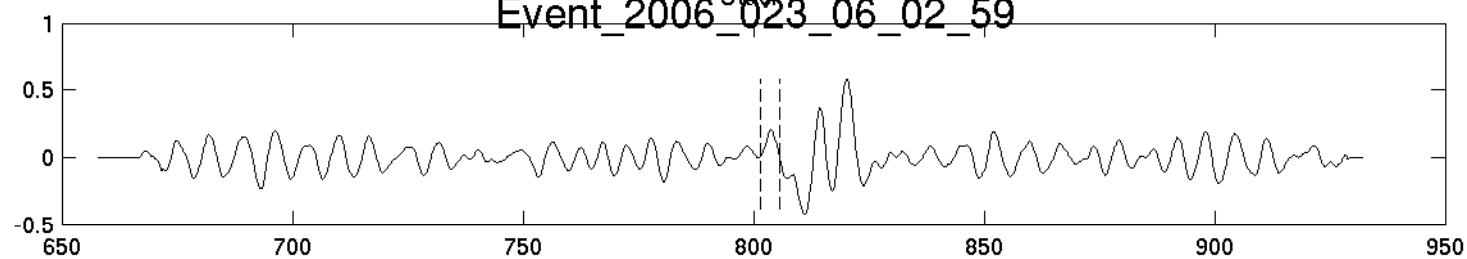




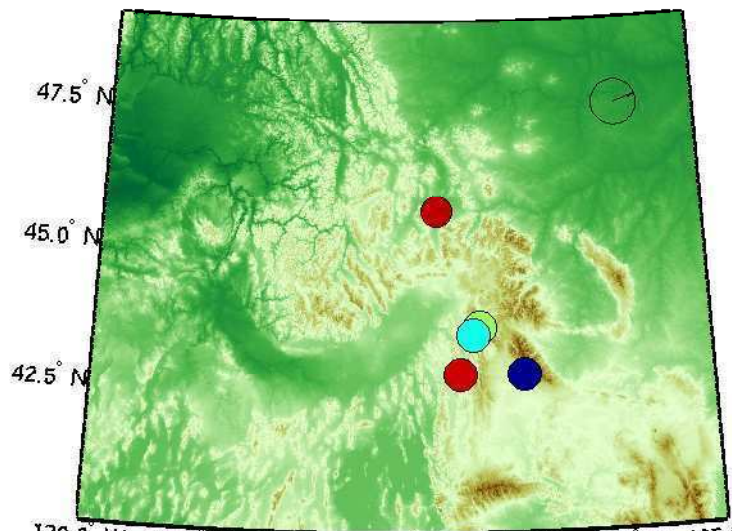
# Event\_2006\_023\_06\_02\_59



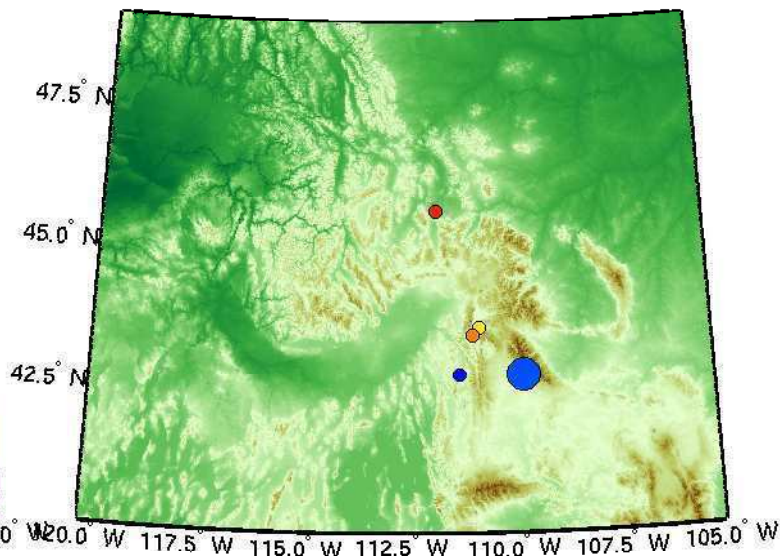
# Event\_2006\_023\_06\_02\_59



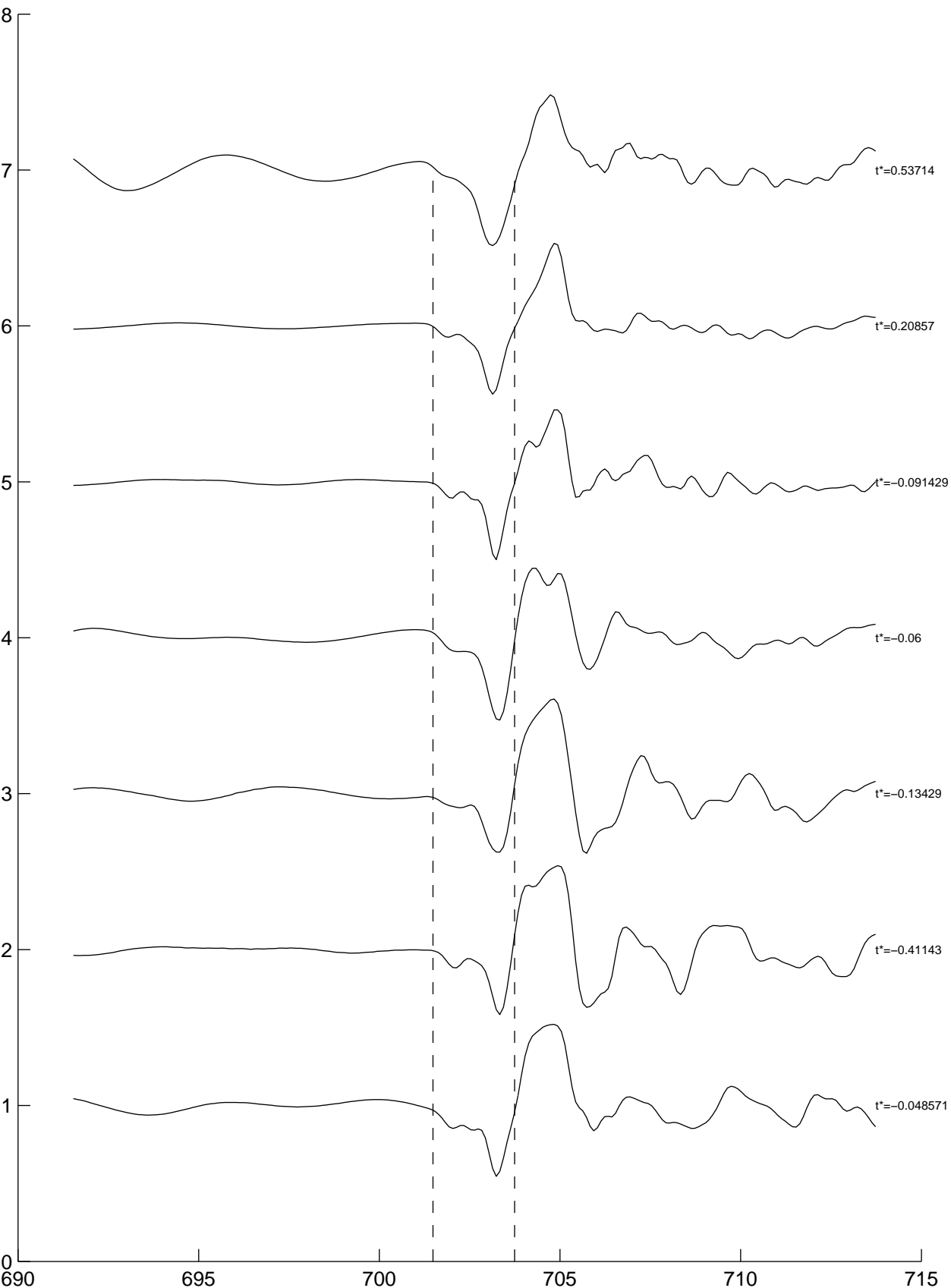
travel time residuals



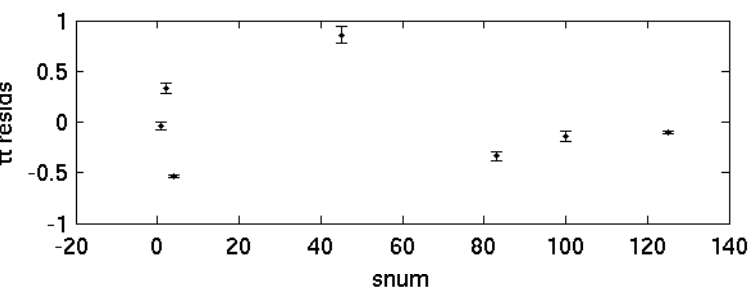
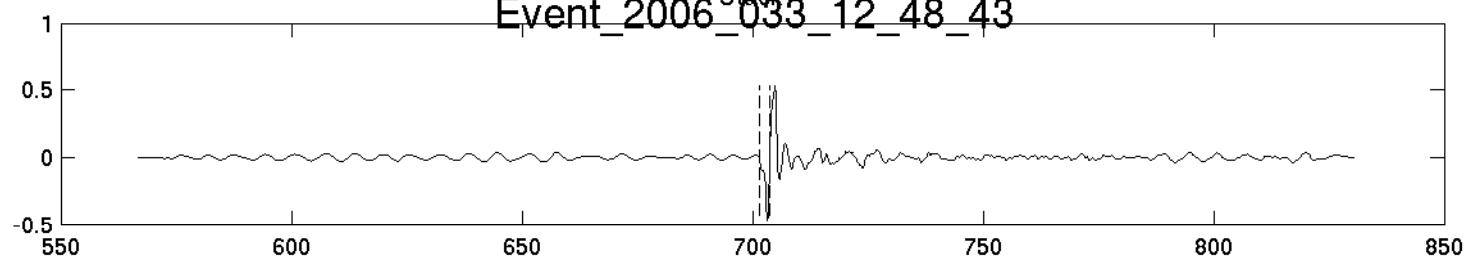
$t^*$  values



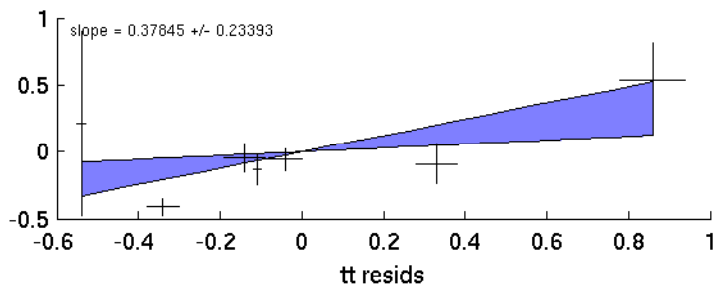
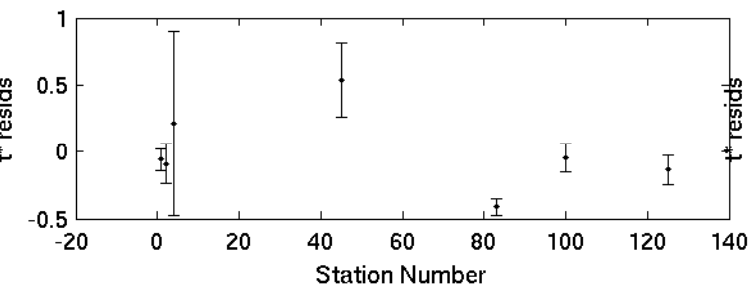
# Event\_2006\_033\_12\_48\_43



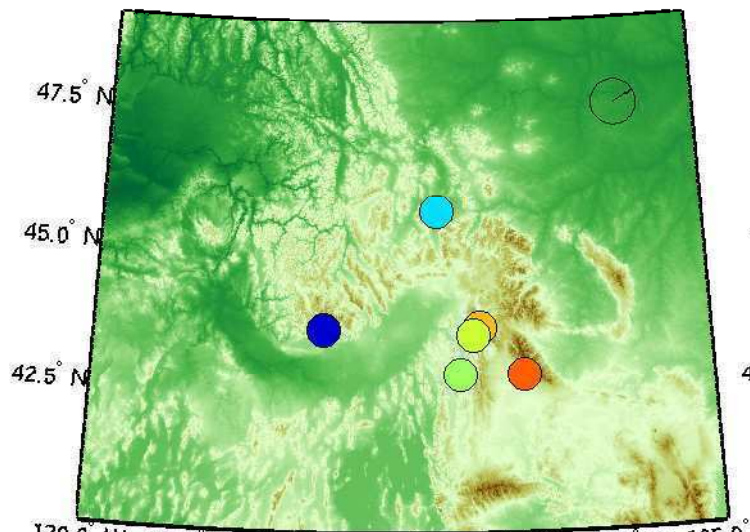
# Event\_2006\_033\_12\_48\_43



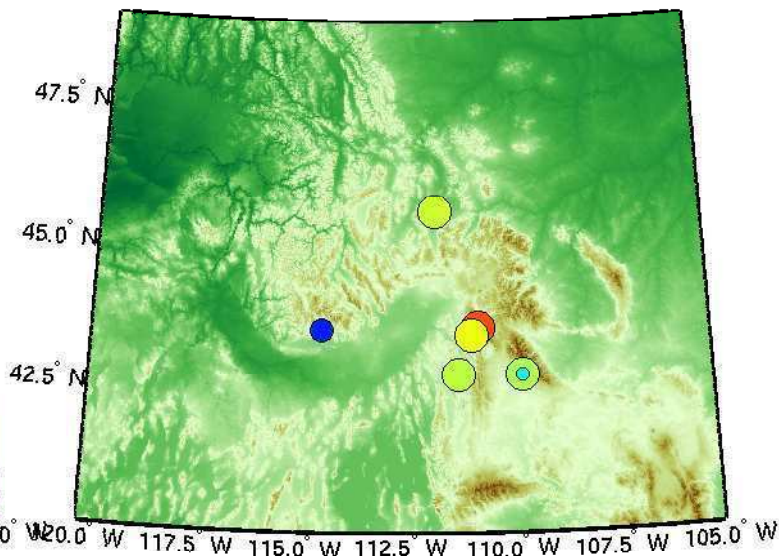
Baz = 241.444  
 Mean xcor value = 0.67286  
 Range of  $t^*$  values is 0.94857  
 Median  $t^*$  err is 0.11083



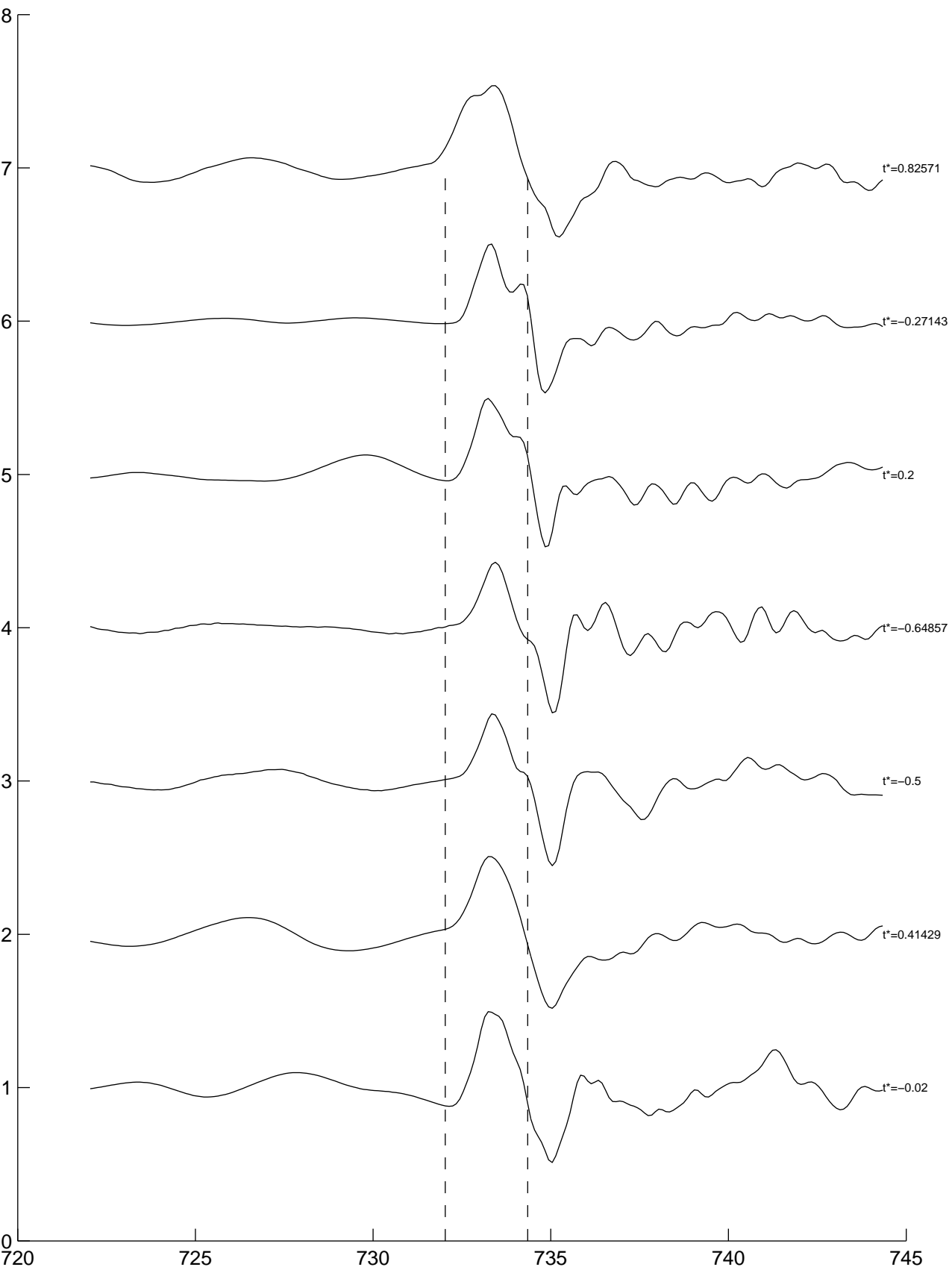
travel time residuals



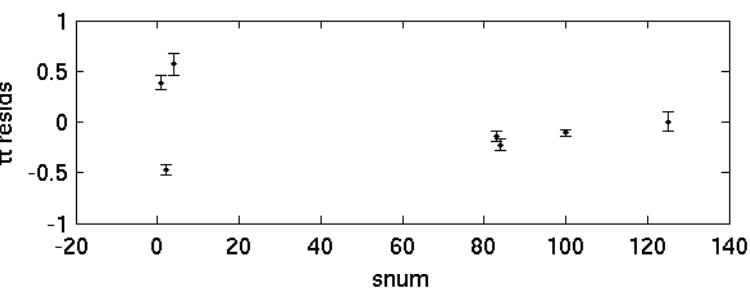
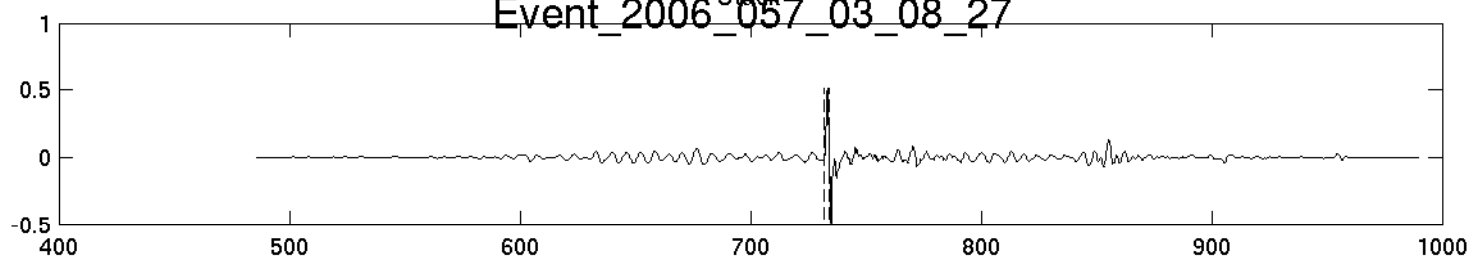
$t^*$  values



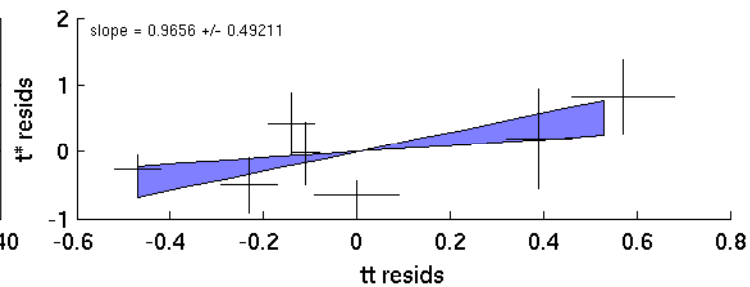
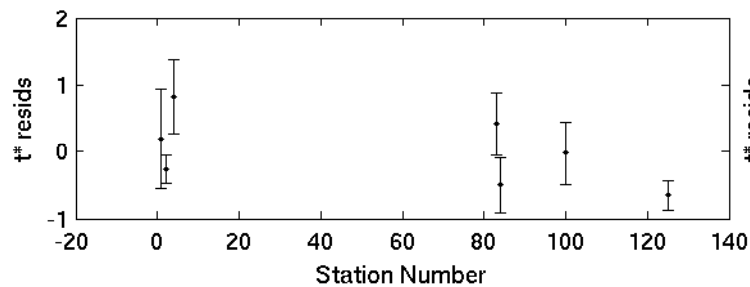
# Event\_2006\_057\_03\_08\_27



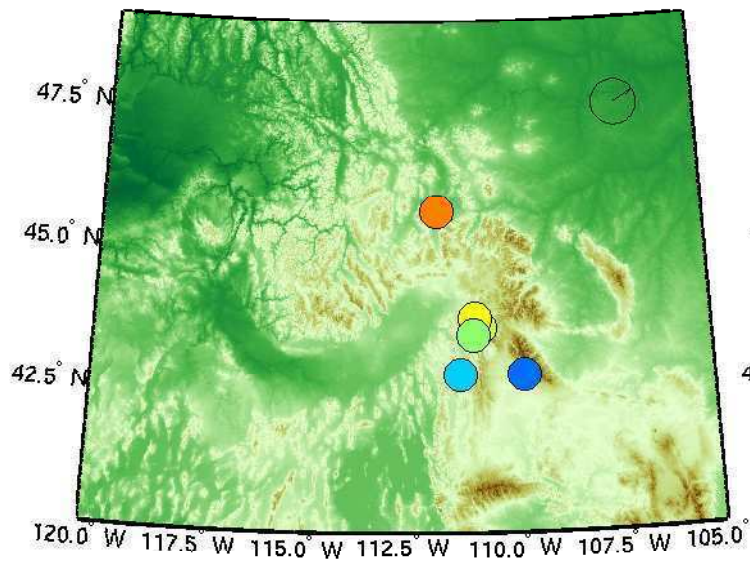
# Event\_2006\_057\_03\_08\_27



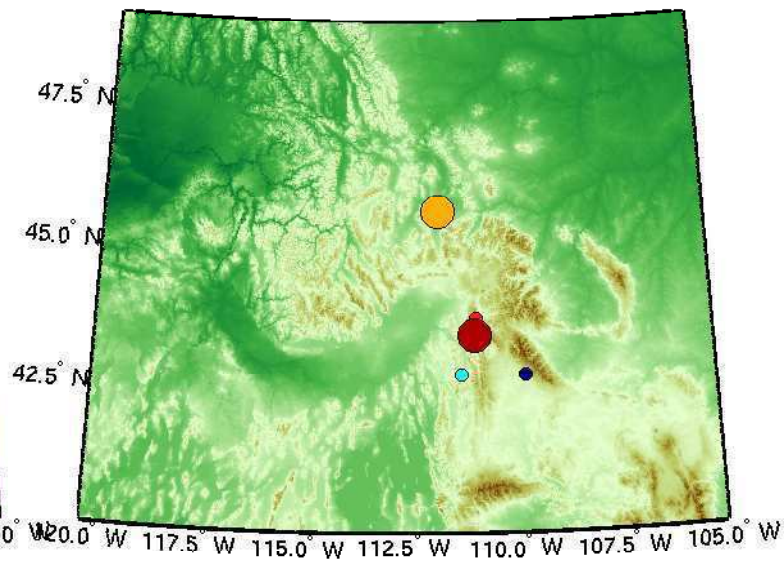
Baz = 238.6922  
 Mean xcor value = 0.68  
 Range of  $t^*$  values is 1.4743  
 Median  $t^*$  err is 0.45903



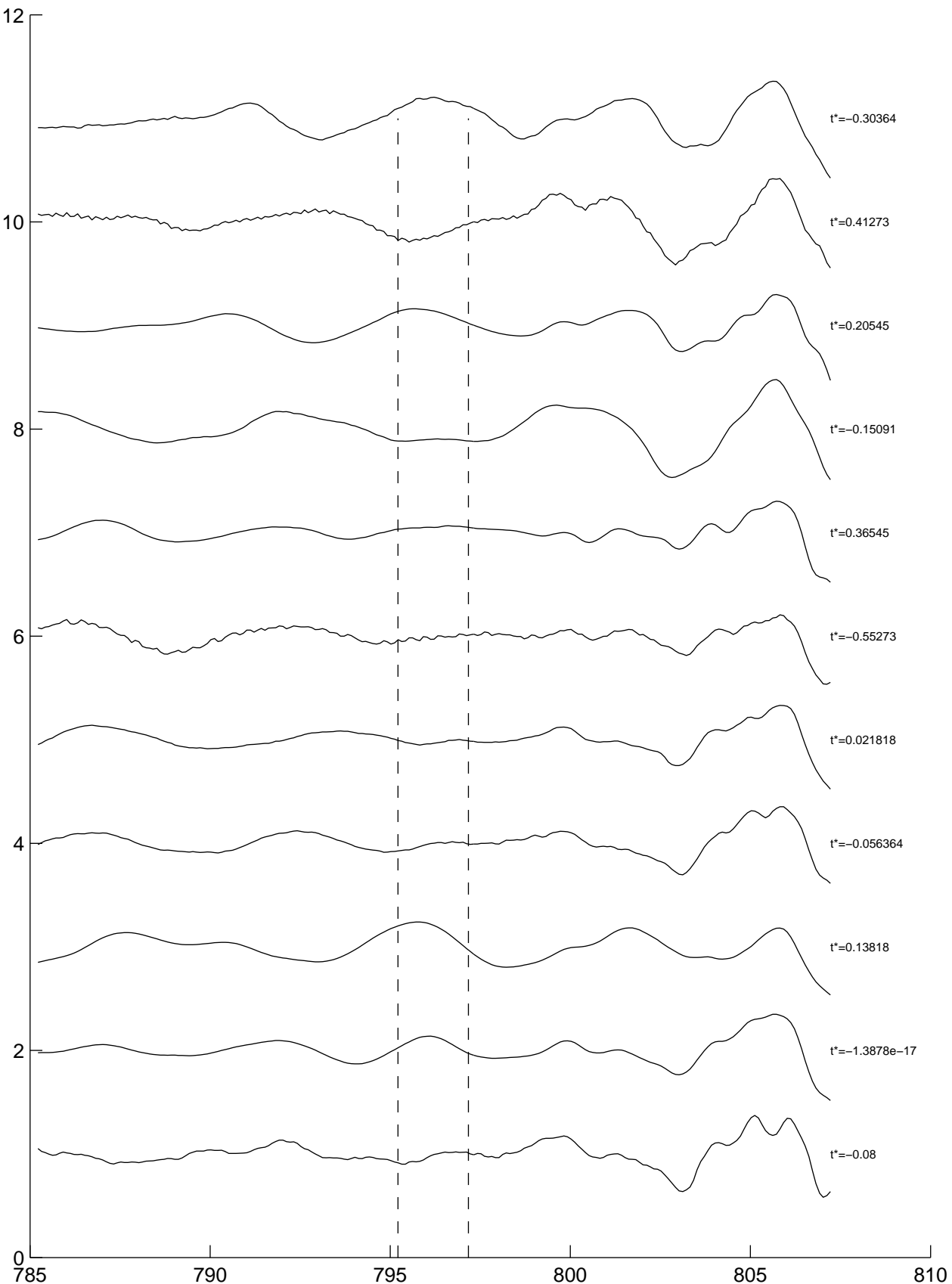
travel time residuals



$t^*$  values

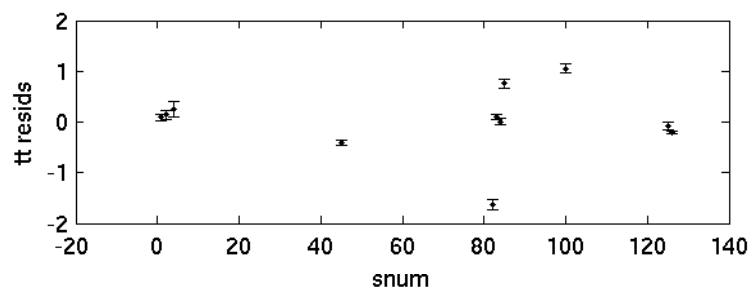
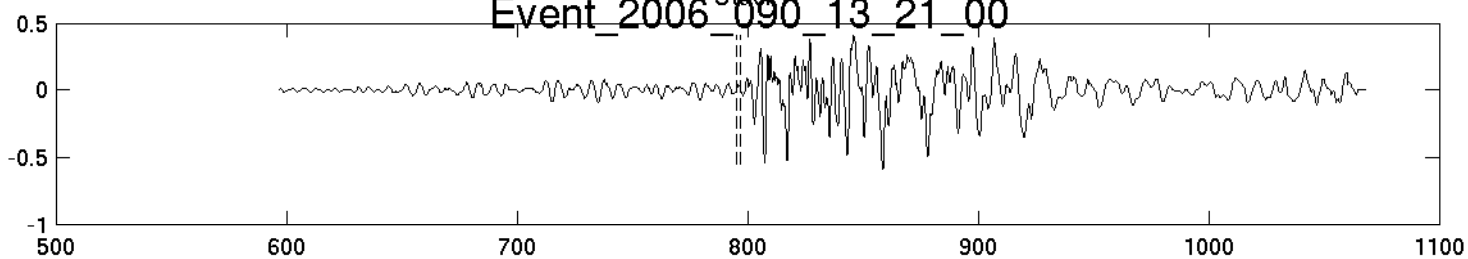


# Event\_2006\_090\_13\_21\_00

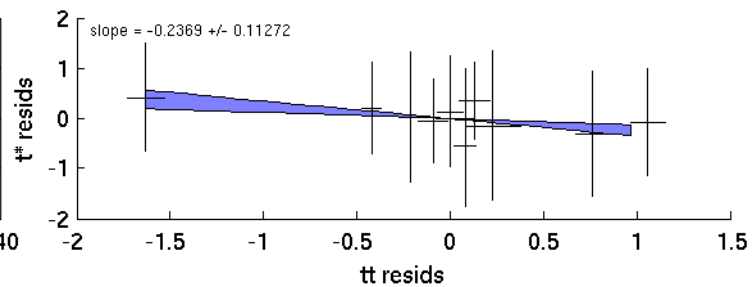
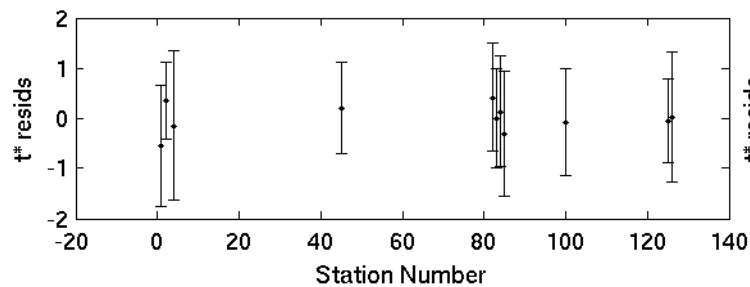




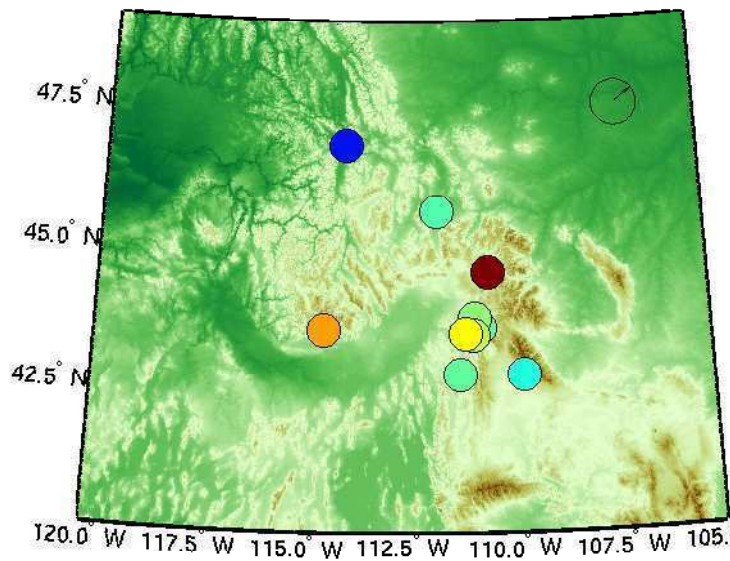
Event\_2006\_090\_13\_21\_00



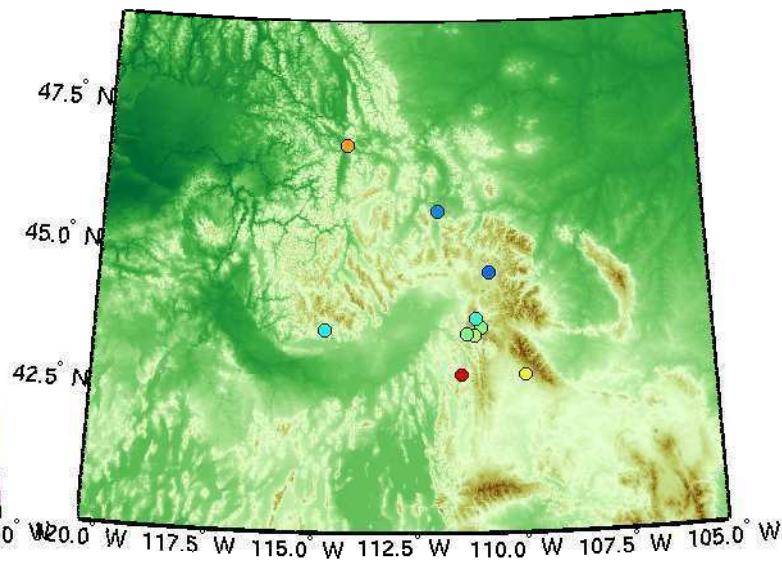
Baz = 232.598  
Mean xcor value = 0.72364  
Range of  $t^*$  values is 0.96545  
Median  $t^*$  err is 1.0876



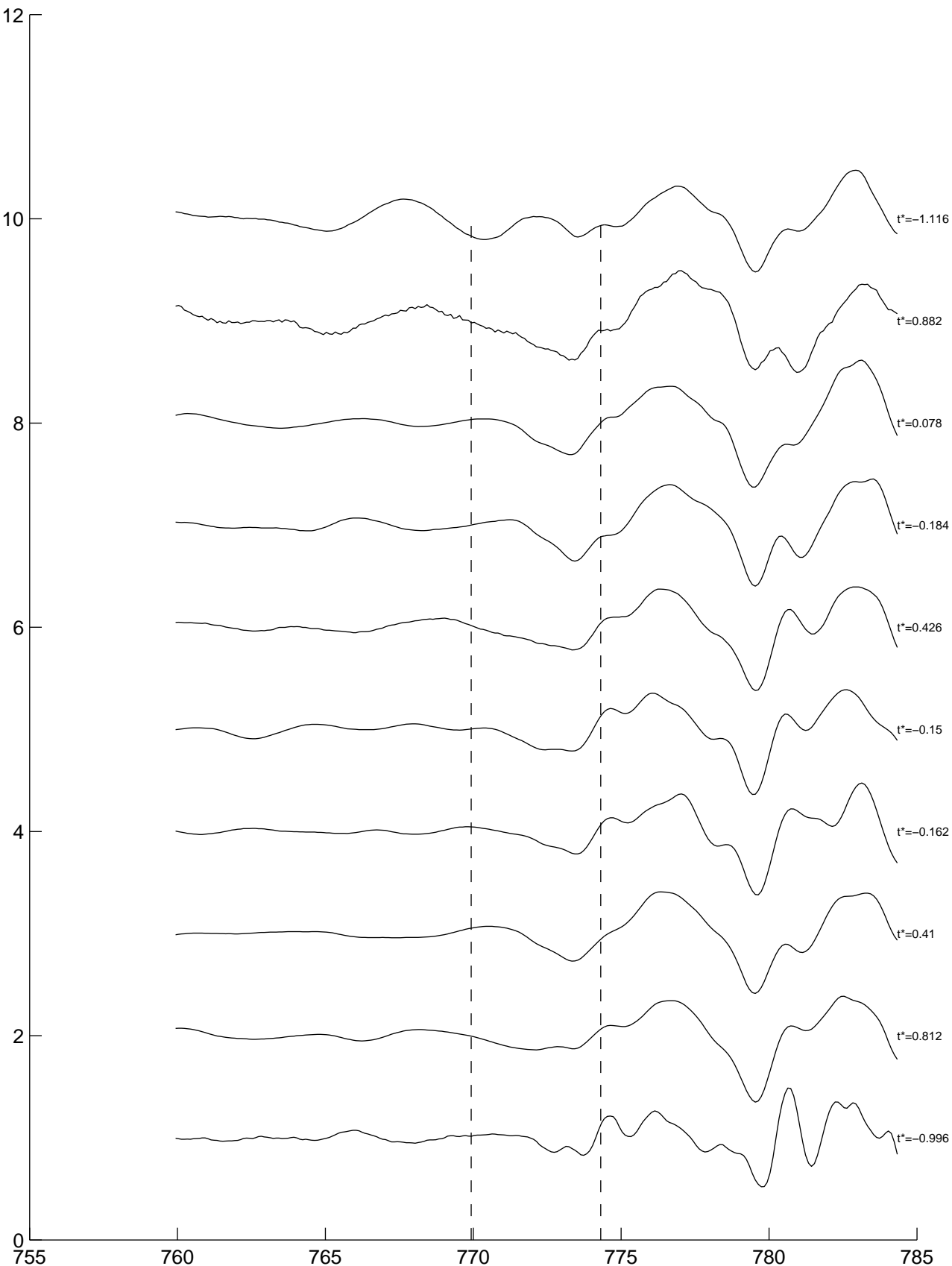
travel time residuals



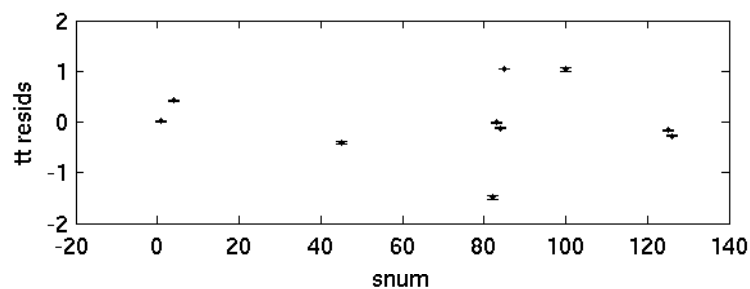
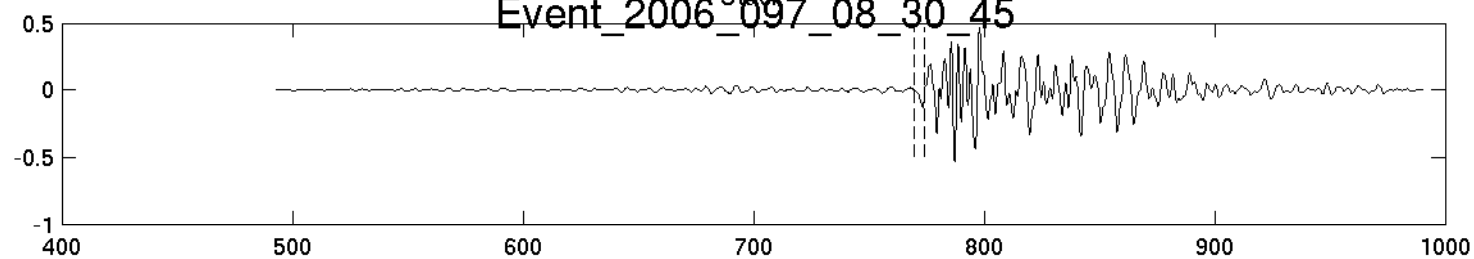
$t^*$  values



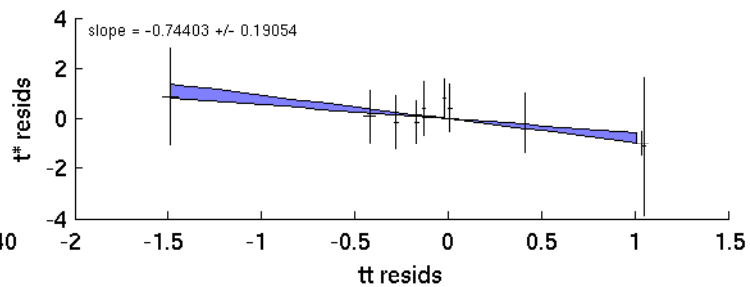
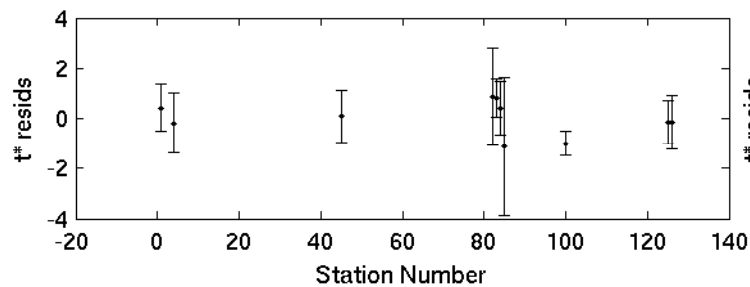
# Event\_2006\_097\_08\_30\_45



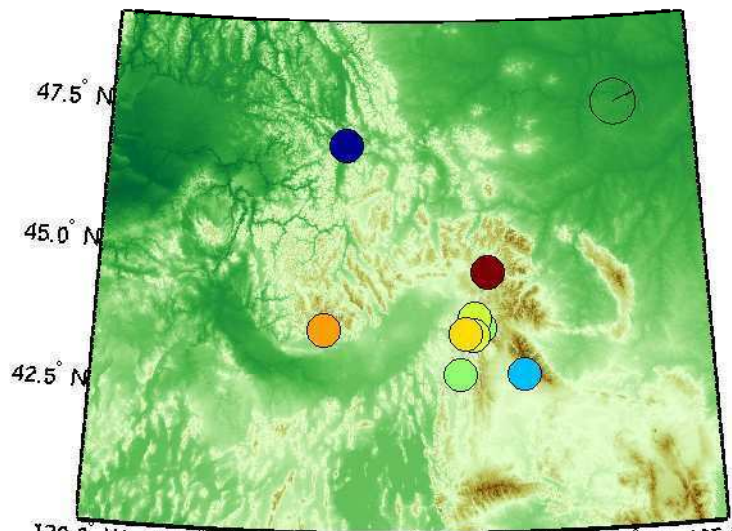
# Event\_2006\_097\_08\_30\_45



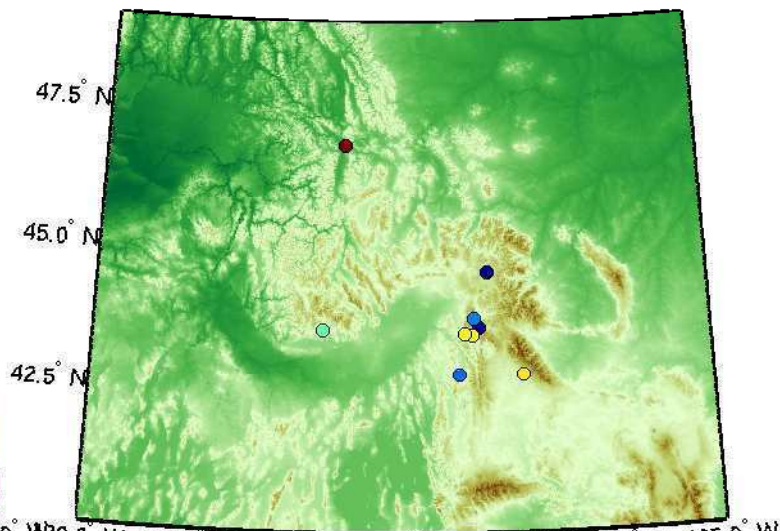
Baz = 245.6233  
Mean xcor value = 0.827  
Range of  $t^*$  values is 1.998  
Median  $t^*$  err is 1.0484



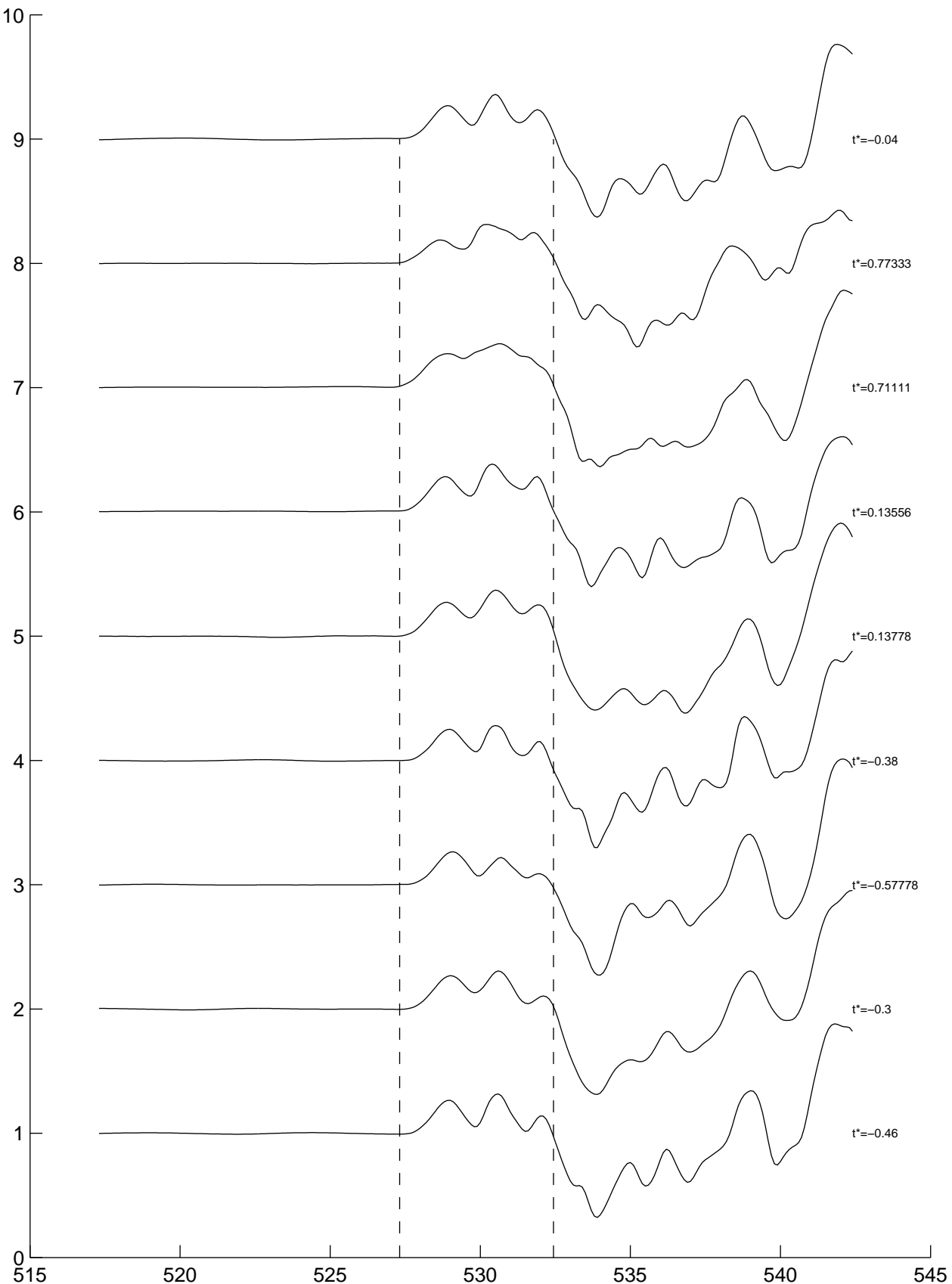
travel time residuals



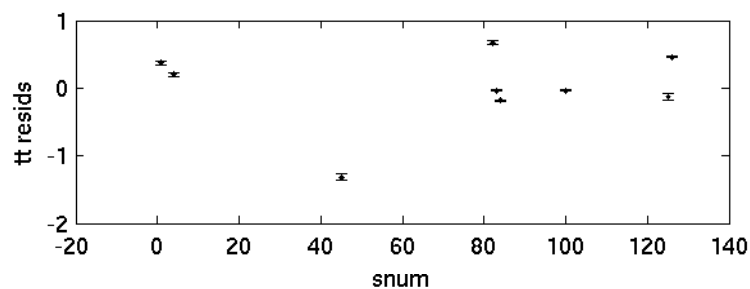
$t^*$  values



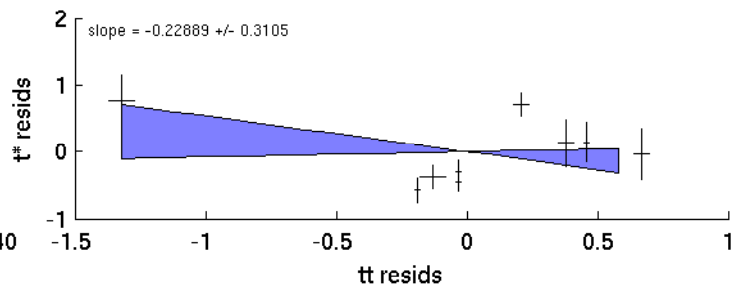
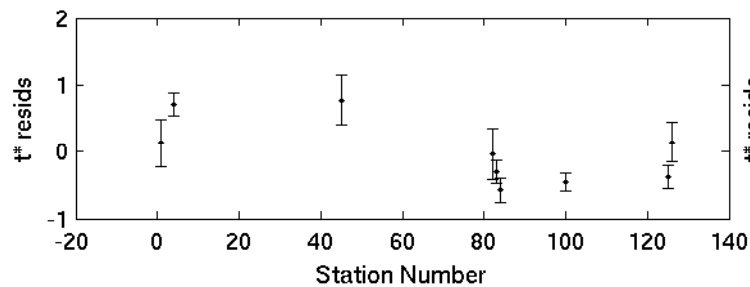
# Event\_2006\_110\_23\_25\_02



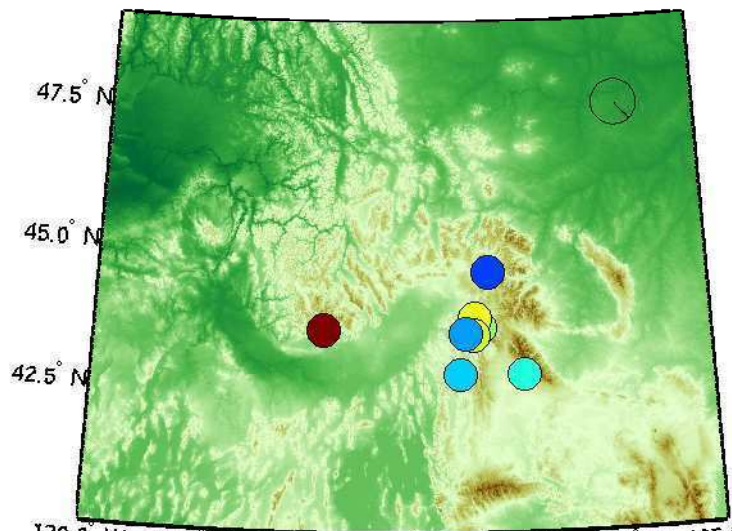
# Event\_2006\_110\_23\_25\_02<sup>Stack</sup>



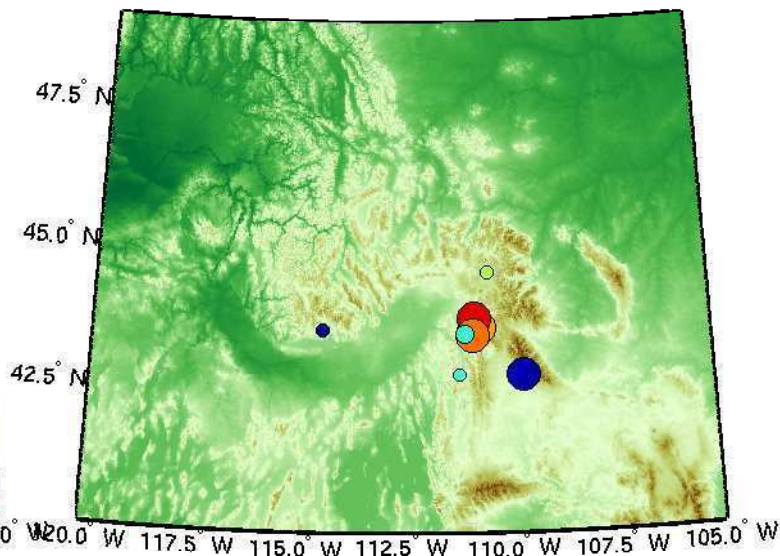
Baz = 320.4838  
 Mean xcor value = 0.84222  
 Range of  $t^*$  values is 1.3511  
 Median  $t^*$  err is 0.18345



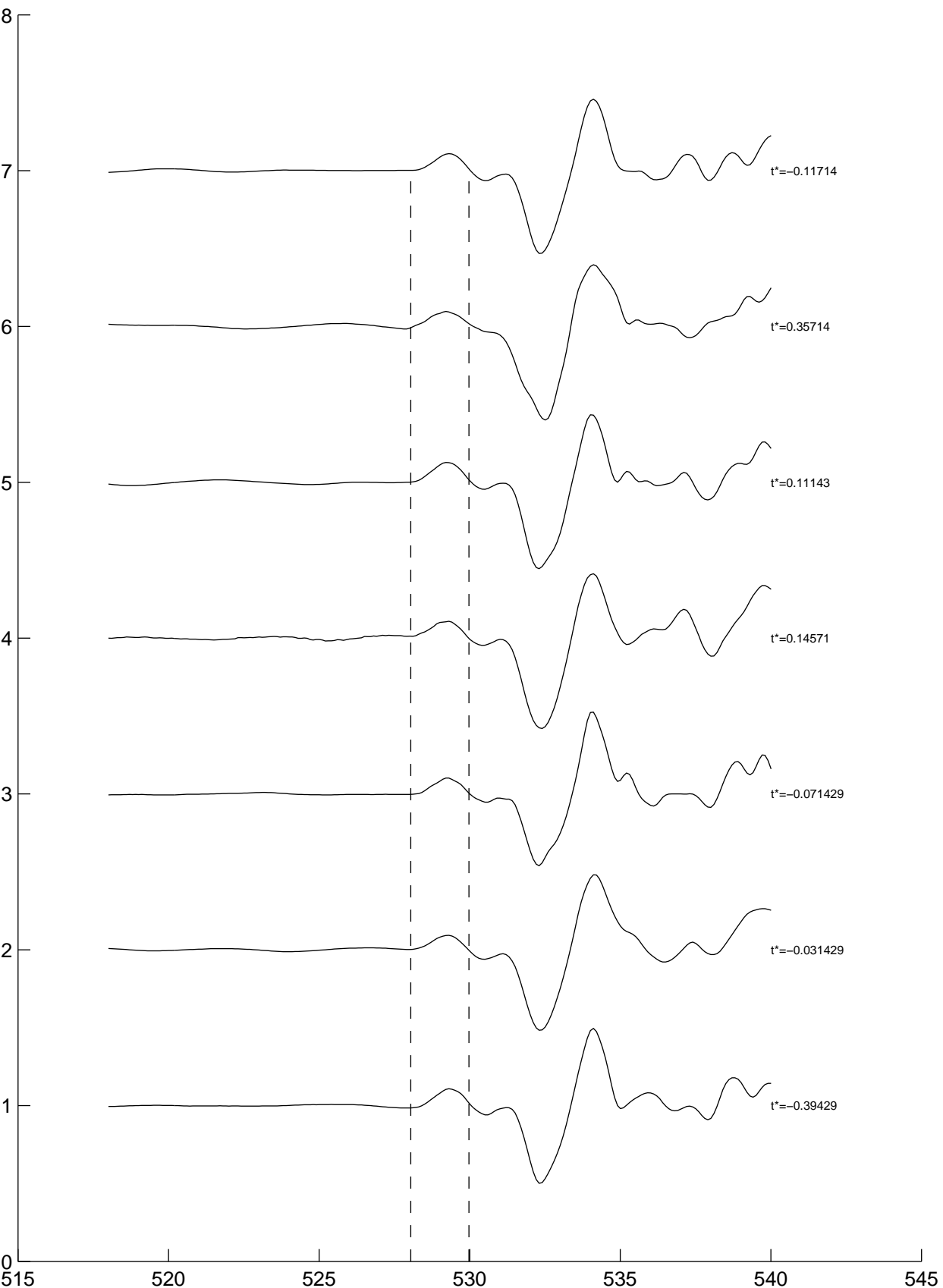
travel time residuals



$t^*$  values

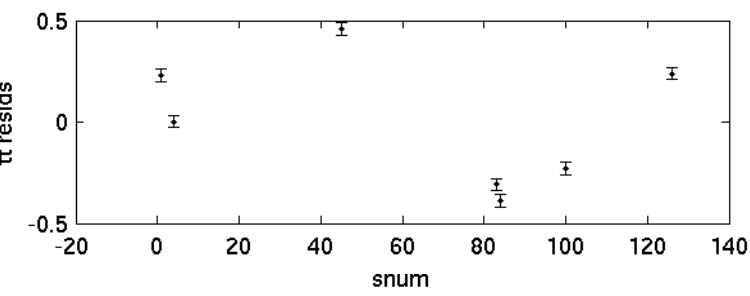
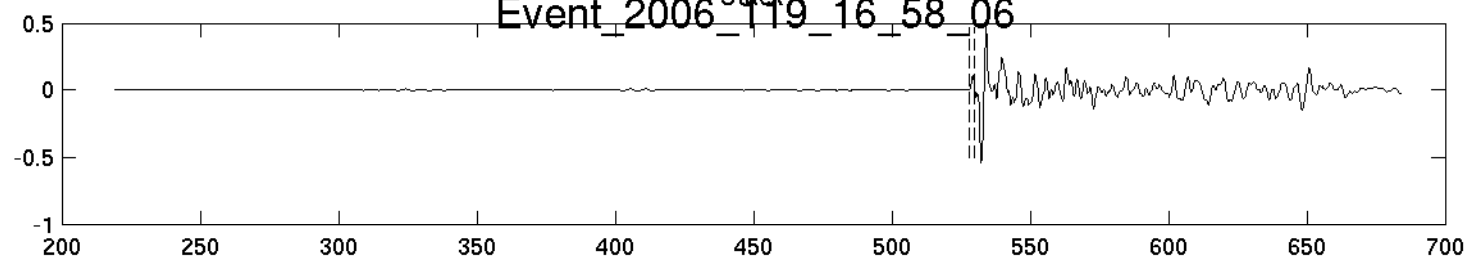


# Event\_2006\_119\_16\_58\_06

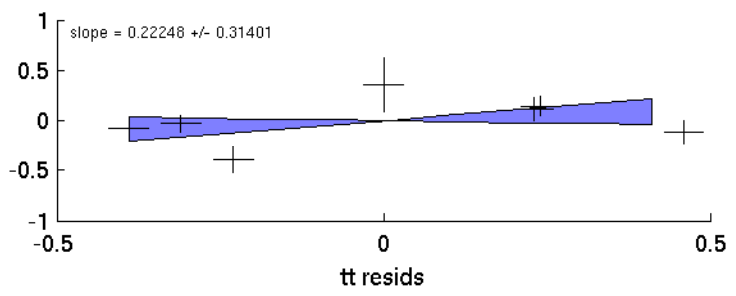
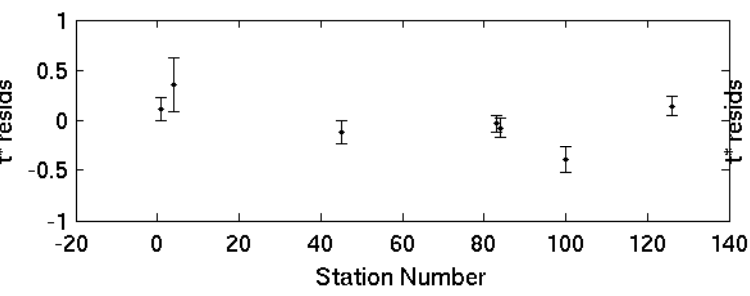




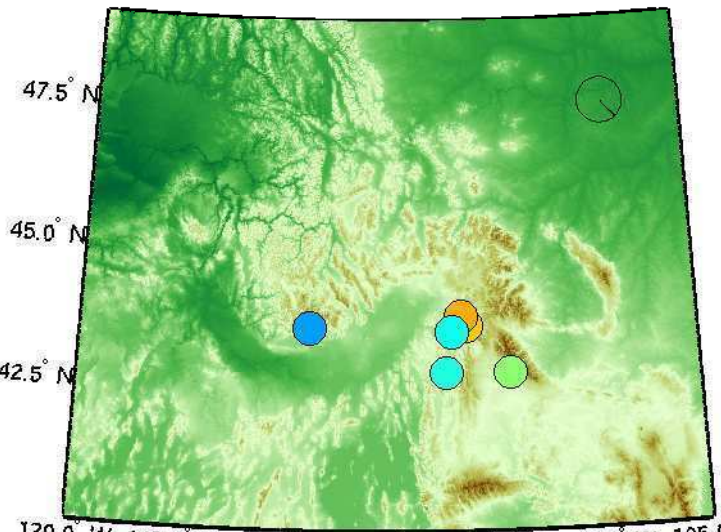
# Event\_2006\_11\_16\_58\_06<sup>Stack</sup>



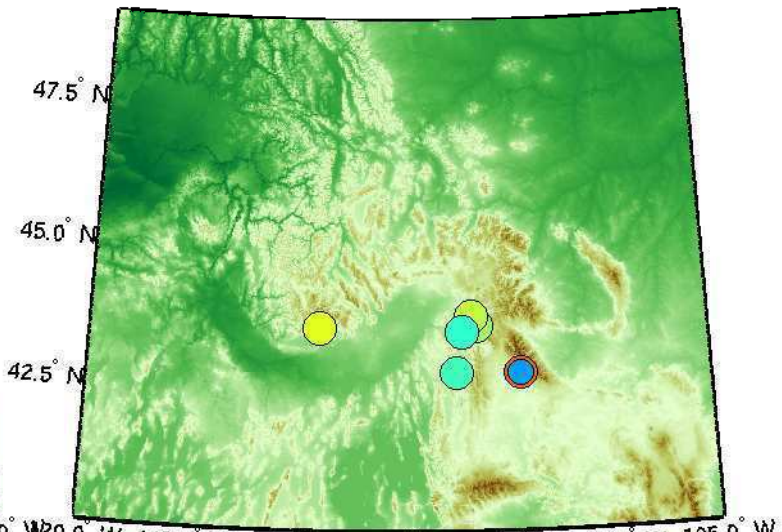
Baz = 319.7892  
Mean xcor value = 0.81857  
Range of  $t^*$  values is 0.75143  
Median  $t^*$  err is 0.11668



travel time residuals

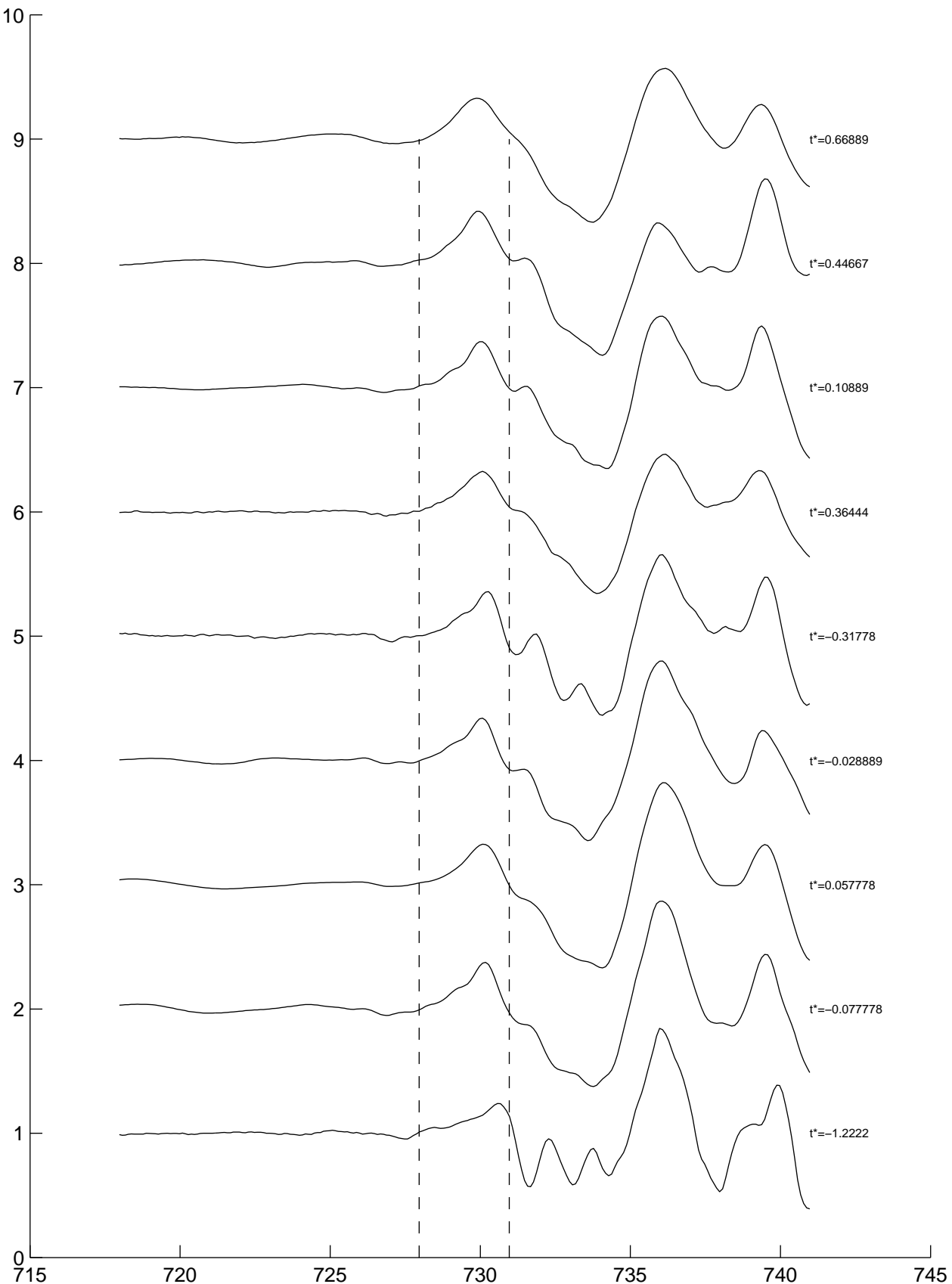


$t^*$  values

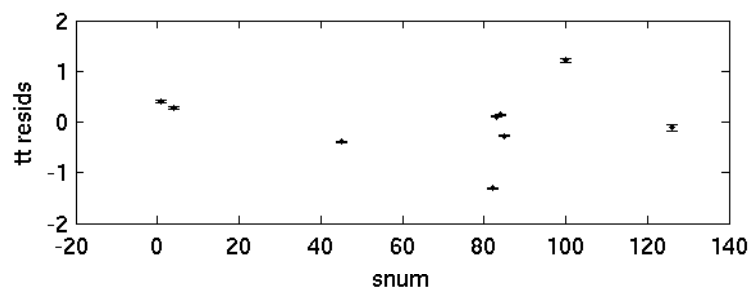
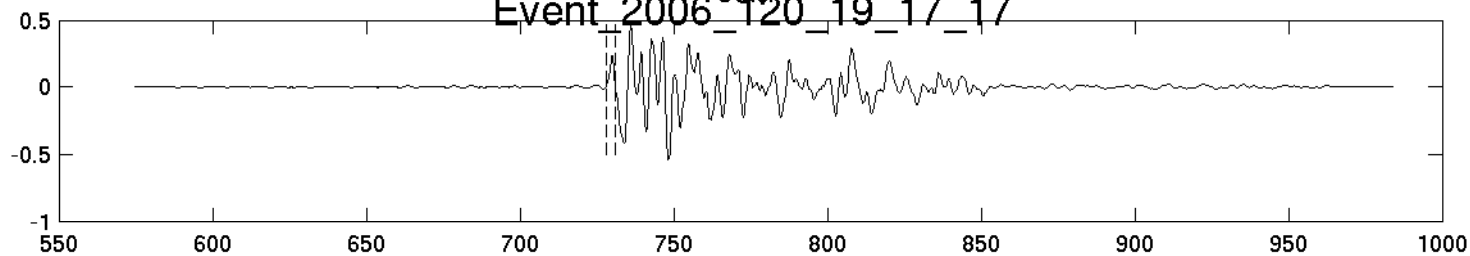




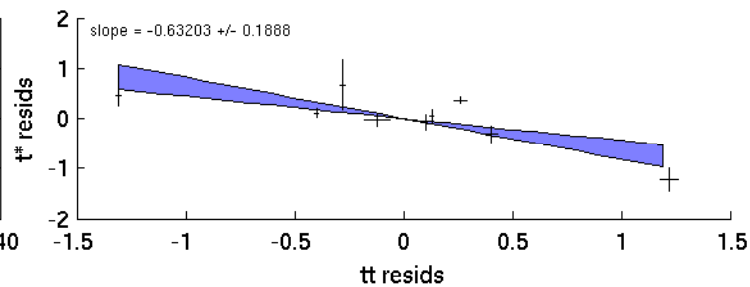
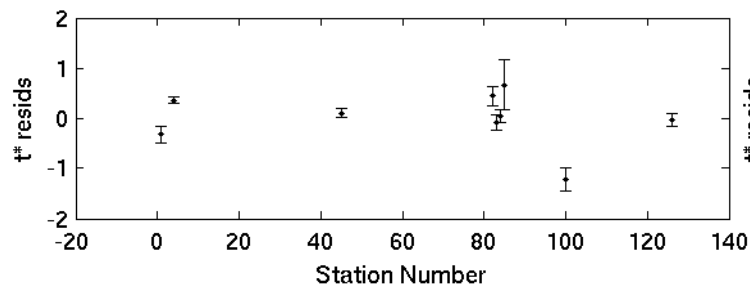
# Event\_2006\_120\_19\_17\_17



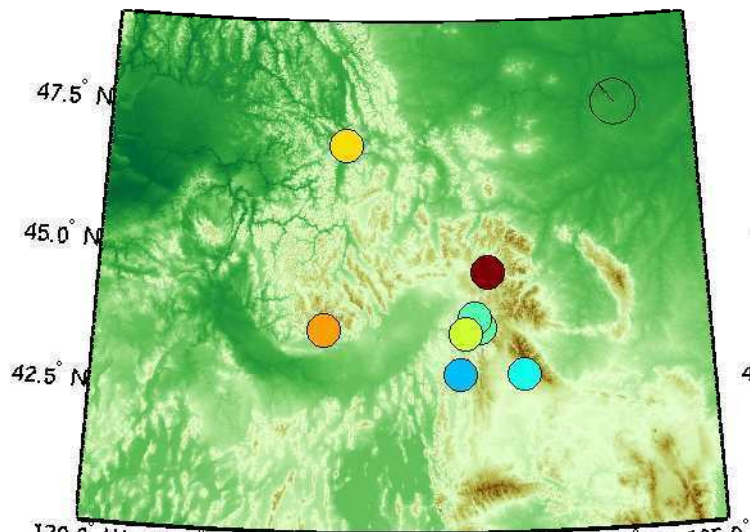
# Event\_2006\_120\_19\_17\_17<sup>Stack</sup>



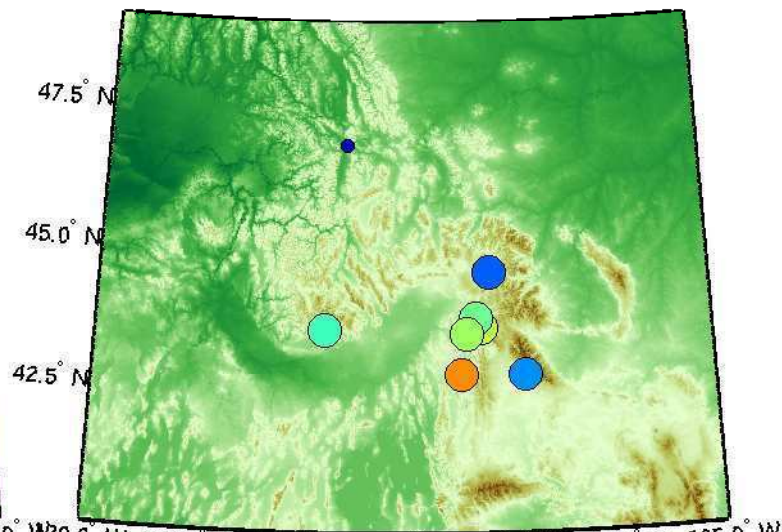
Baz = 144.1731  
 Mean xcor value = 0.87778  
 Range of  $t^*$  values is 1.8911  
 Median  $t^*$  err is 0.14578



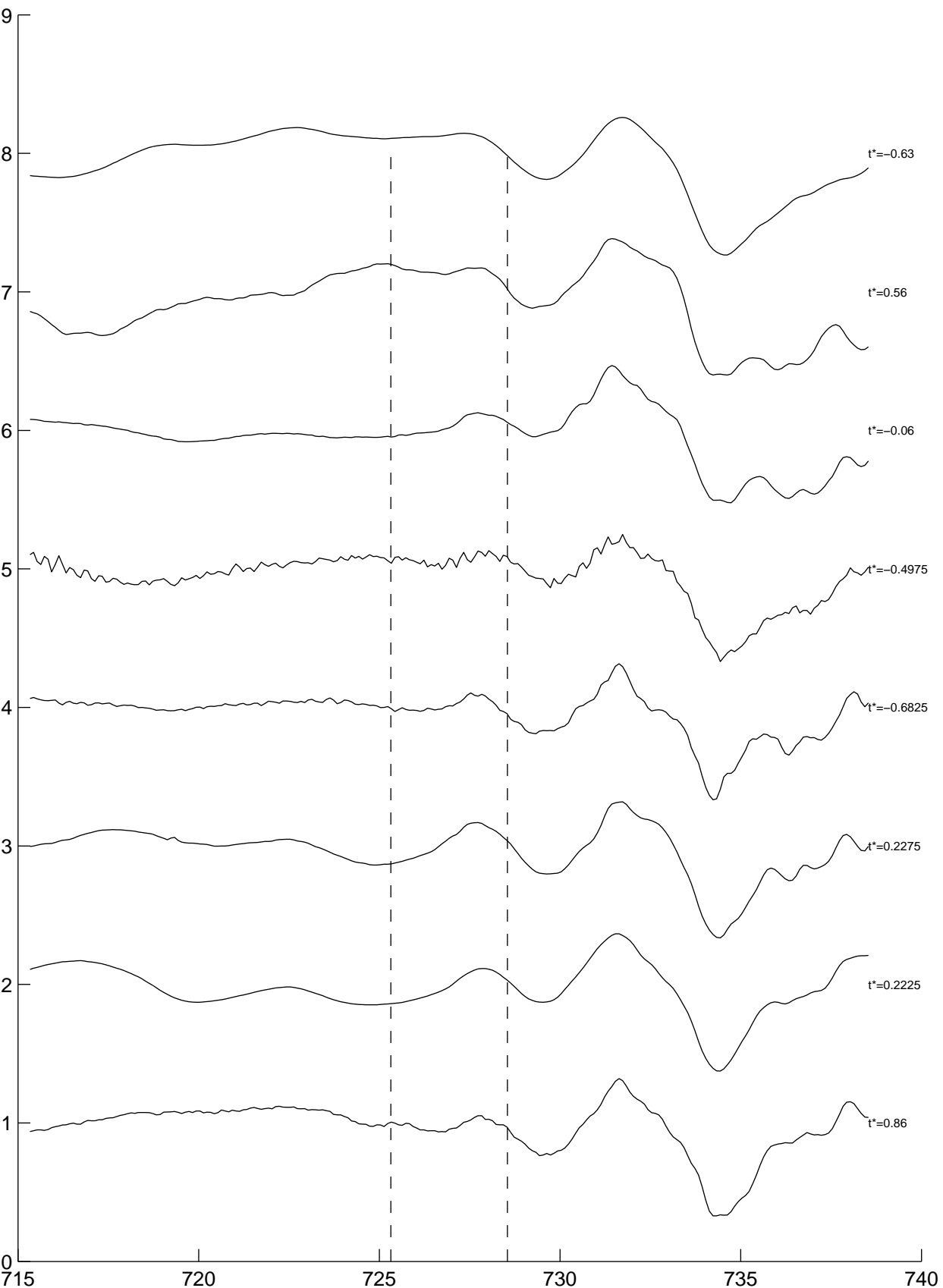
travel time residuals



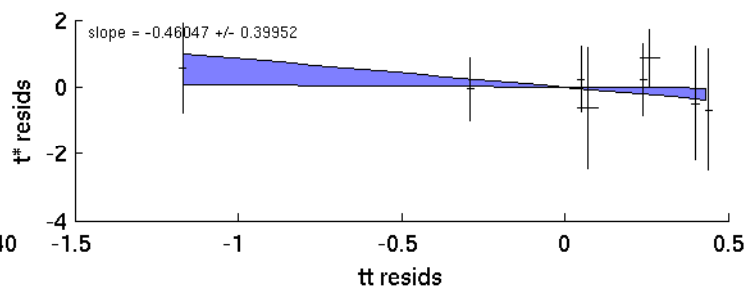
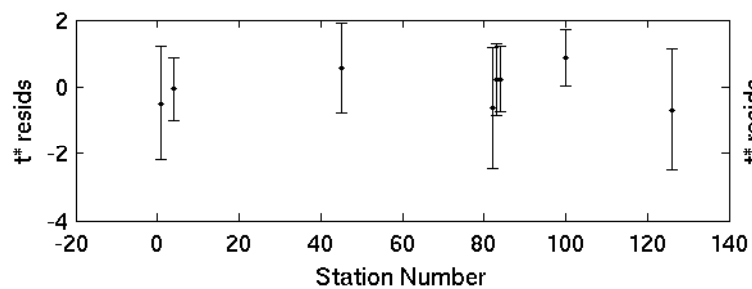
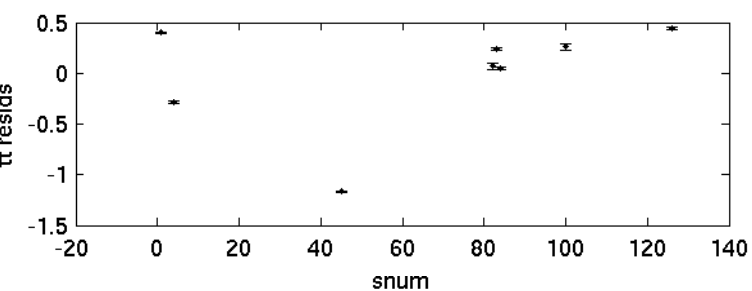
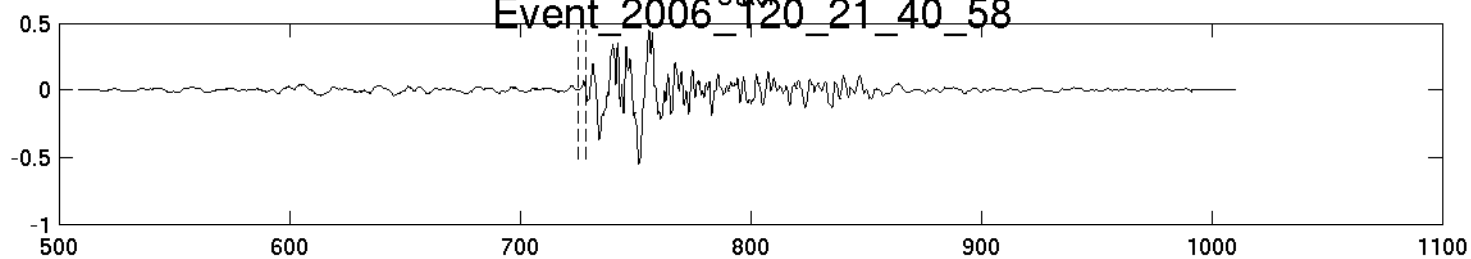
$t^*$  values



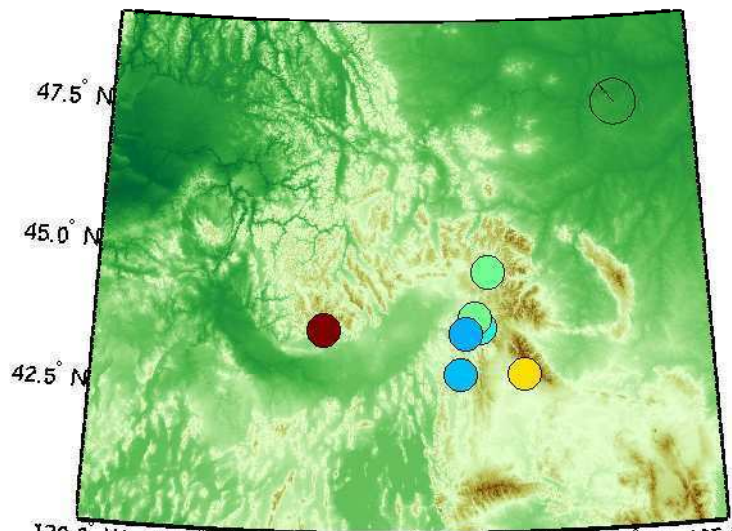
# Event\_2006\_120\_21\_40\_58



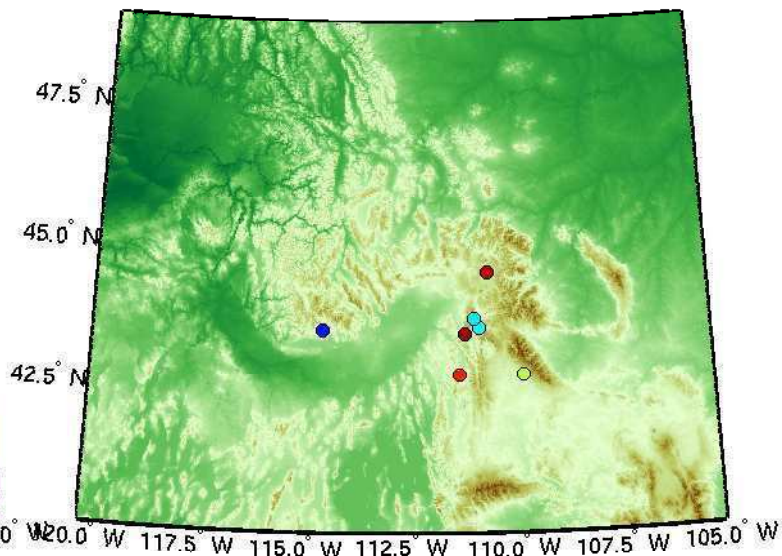
# Event\_2006\_Stack\_120\_21\_40\_58



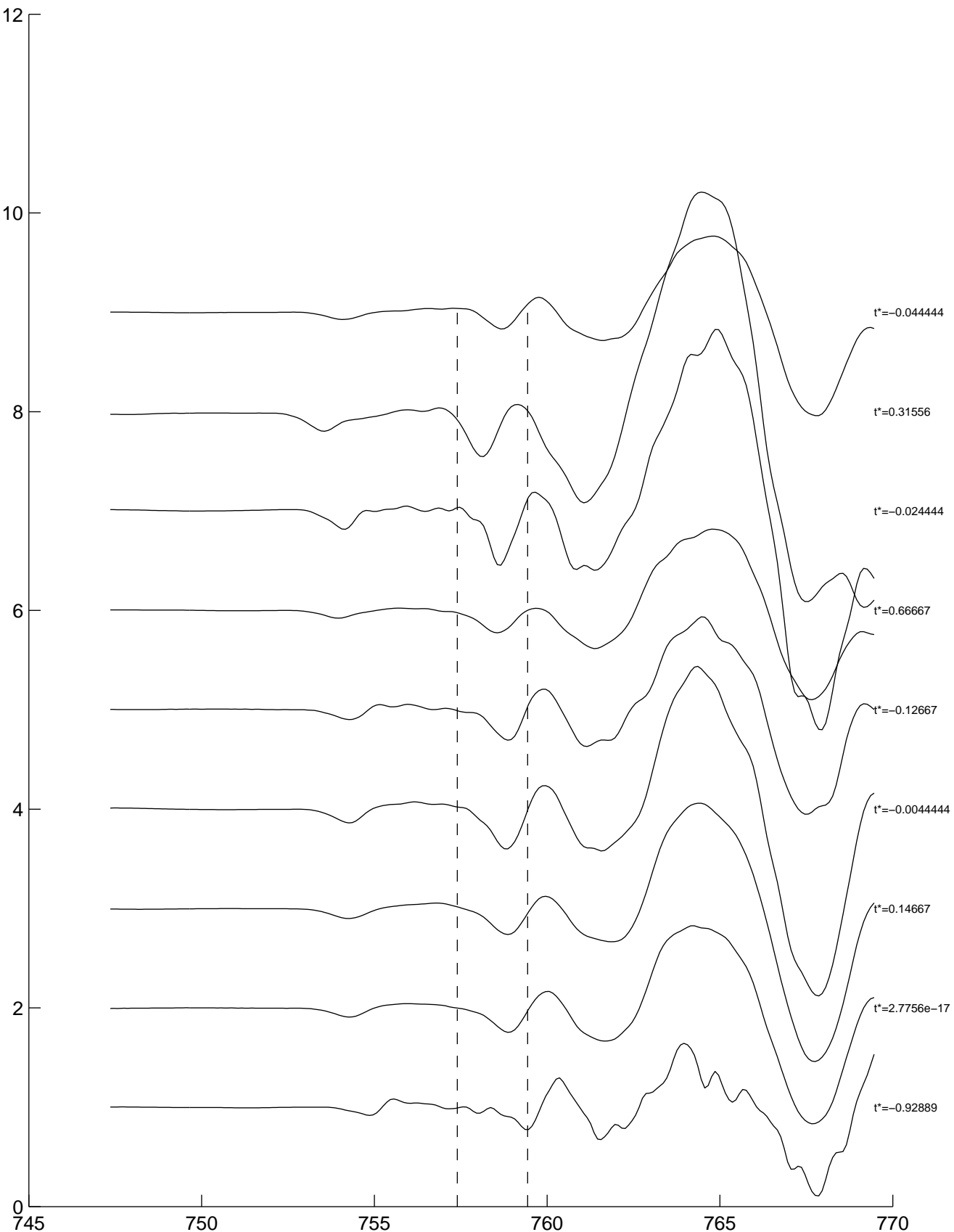
travel time residuals



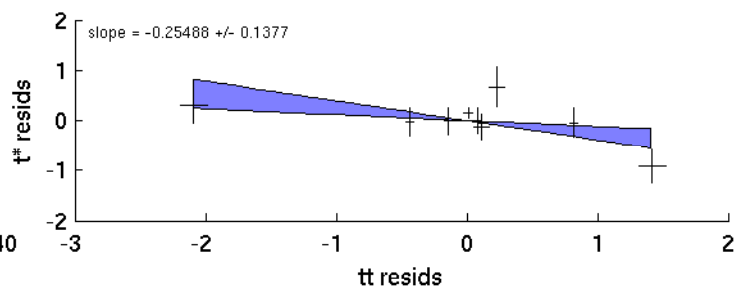
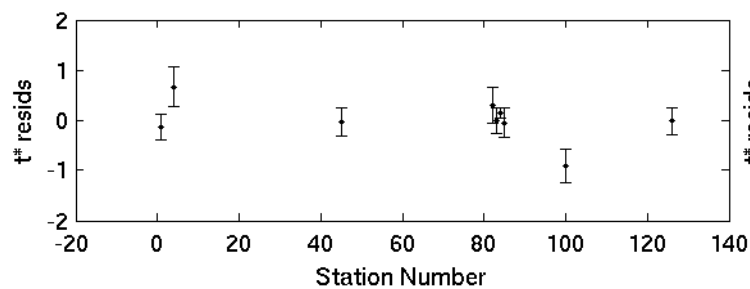
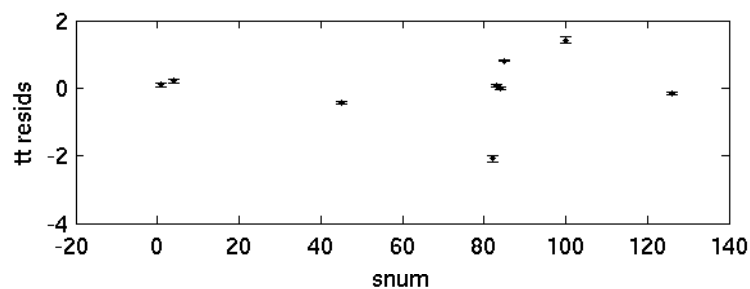
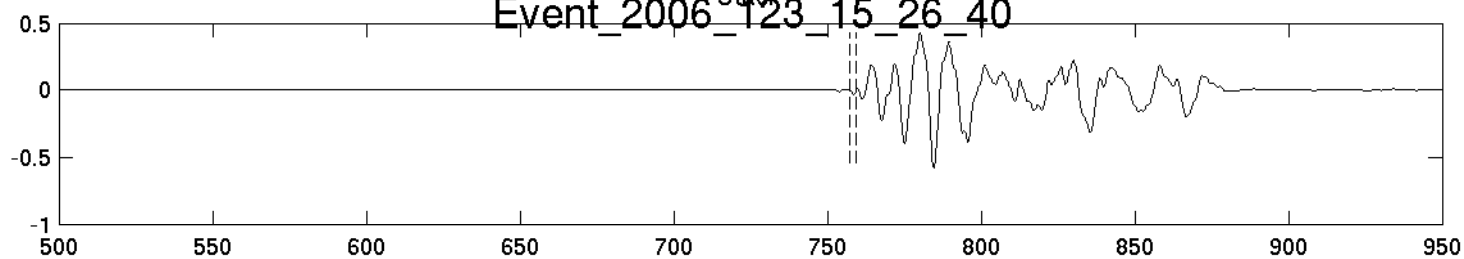
$t^*$  values



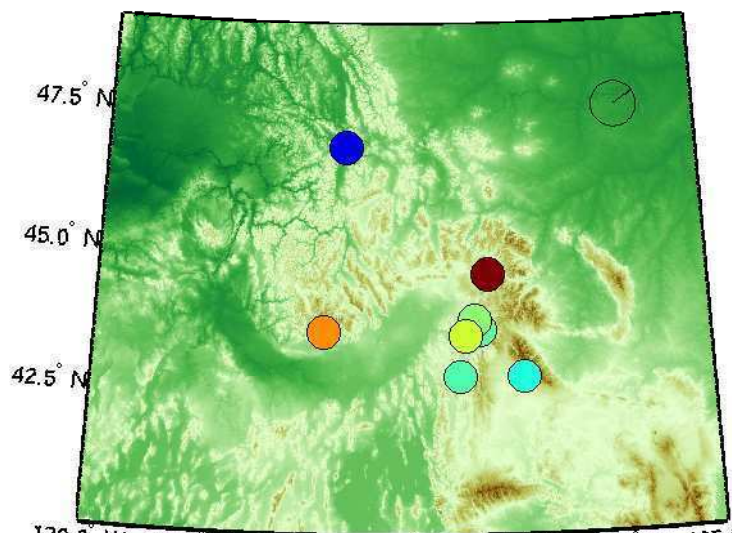
# Event\_2006\_123\_15\_26\_40



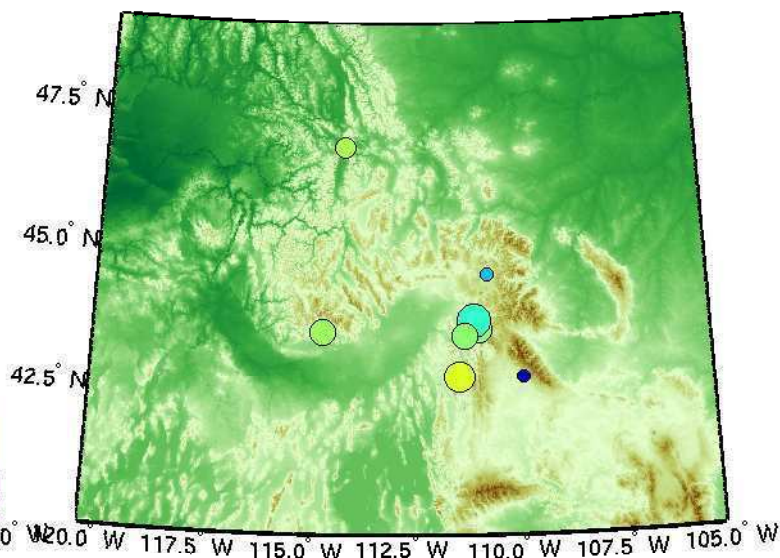
# Event\_2006\_Stack\_123\_15\_26\_40



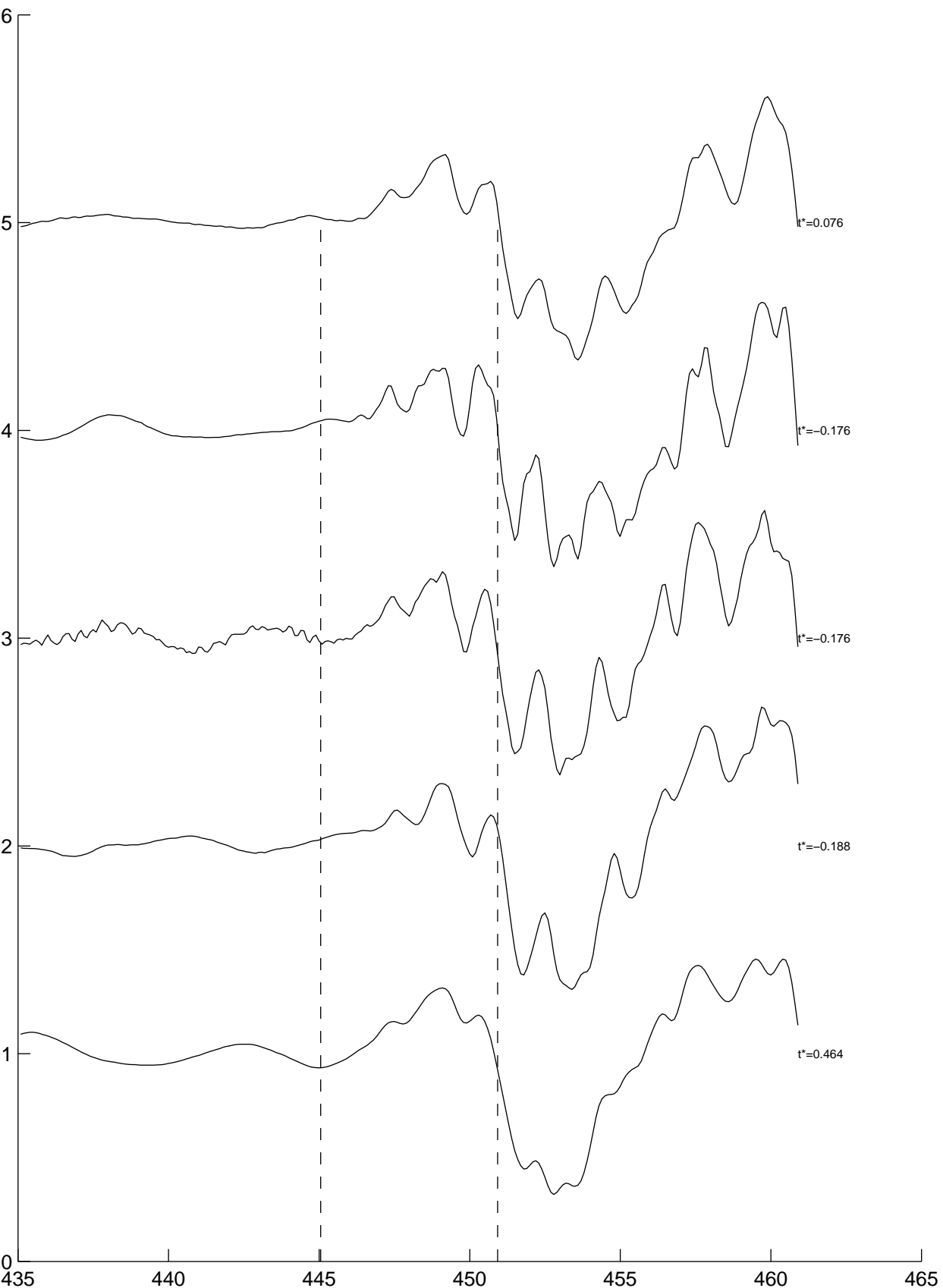
travel time residuals



$t^*$  values

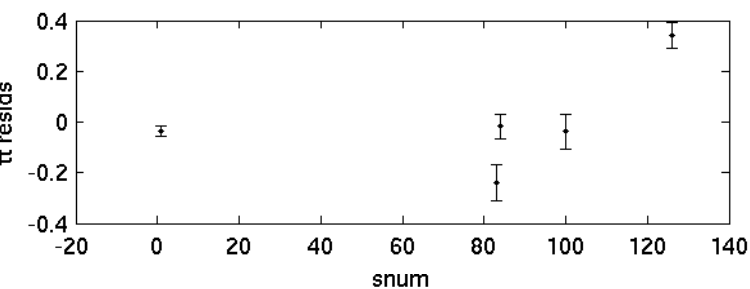
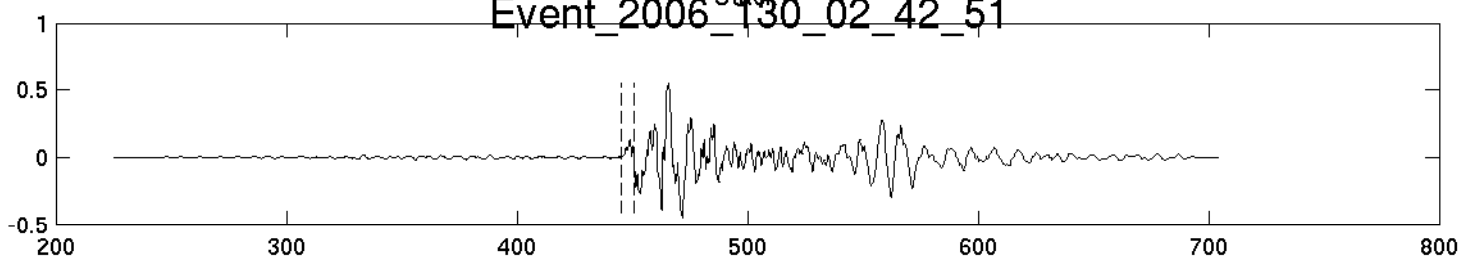


# Event\_2006\_130\_02\_42\_51

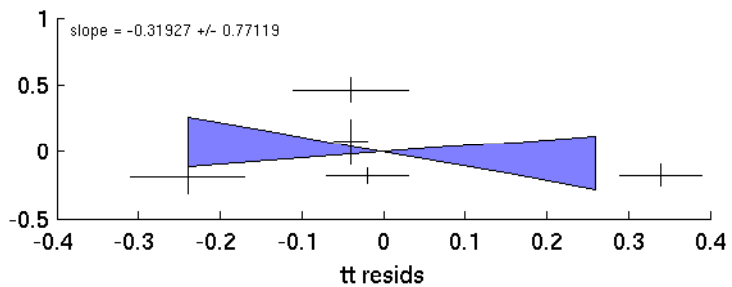
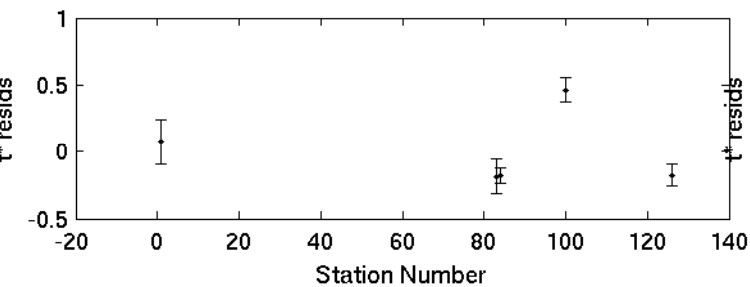




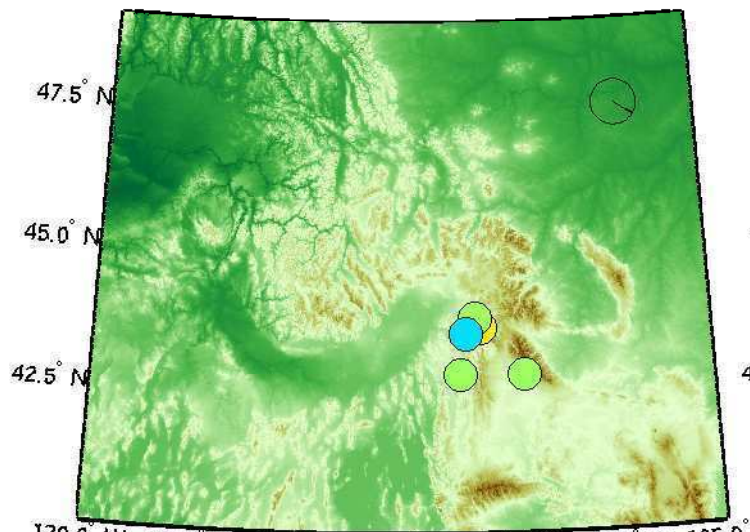
# Event\_2006\_130\_02\_42\_51



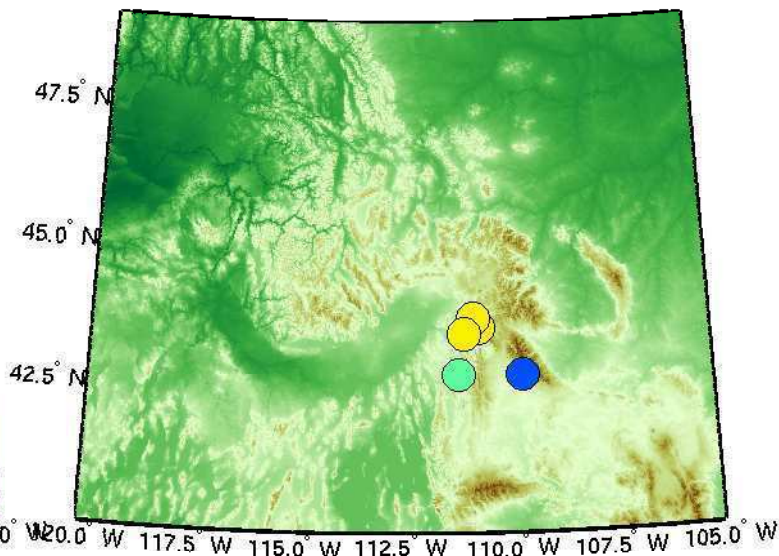
Baz = 304.5699  
 Mean xcor value = 0.684  
 Range of  $t^*$  values is 0.652  
 Median  $t^*$  err is 0.086784



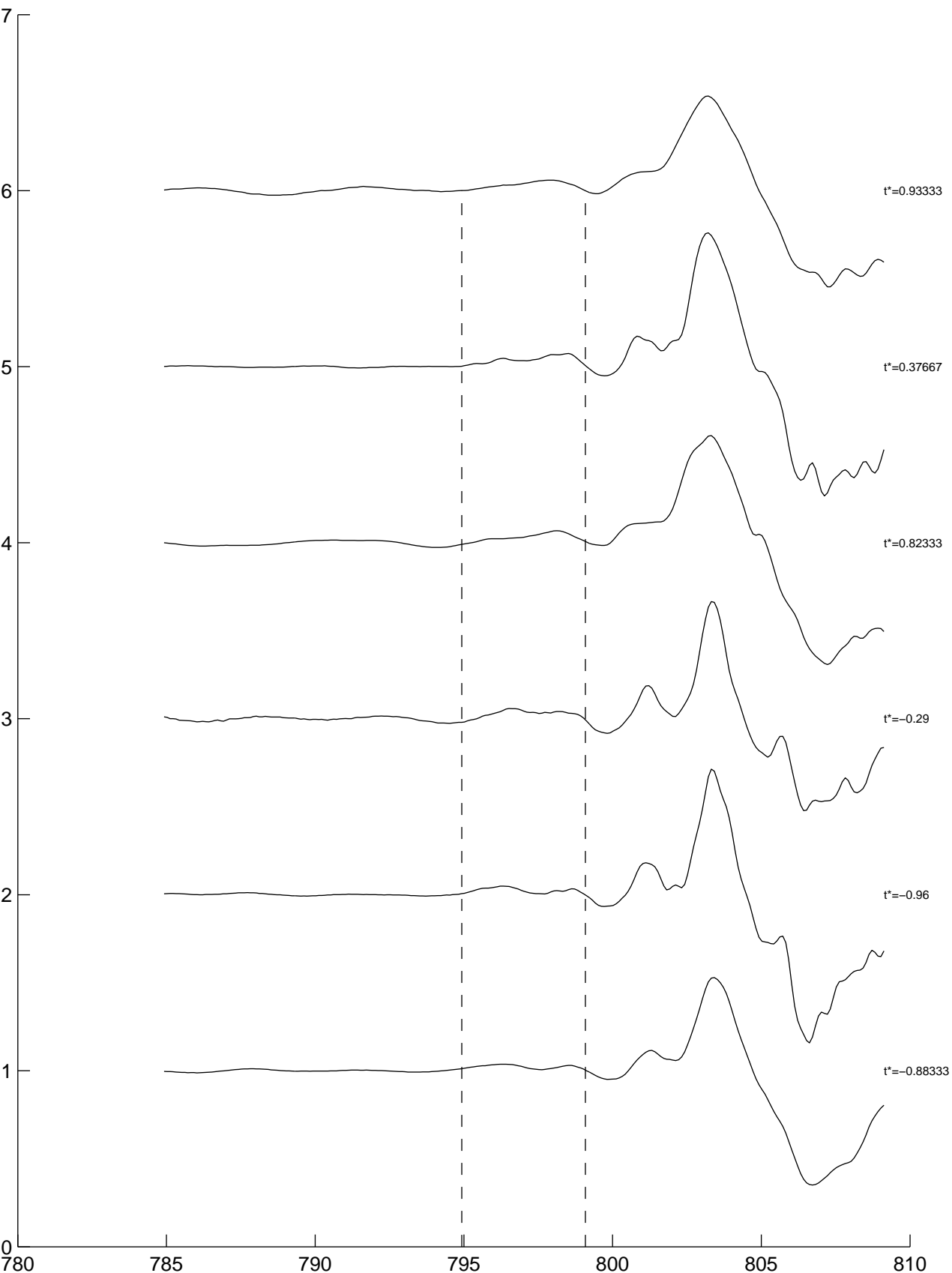
travel time residuals



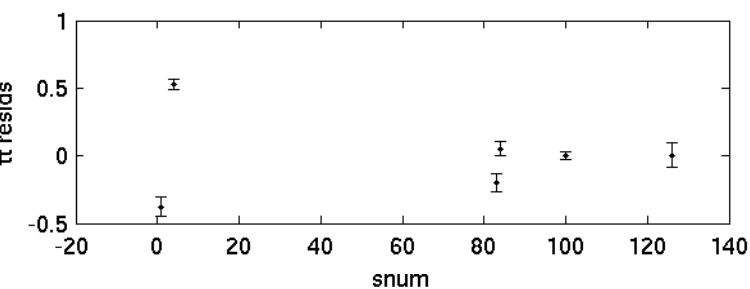
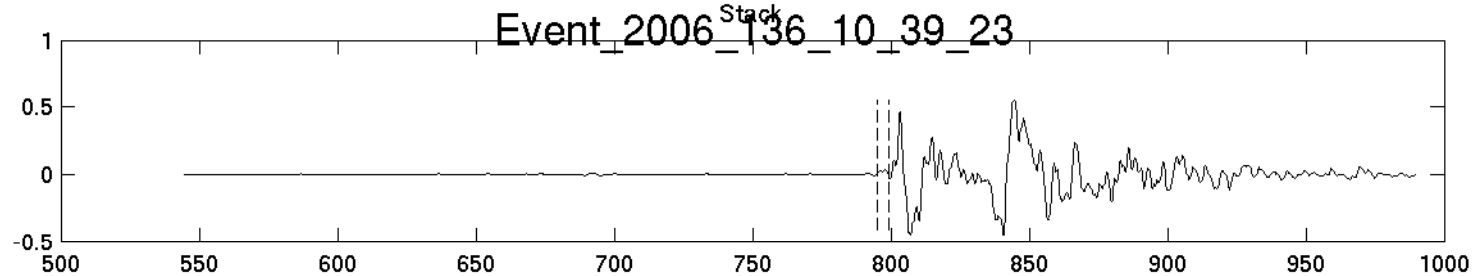
$t^*$  values



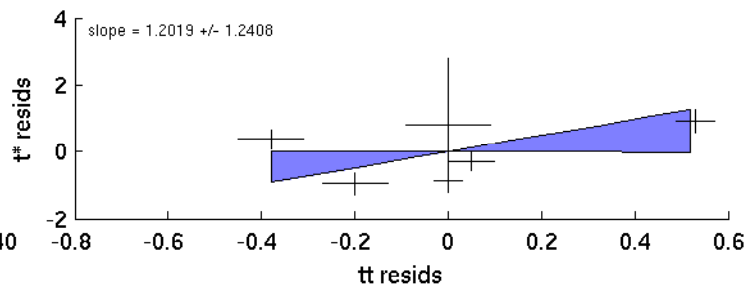
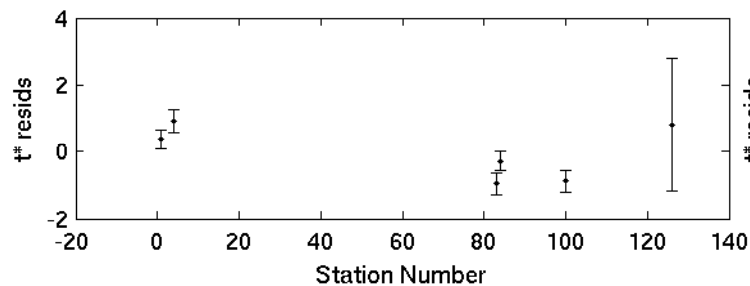
# Event\_2006\_136\_10\_39\_23



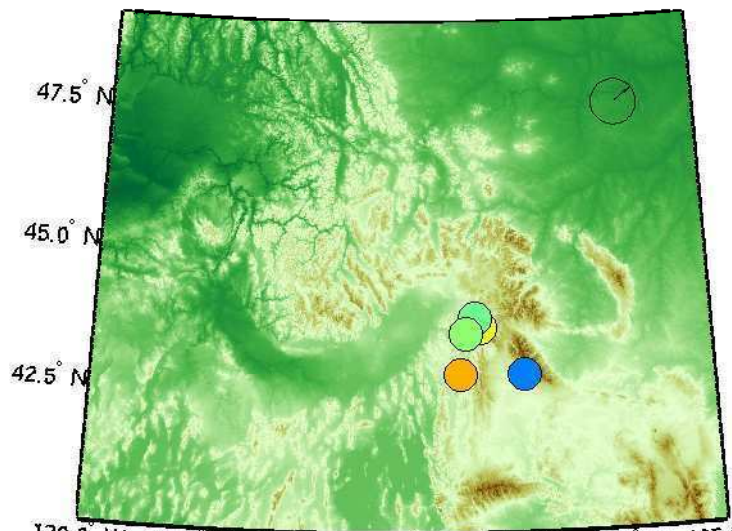
# Event\_2006\_136\_10\_39\_23



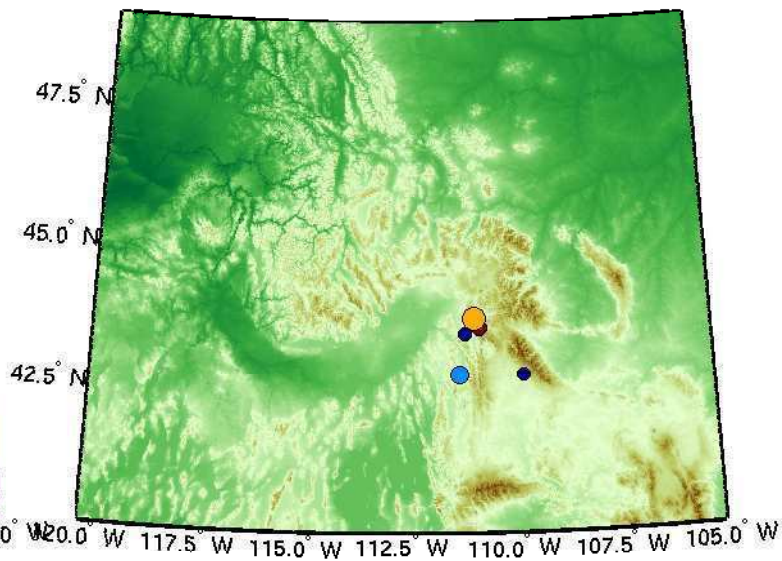
Baz = 232.6443  
Mean xcor value = 0.74667  
Range of  $t^*$  values is 1.8933  
Median  $t^*$  err is 0.32412



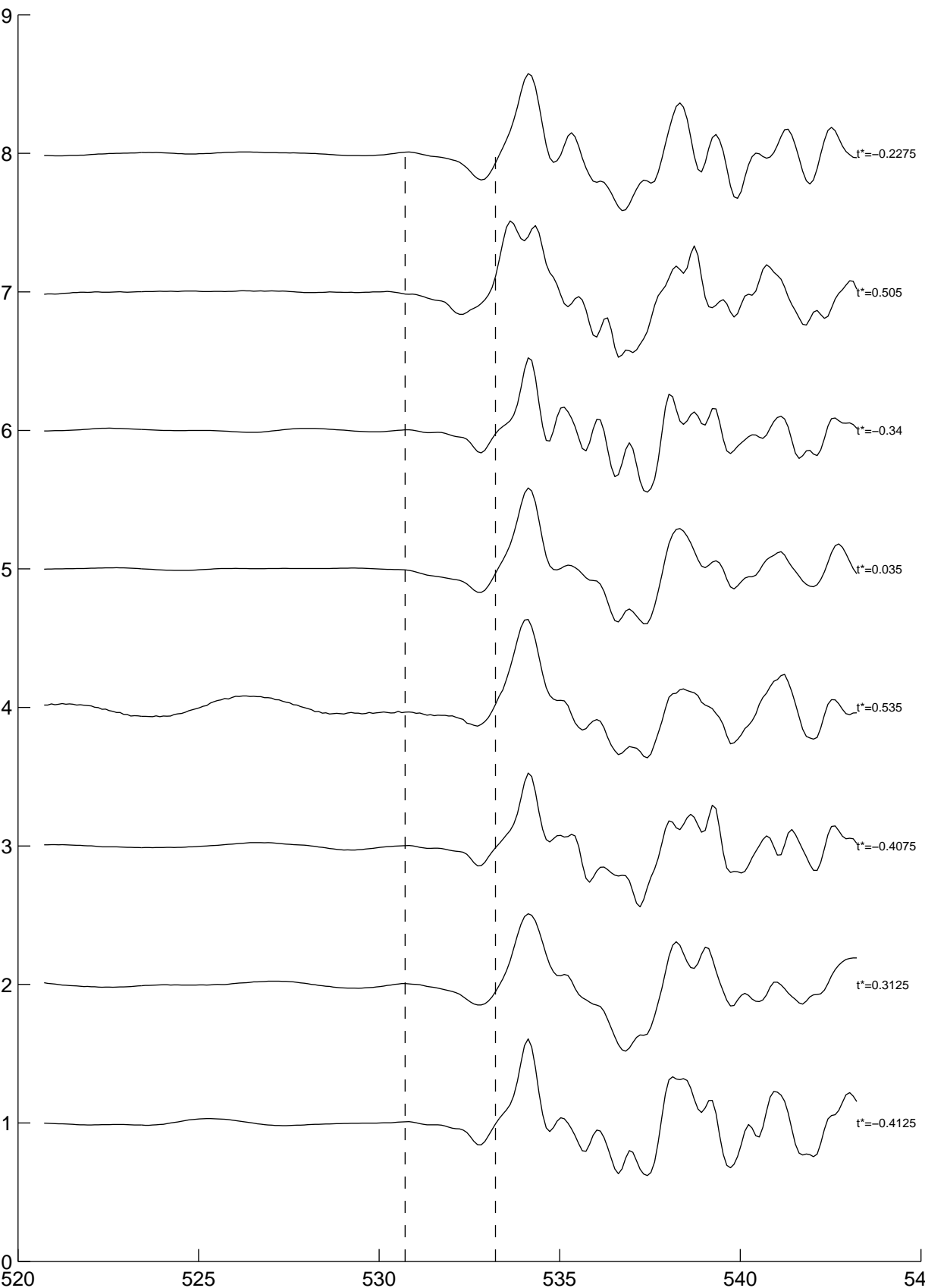
travel time residuals



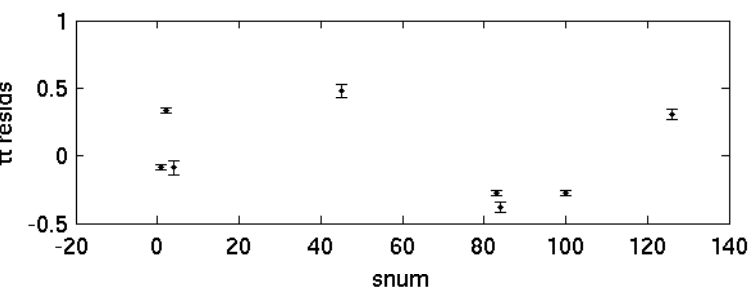
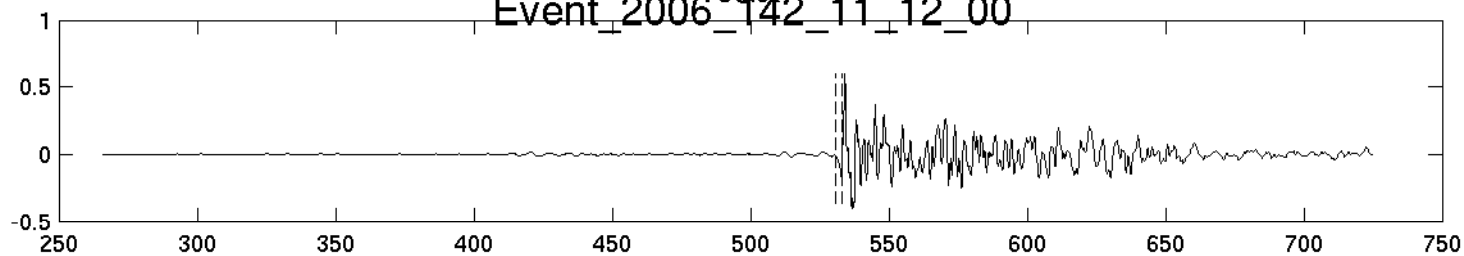
$t^*$  values



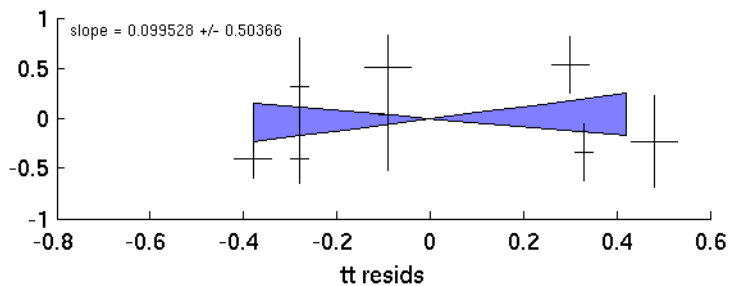
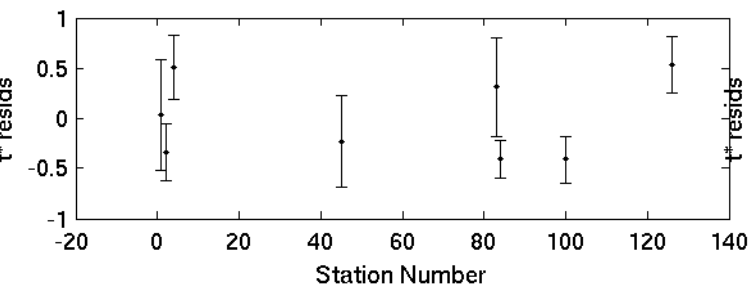
# Event\_2006\_142\_11\_12\_00



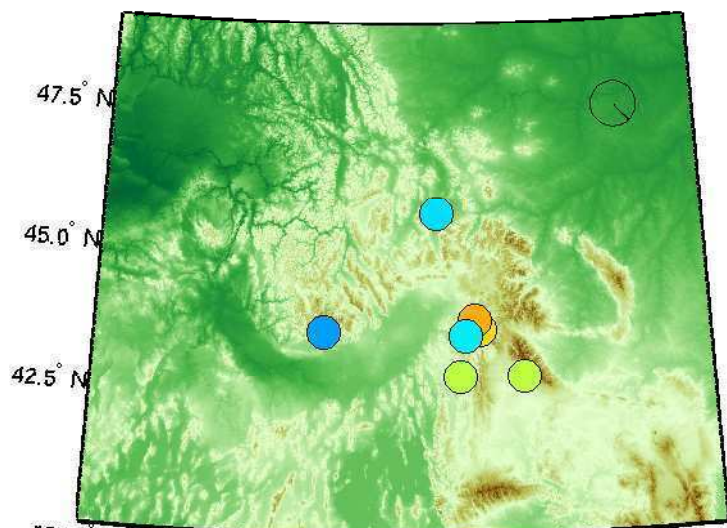
# Event\_2006\_Stack\_11\_12\_00



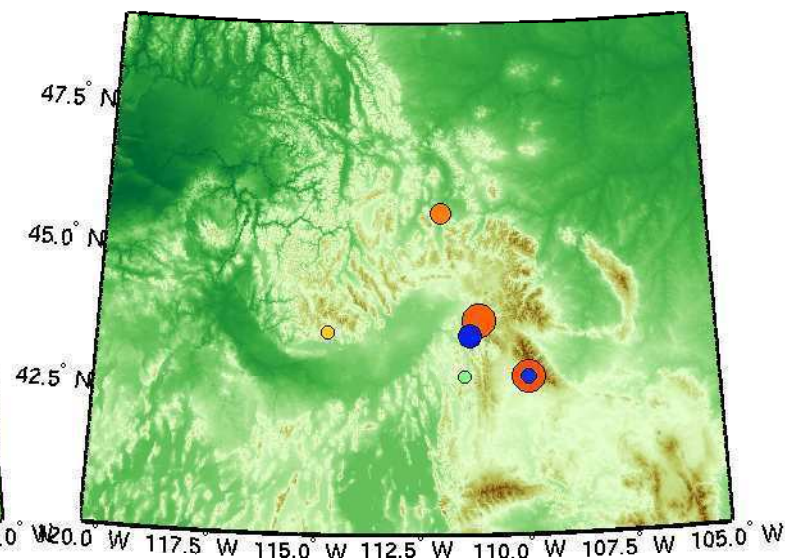
Baz = 320.4103  
 Mean xcor value = 0.7325  
 Range of  $t^*$  values is 0.9475  
 Median  $t^*$  err is 0.3005



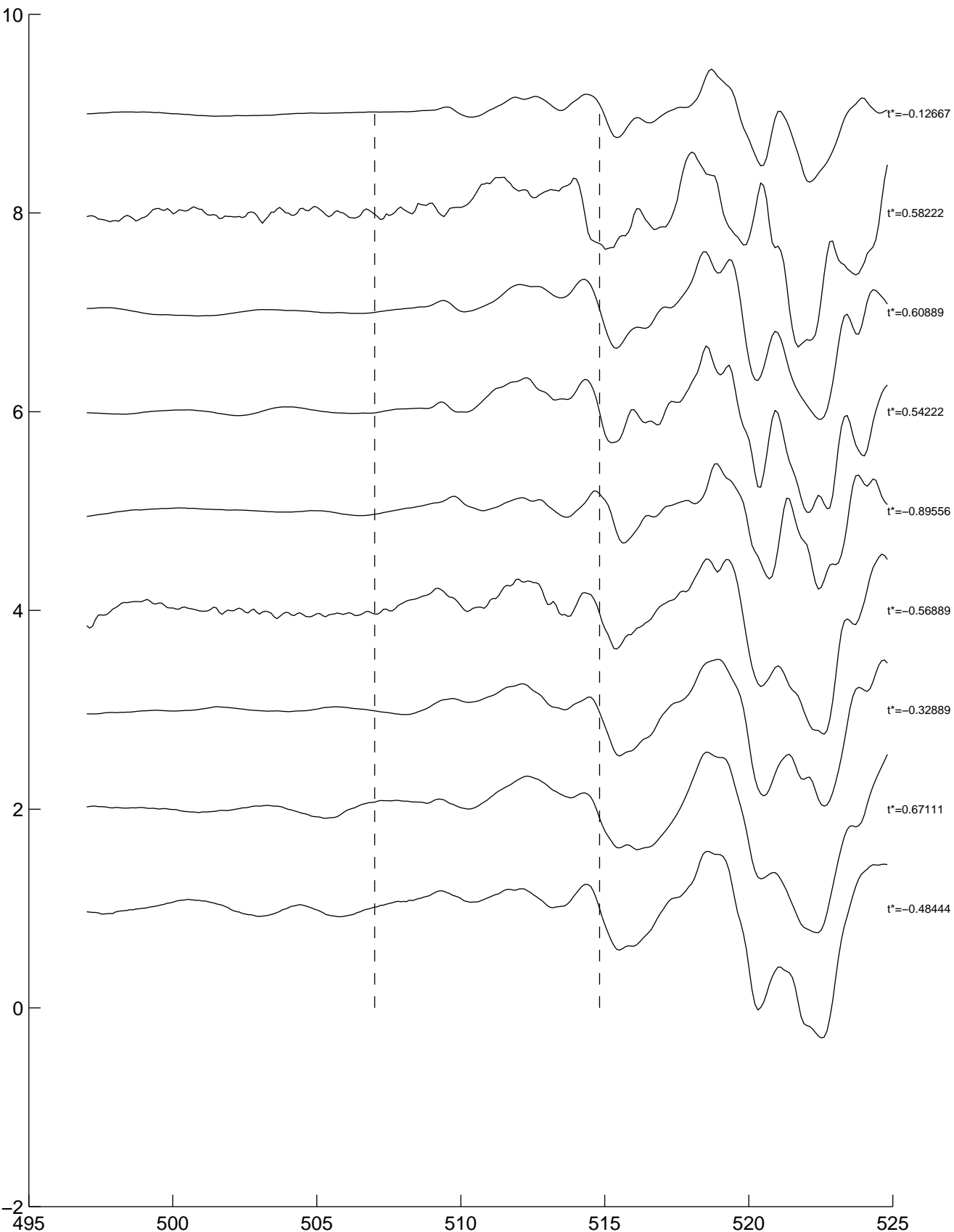
travel time residuals



$t^*$  values

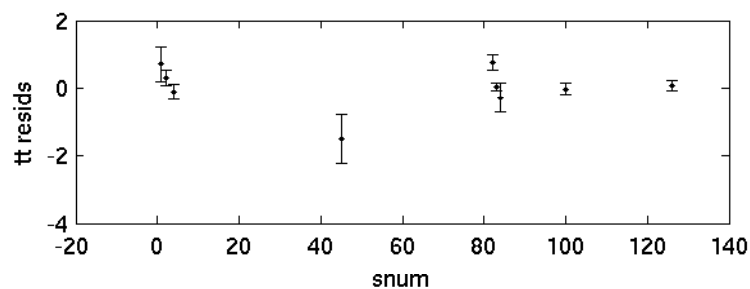
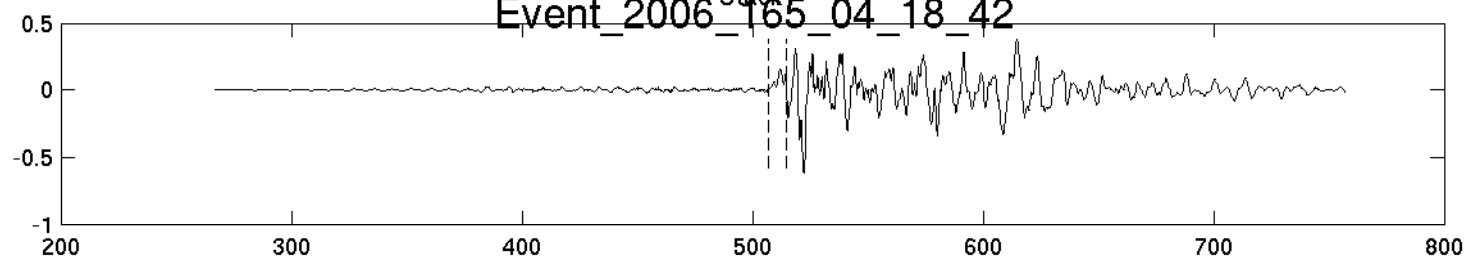


# Event\_2006\_165\_04\_18\_42

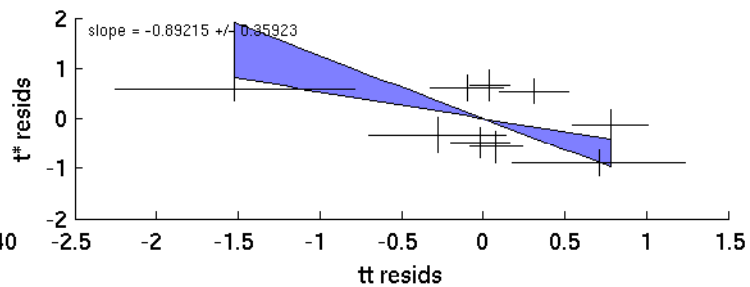
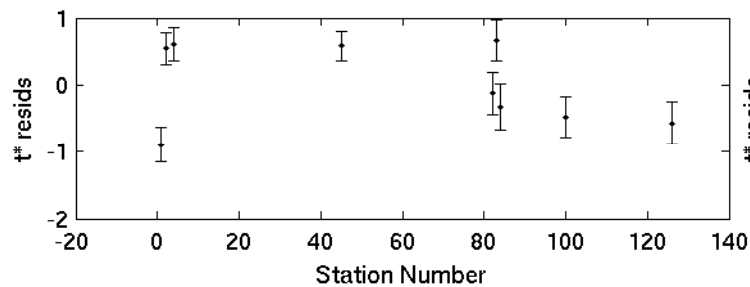




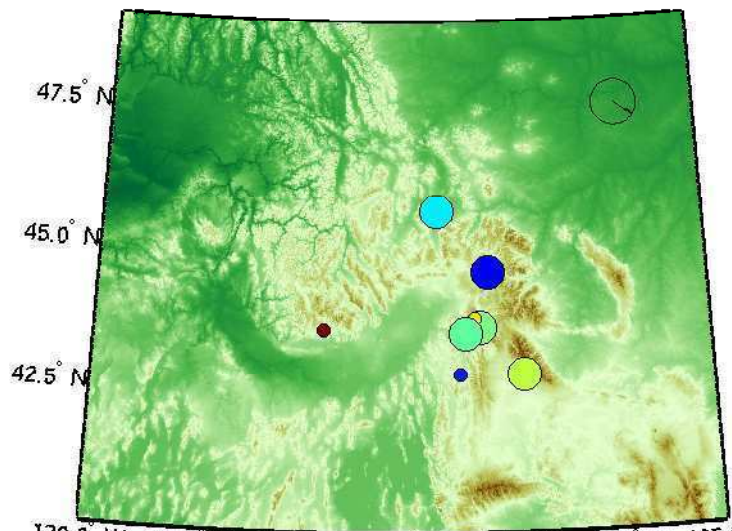
# Event\_2006\_165\_04\_18\_42



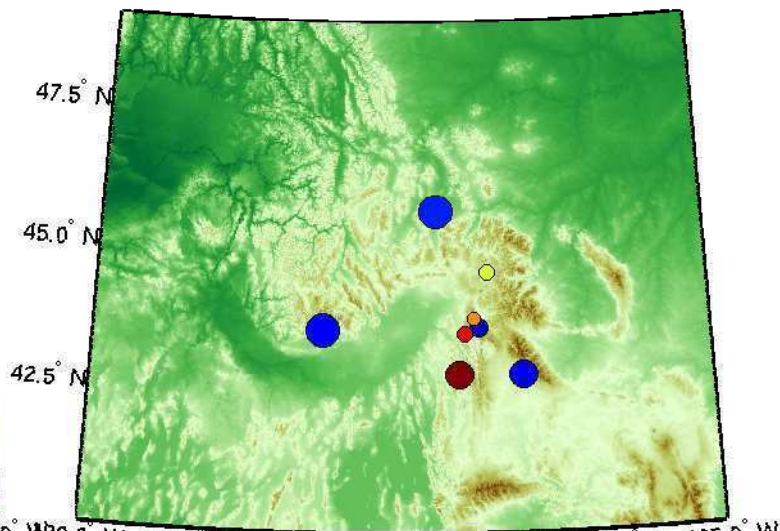
Baz = 306.1463  
Mean xcor value = 0.77333  
Range of  $t^*$  values is 1.5667  
Median  $t^*$  err is 0.30222



travel time residuals

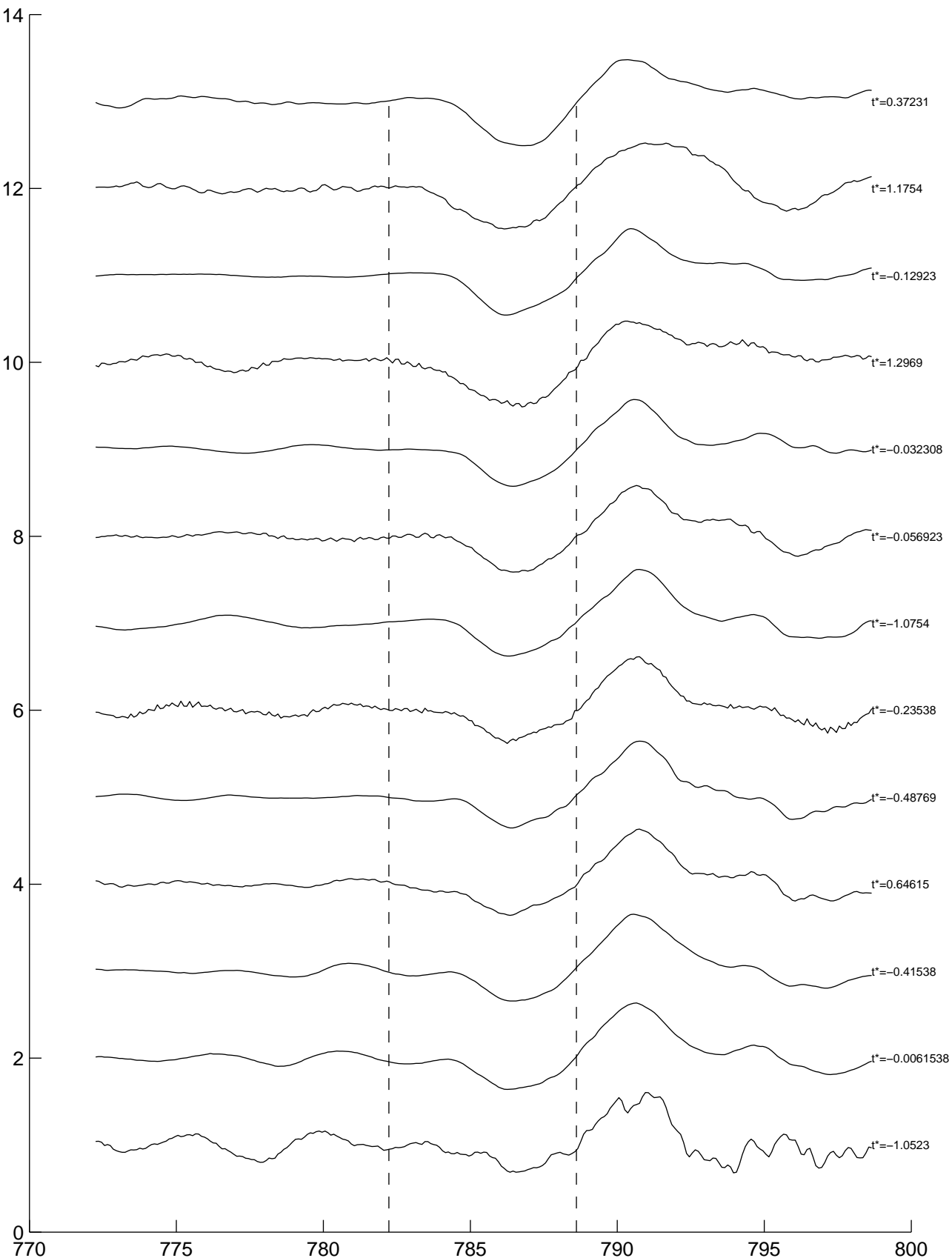


$t^*$  values

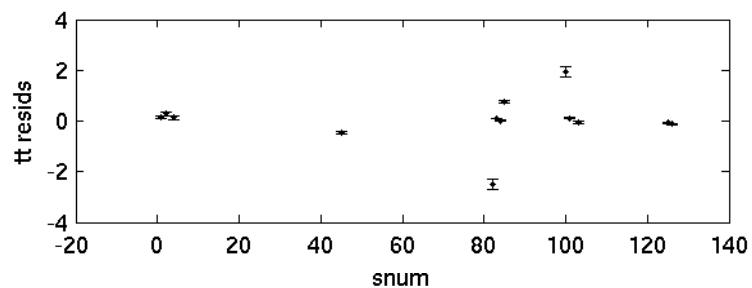
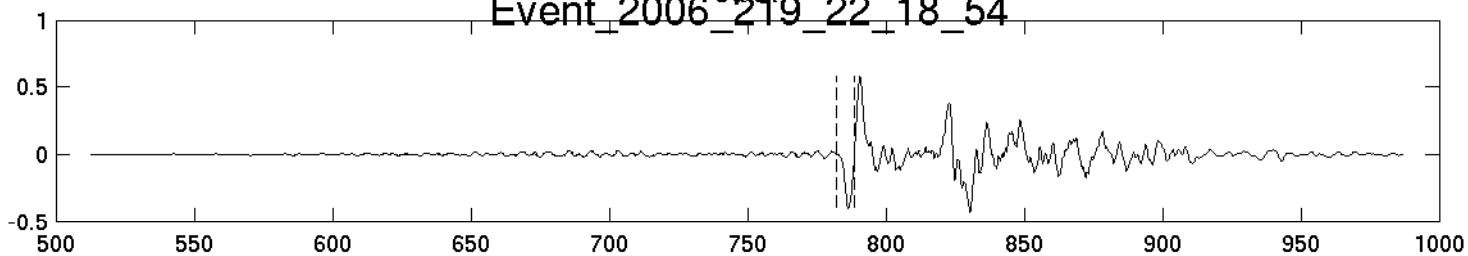




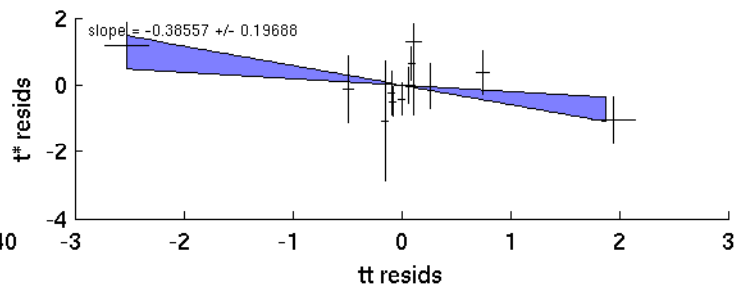
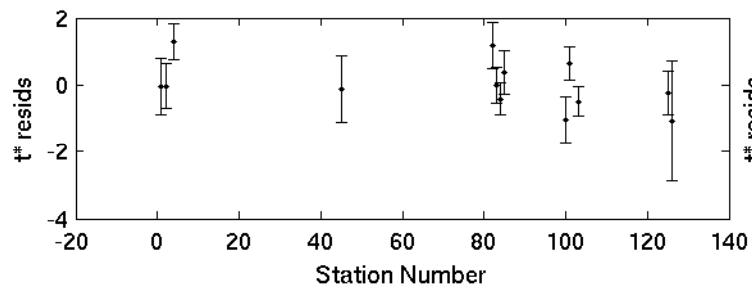
# Event\_2006\_219\_22\_18\_54



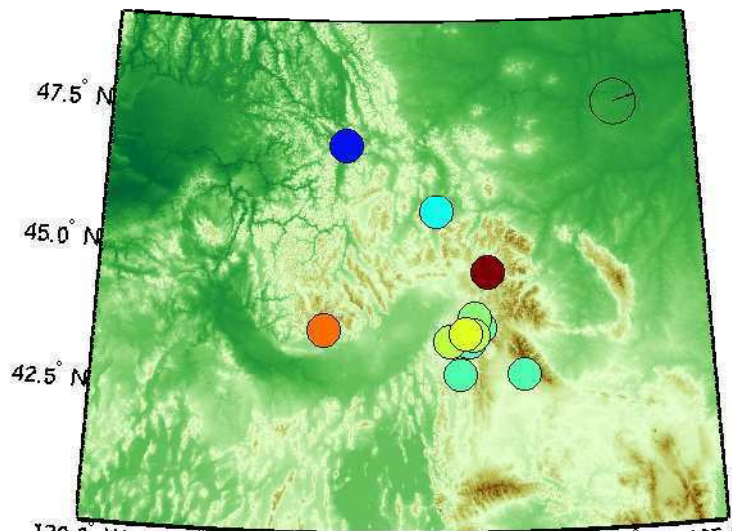
# Event\_2006\_219\_22\_18\_54



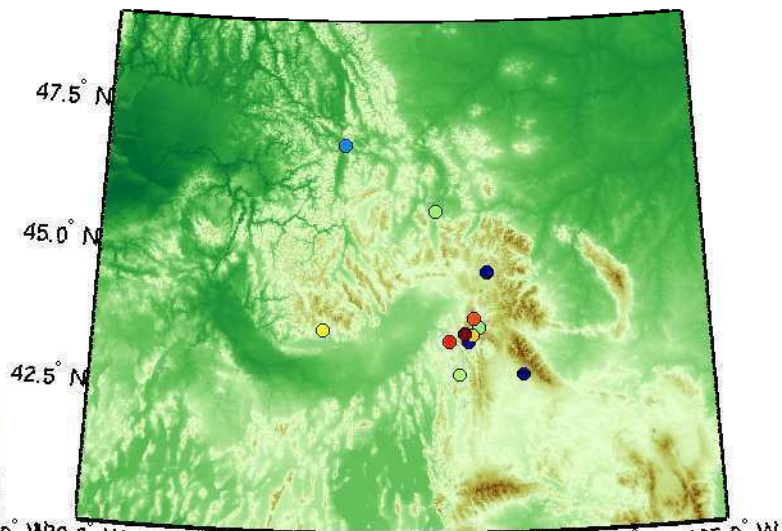
Baz = 252.4416  
Mean xcor value = 0.88538  
Range of  $t^*$  values is 2.3723  
Median  $t^*$  err is 0.66311



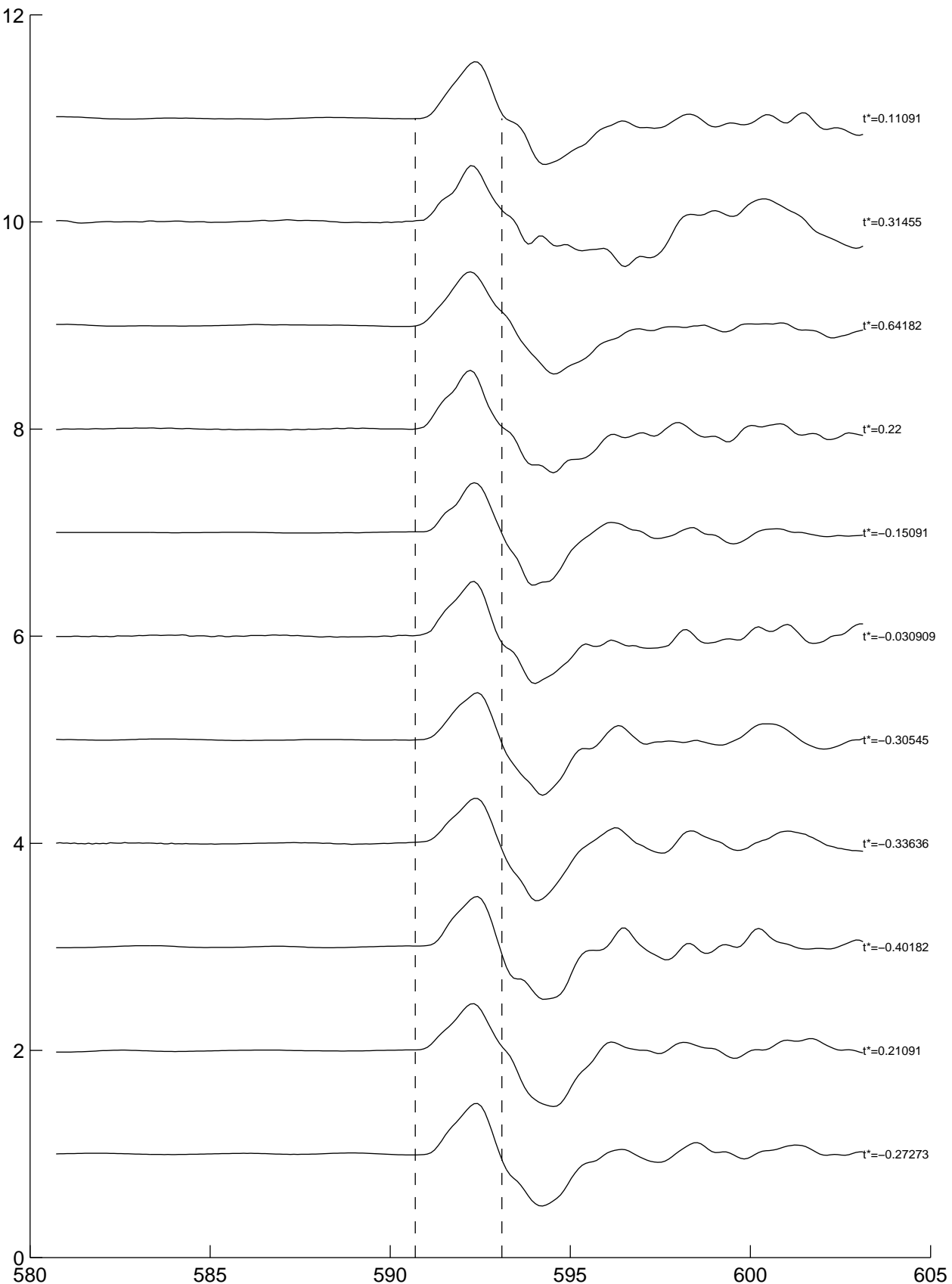
travel time residuals



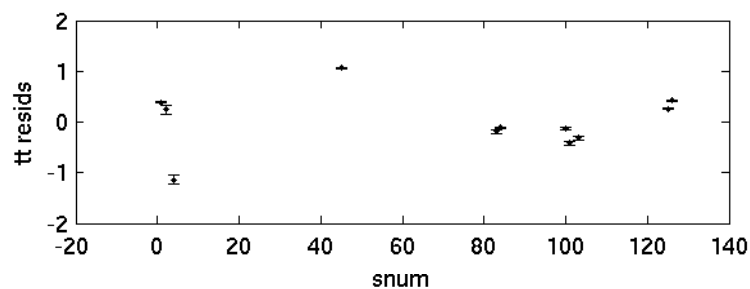
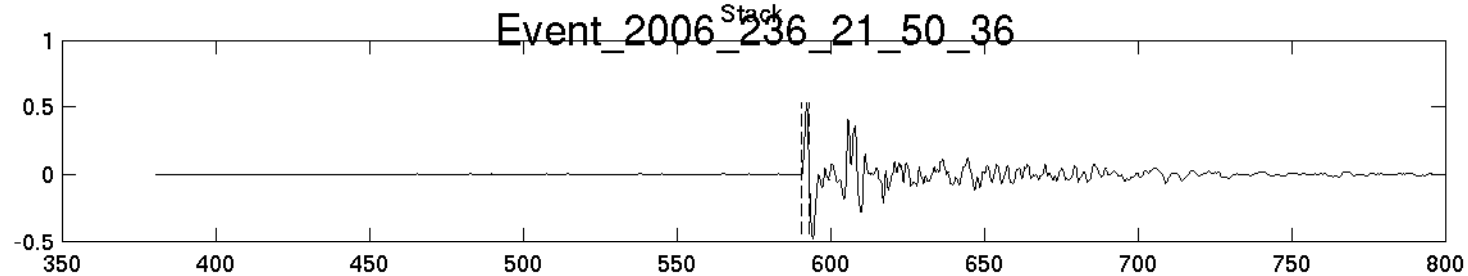
$t^*$  values



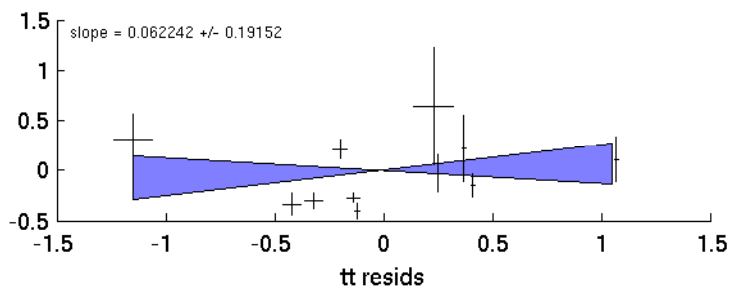
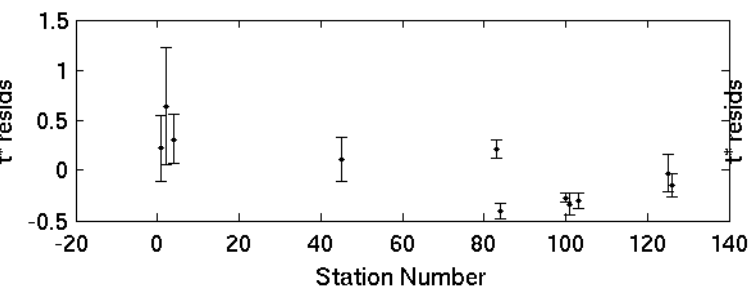
# Event\_2006\_236\_21\_50\_36



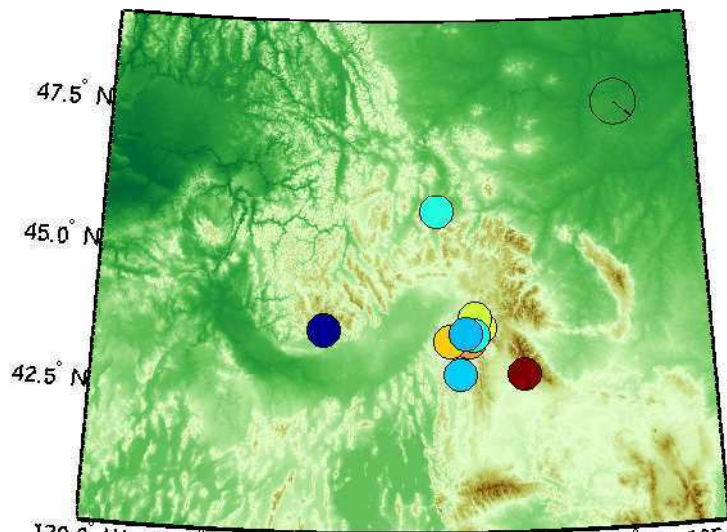
# Event\_2006\_236\_21\_50\_36



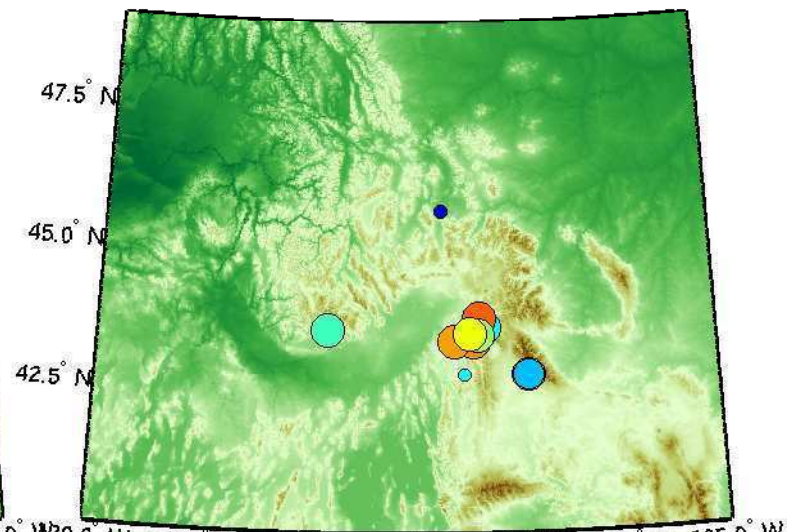
Baz = 312.3116  
 Mean xcor value = 0.78545  
 Range of  $t^*$  values is 1.0436  
 Median  $t^*$  err is 0.11425



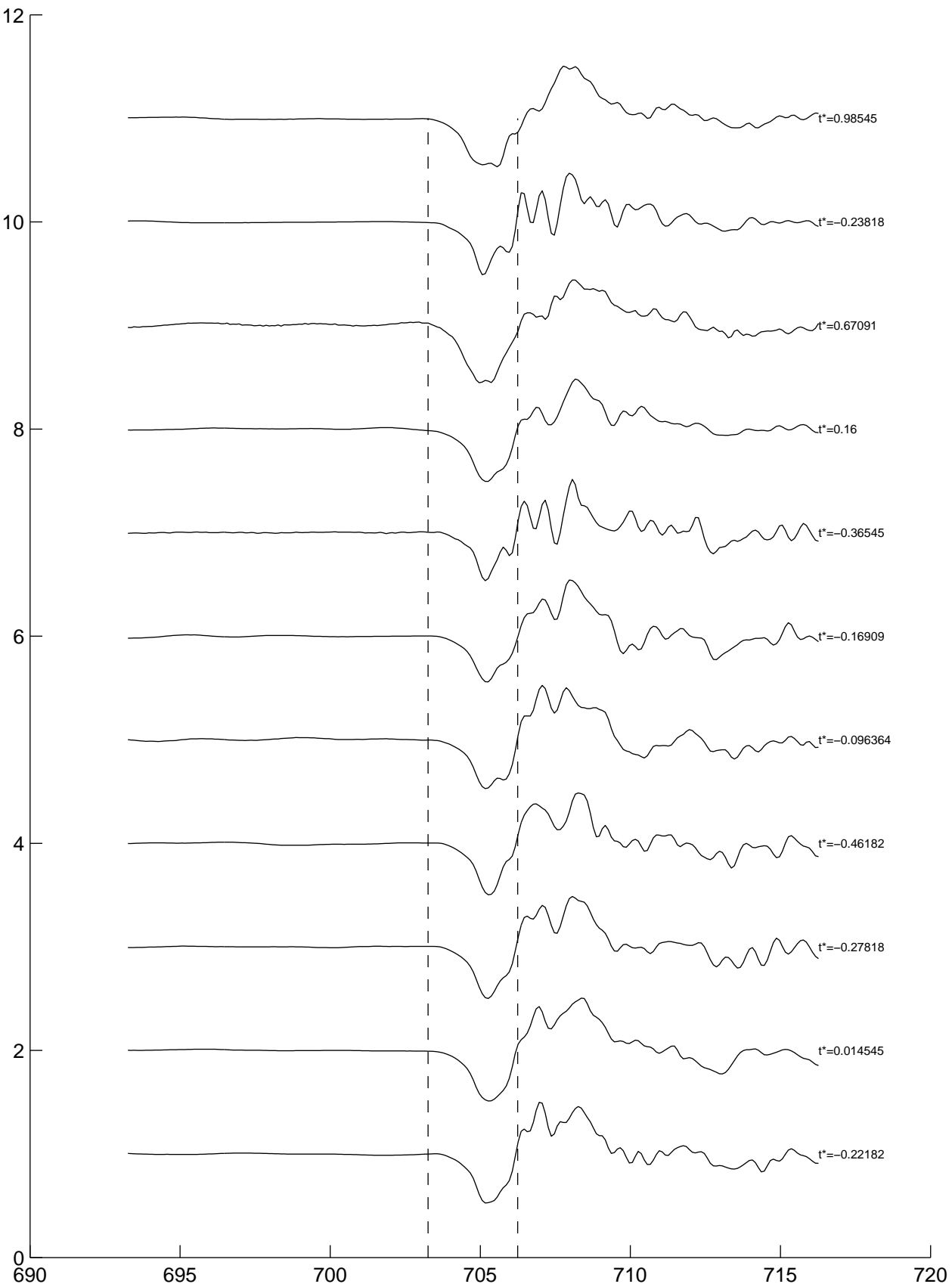
travel time residuals



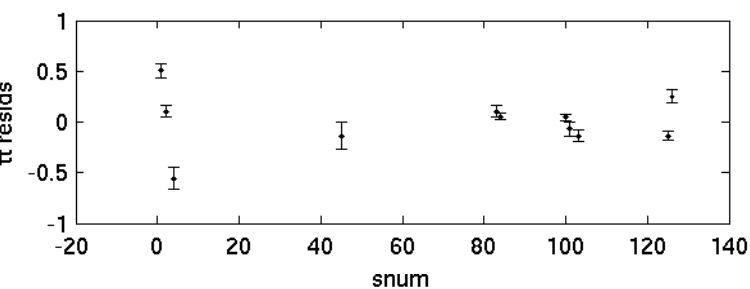
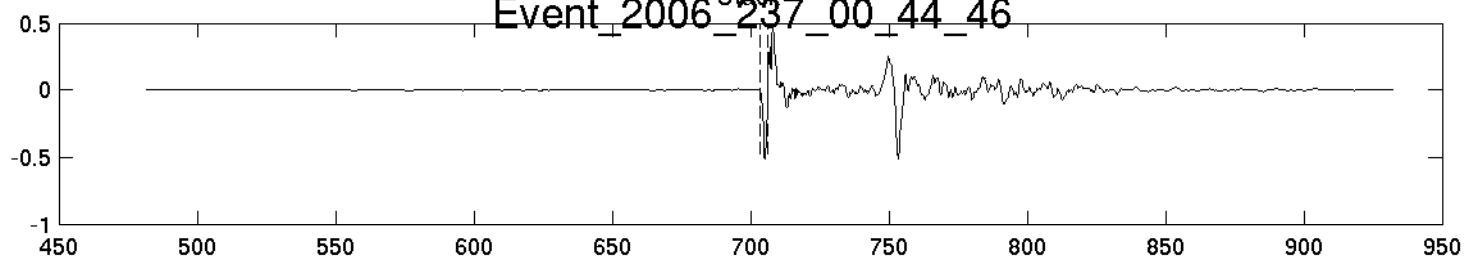
$t^*$  values



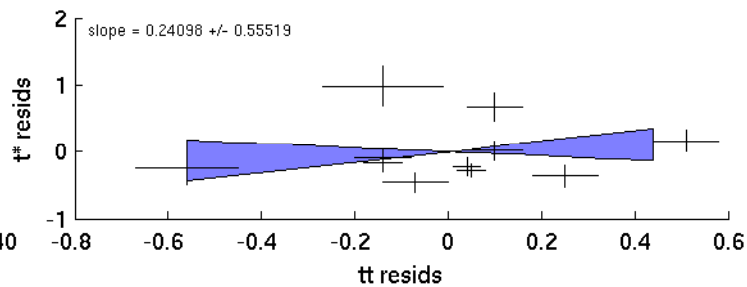
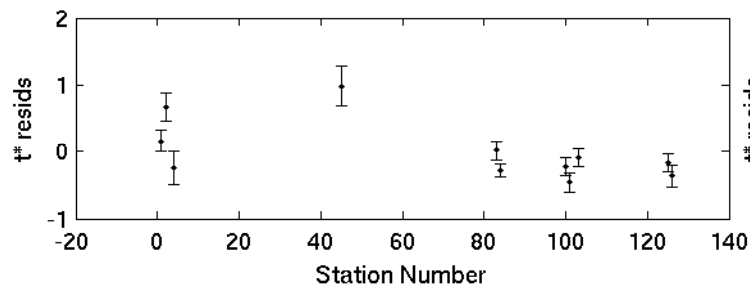
# Event\_2006\_237\_00\_44\_46



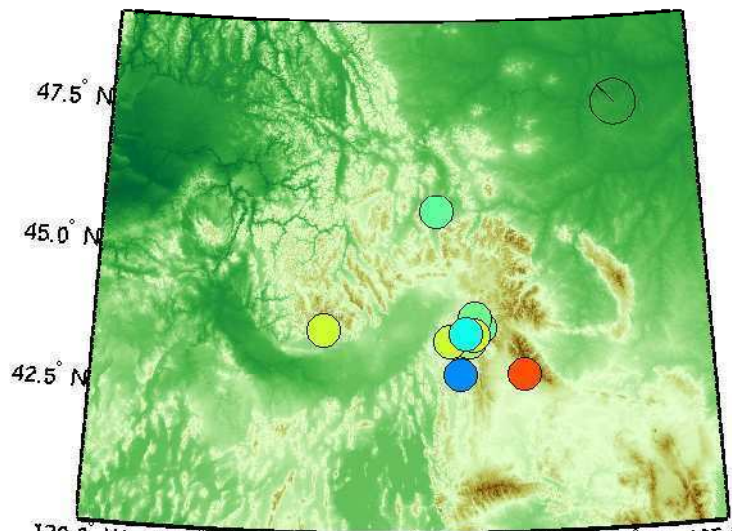
# Event\_2006\_237\_00\_44\_46



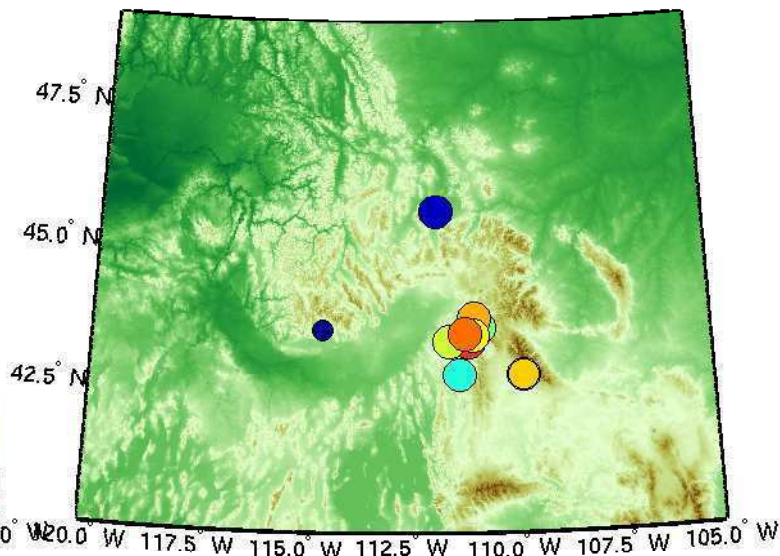
Baz = 139.7032  
 Mean xcor value = 0.81364  
 Range of  $t^*$  values is 1.4473  
 Median  $t^*$  err is 0.14775



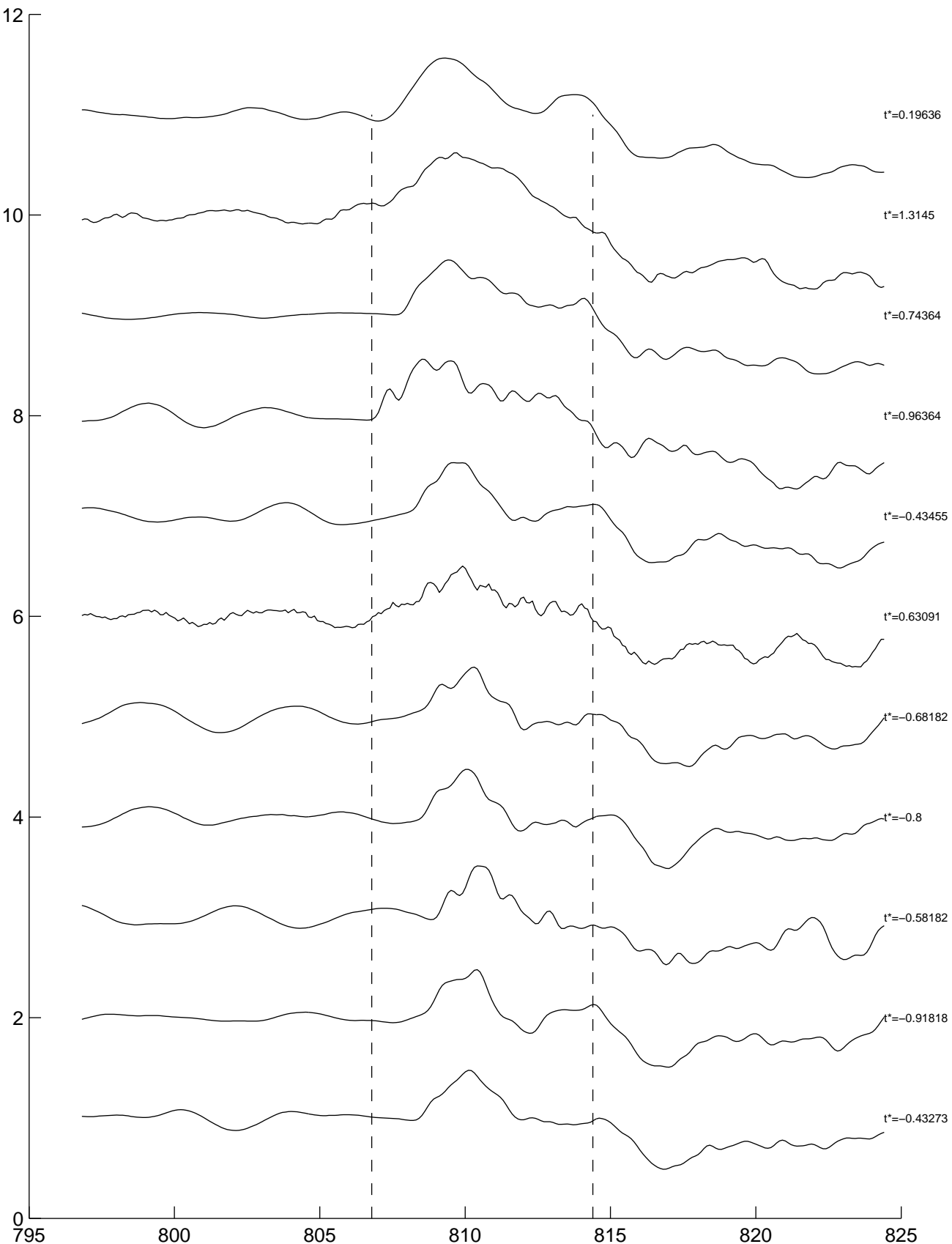
travel time residuals



$t^*$  values

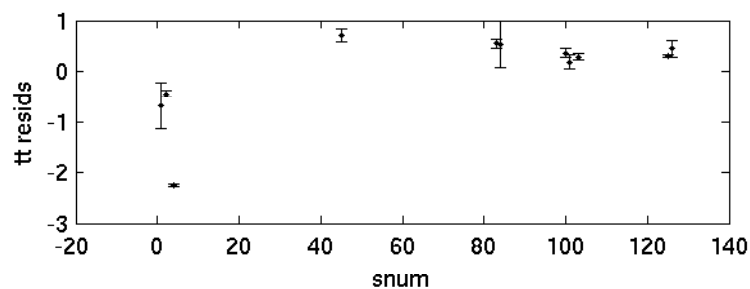
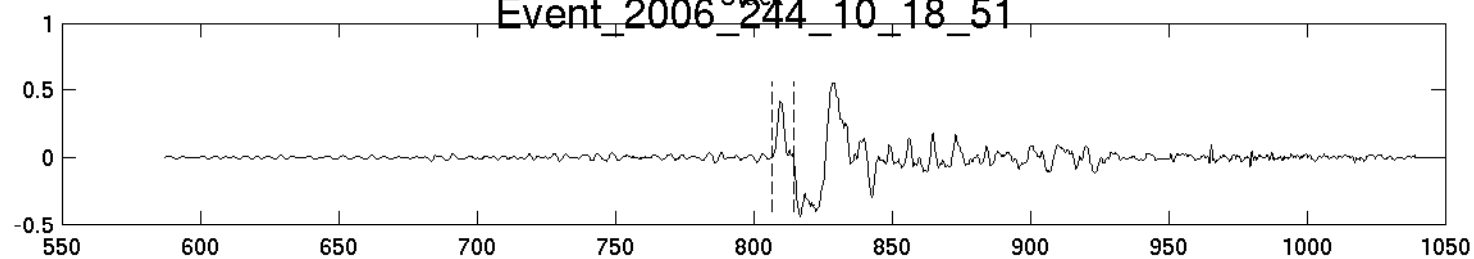


# Event\_2006\_244\_10\_18\_51

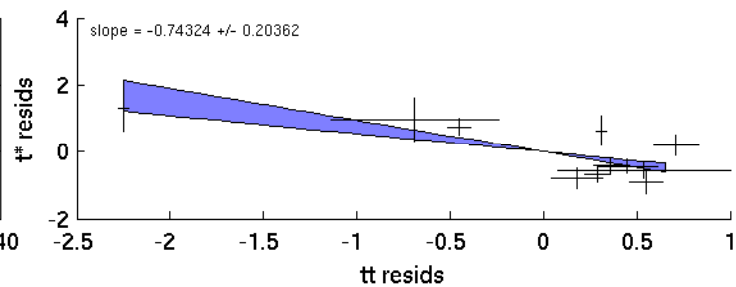
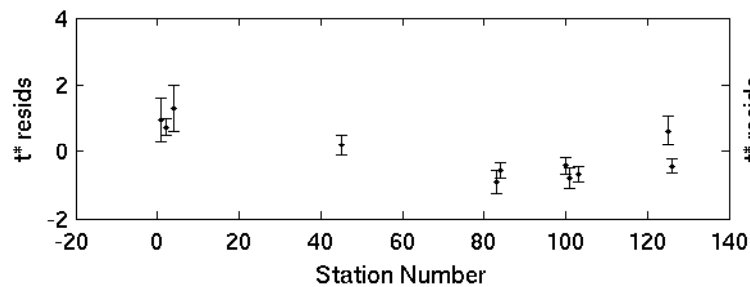




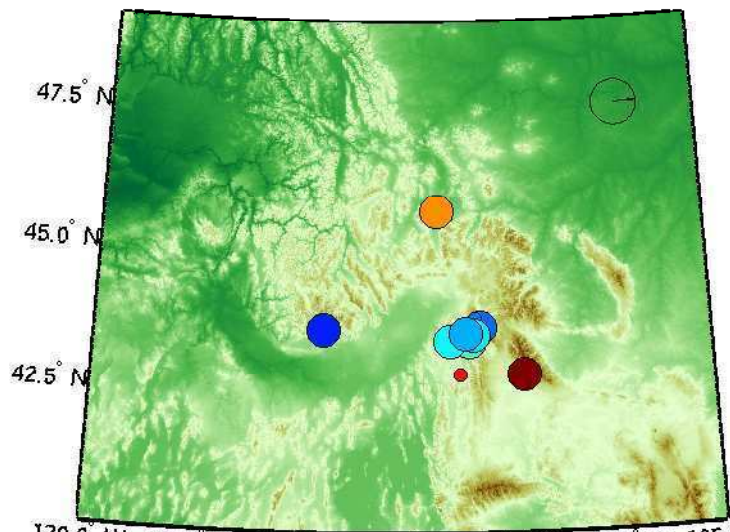
# Event\_2006\_244\_10\_18\_51



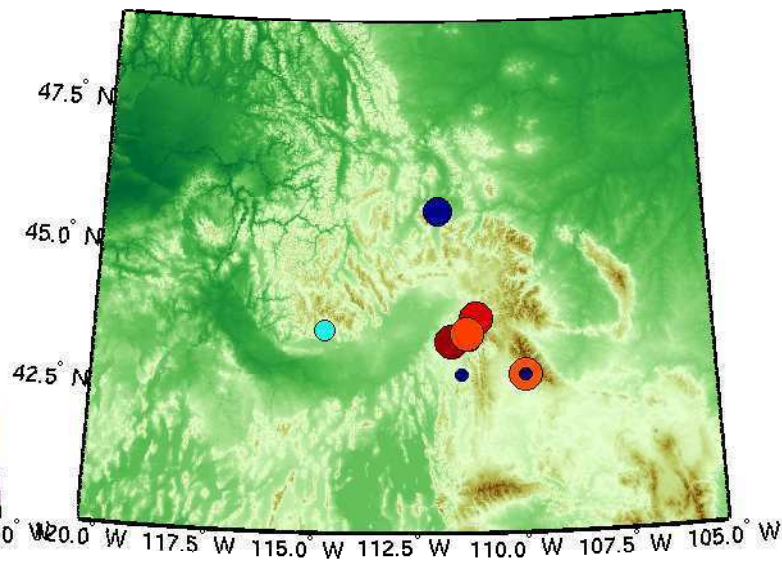
Baz = 267.3536  
 Mean xcor value = 0.73364  
 Range of  $t^*$  values is 2.2327  
 Median  $t^*$  err is 0.2927



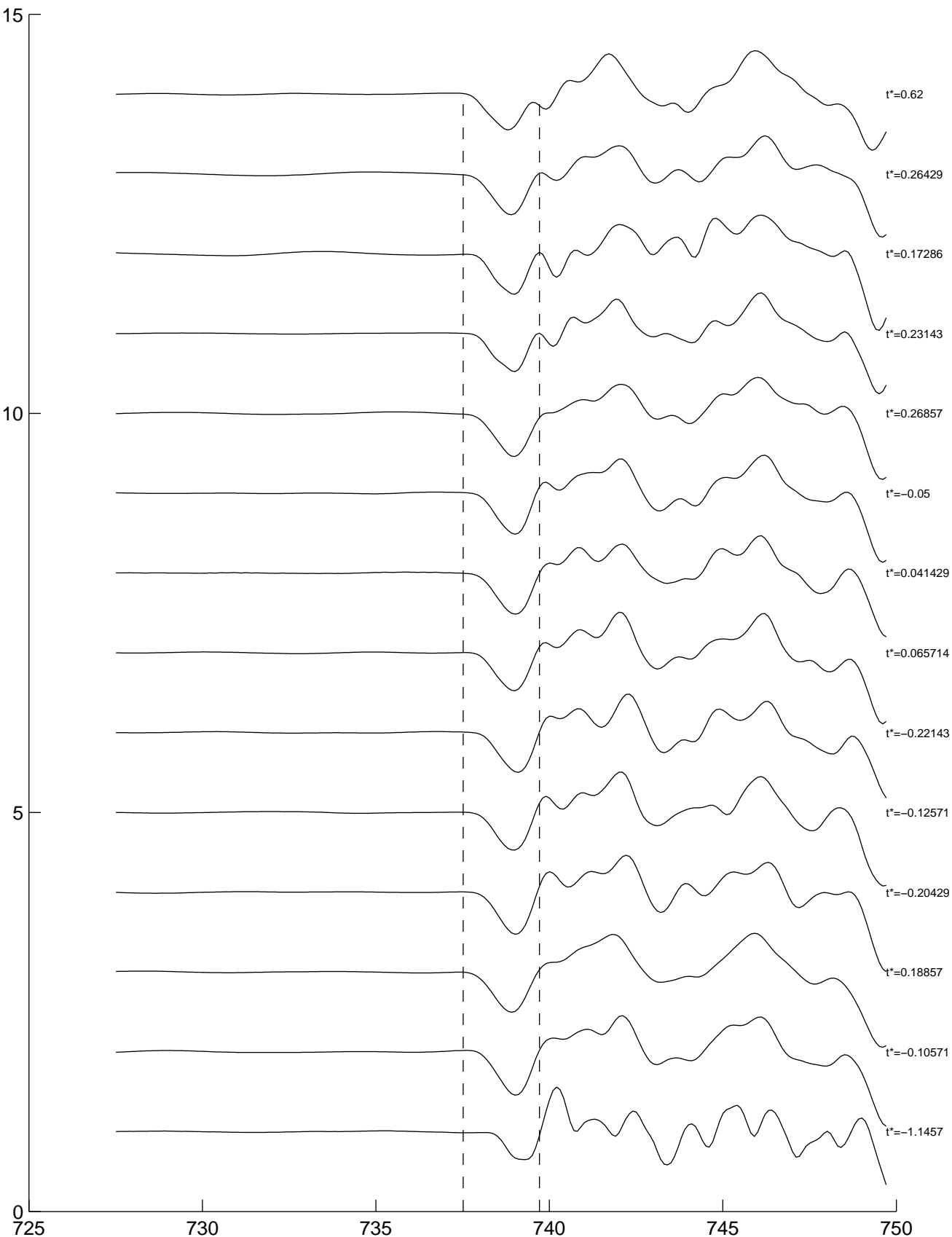
travel time residuals



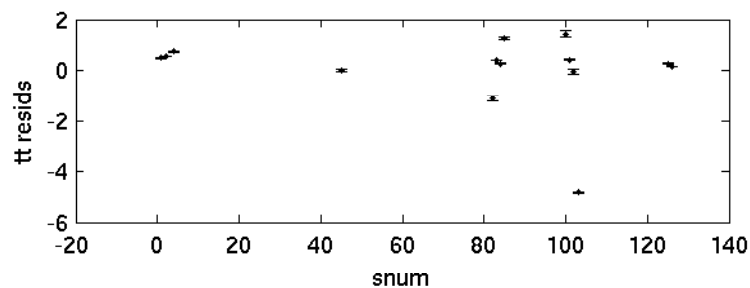
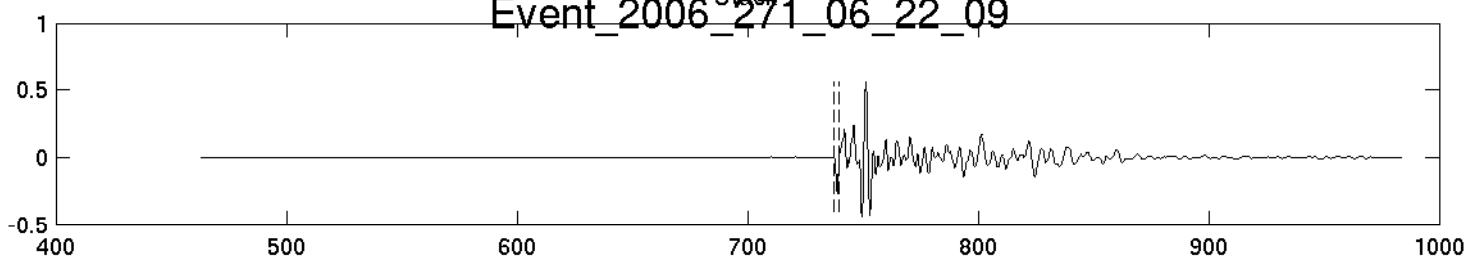
$t^*$  values



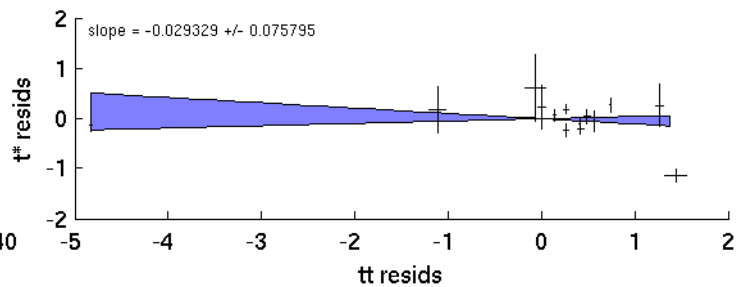
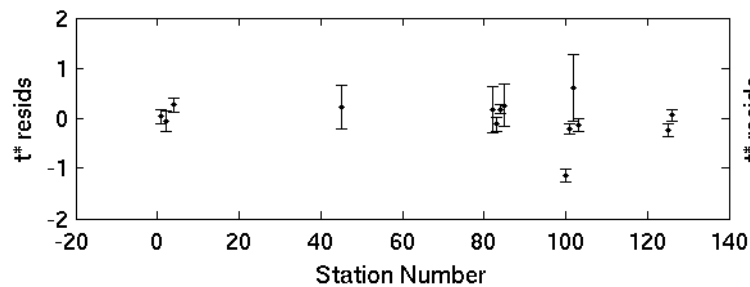
# Event\_2006\_271\_06\_22\_09



# Event\_2006\_271\_06\_22\_09

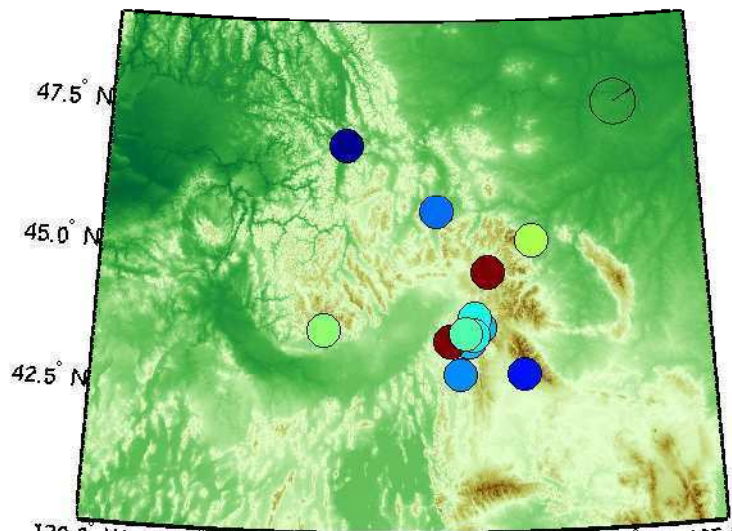


Baz = 237.7532  
Mean xcor value = 0.88071  
Range of  $t^*$  values is 1.7657  
Median  $t^*$  err is 0.14203

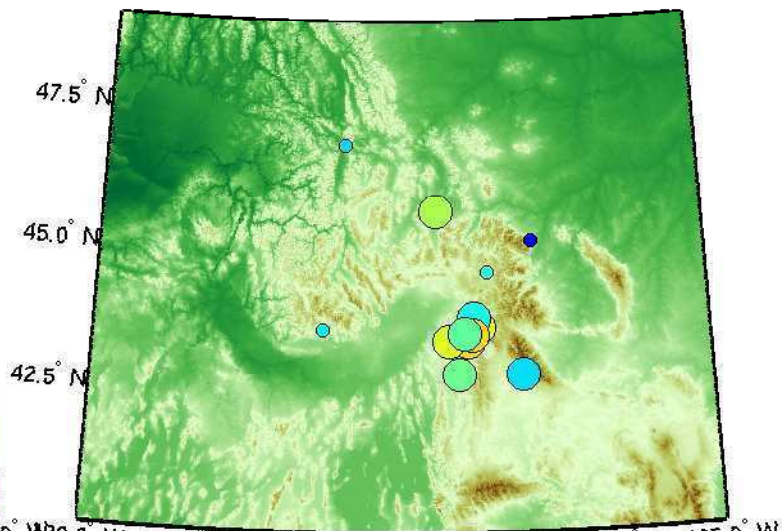


slope = -0.029329 +/- 0.075795

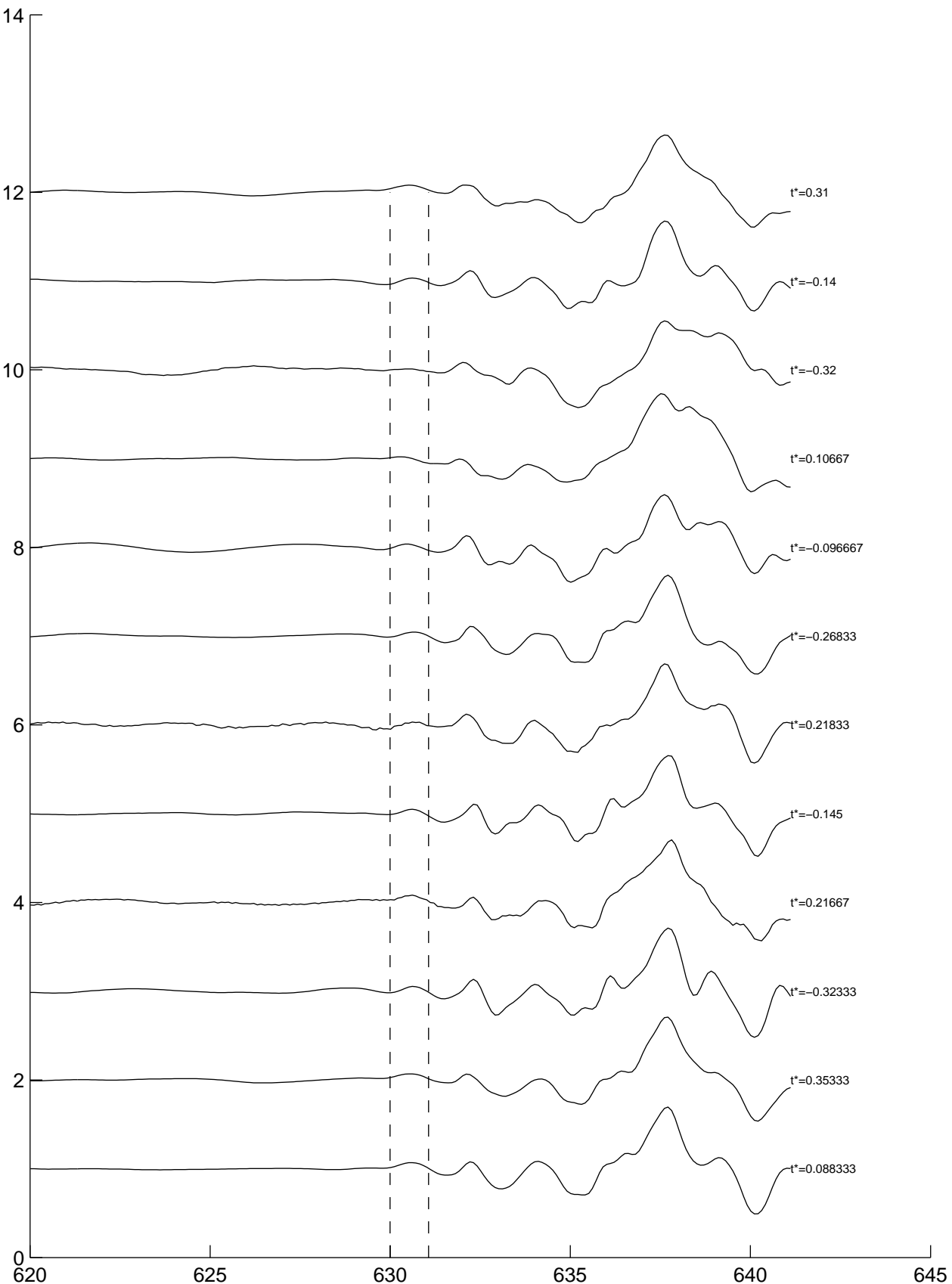
travel time residuals



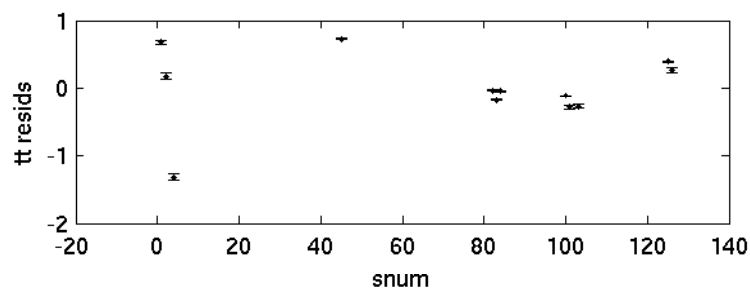
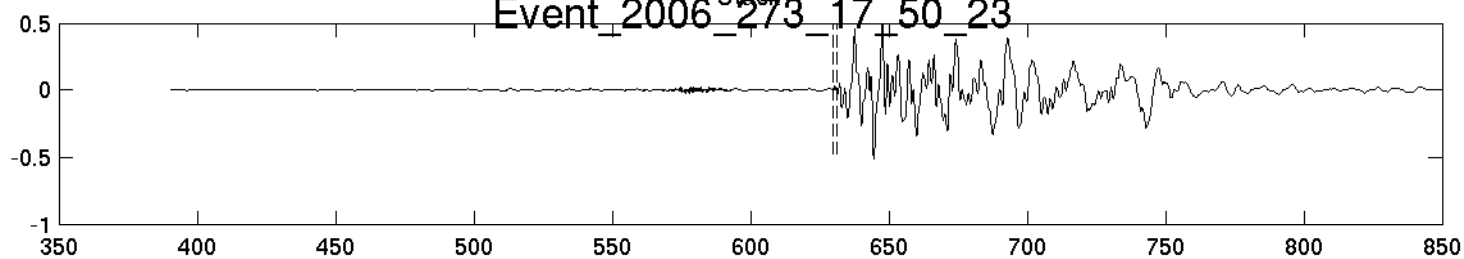
$t^*$  values



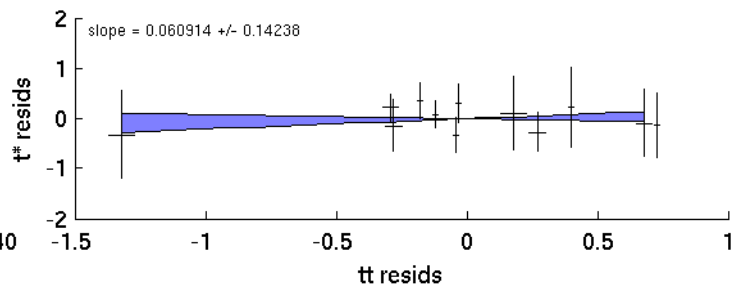
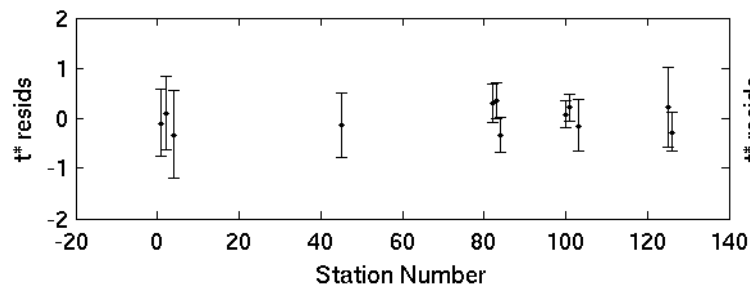
# Event\_2006\_273\_17\_50\_23



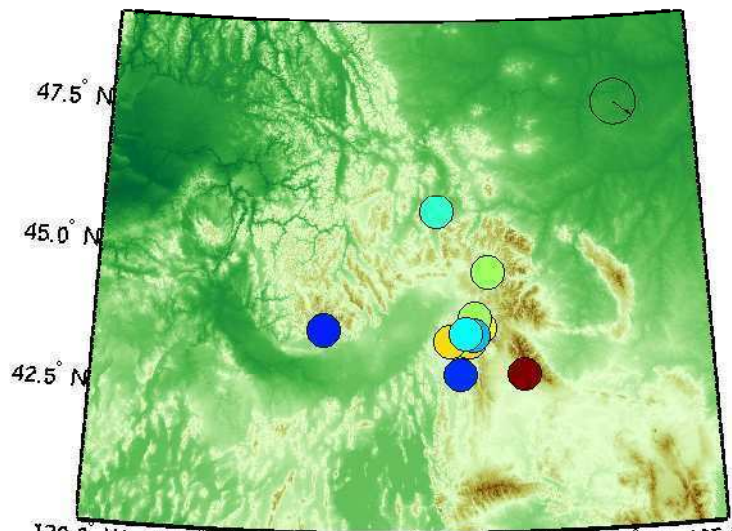
# Event\_2006\_273\_17\_50\_23



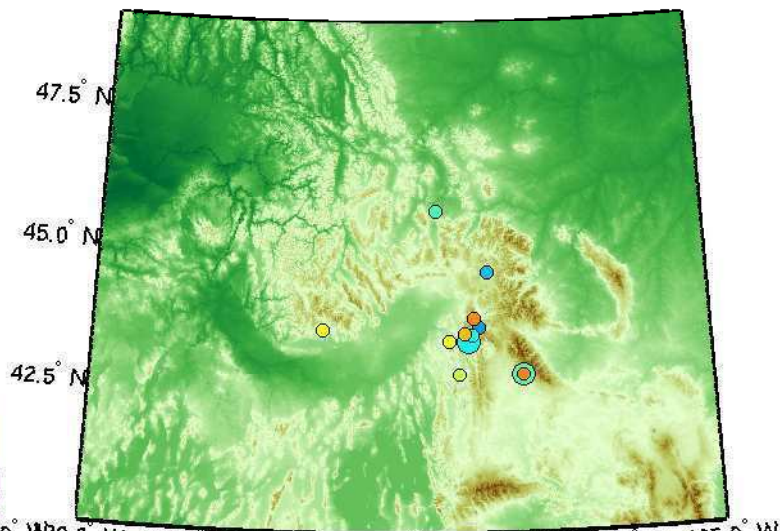
Baz = 309.6354  
Mean xcor value = 0.80583  
Range of  $t^*$  values is 0.67667  
Median  $t^*$  err is 0.45765



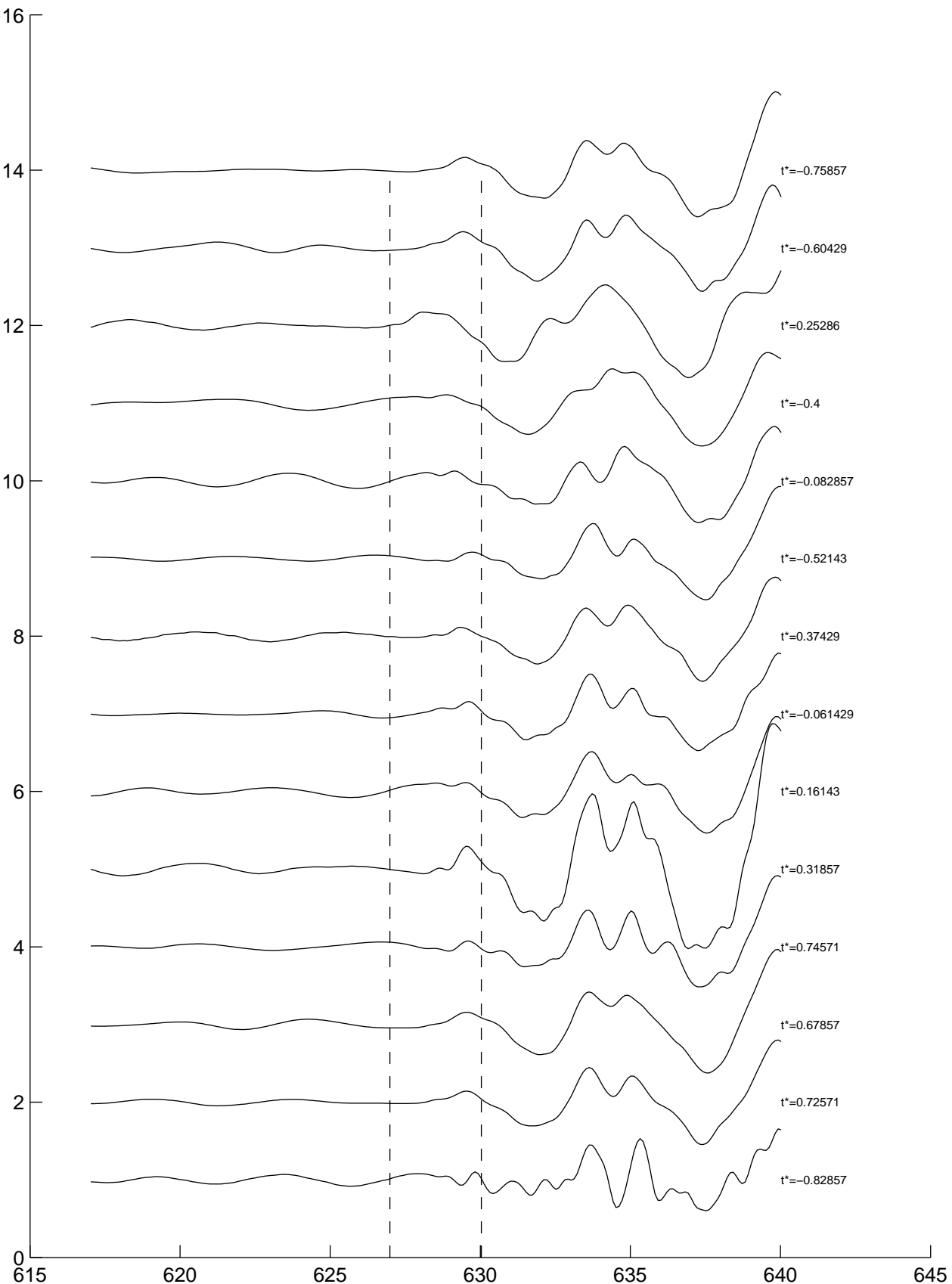
travel time residuals



$t^*$  values

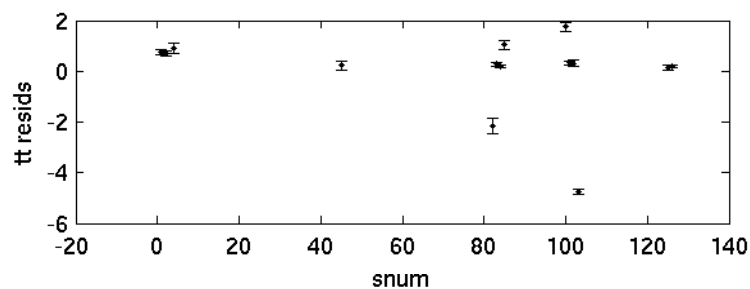
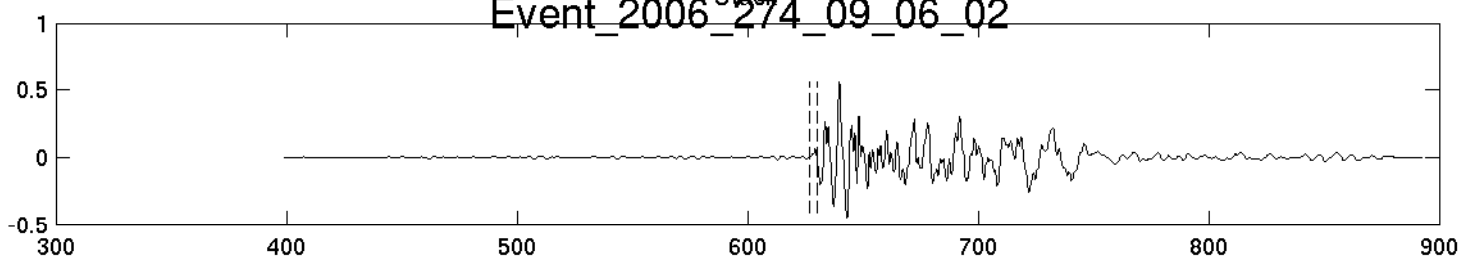


# Event\_2006\_274\_09\_06\_02

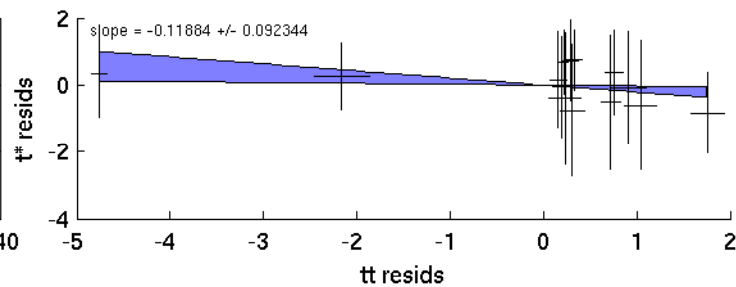
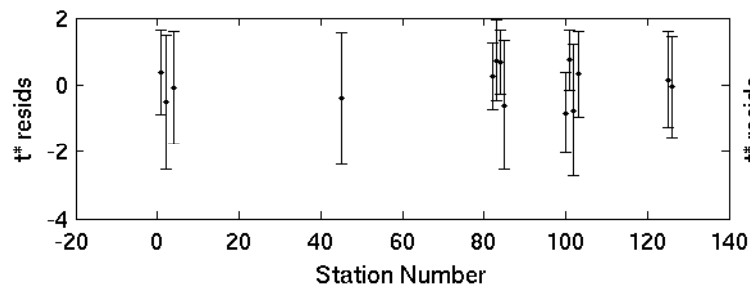




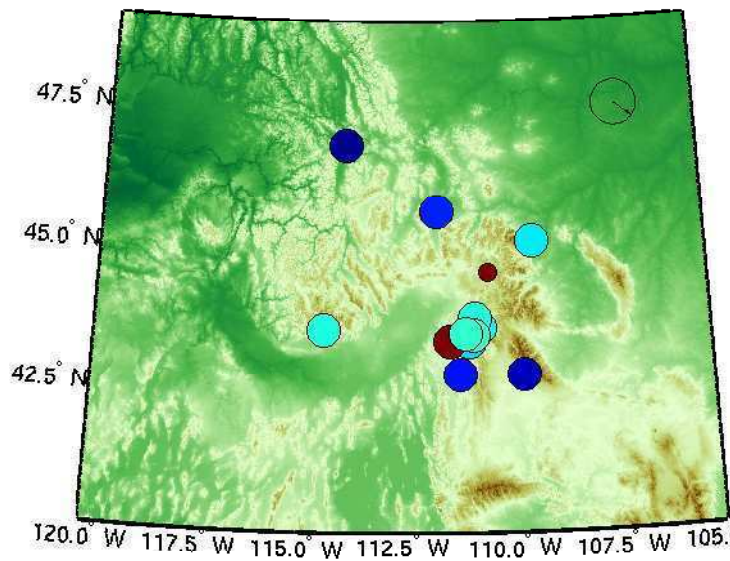
# Event\_2006\_274\_09\_06\_02



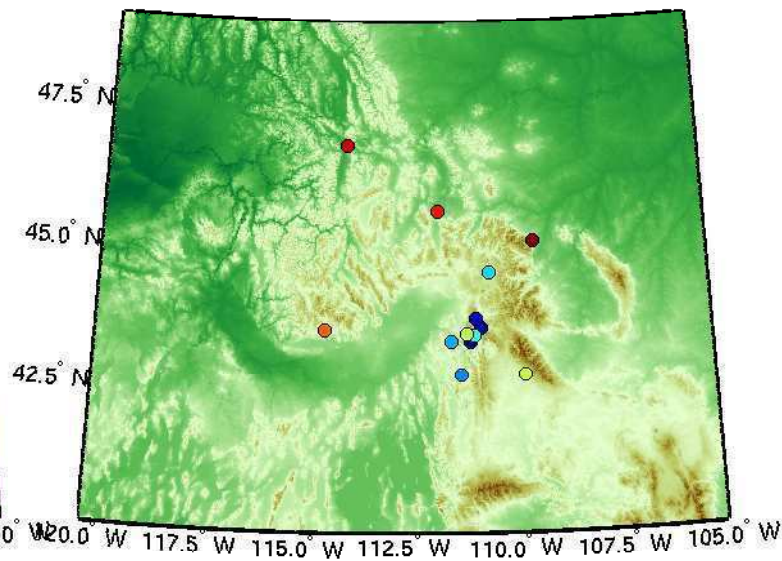
Baz = 309.7086  
Mean xcor value = 0.82214  
Range of  $t^*$  values is 1.5743  
Median  $t^*$  err is 1.3421



travel time residuals

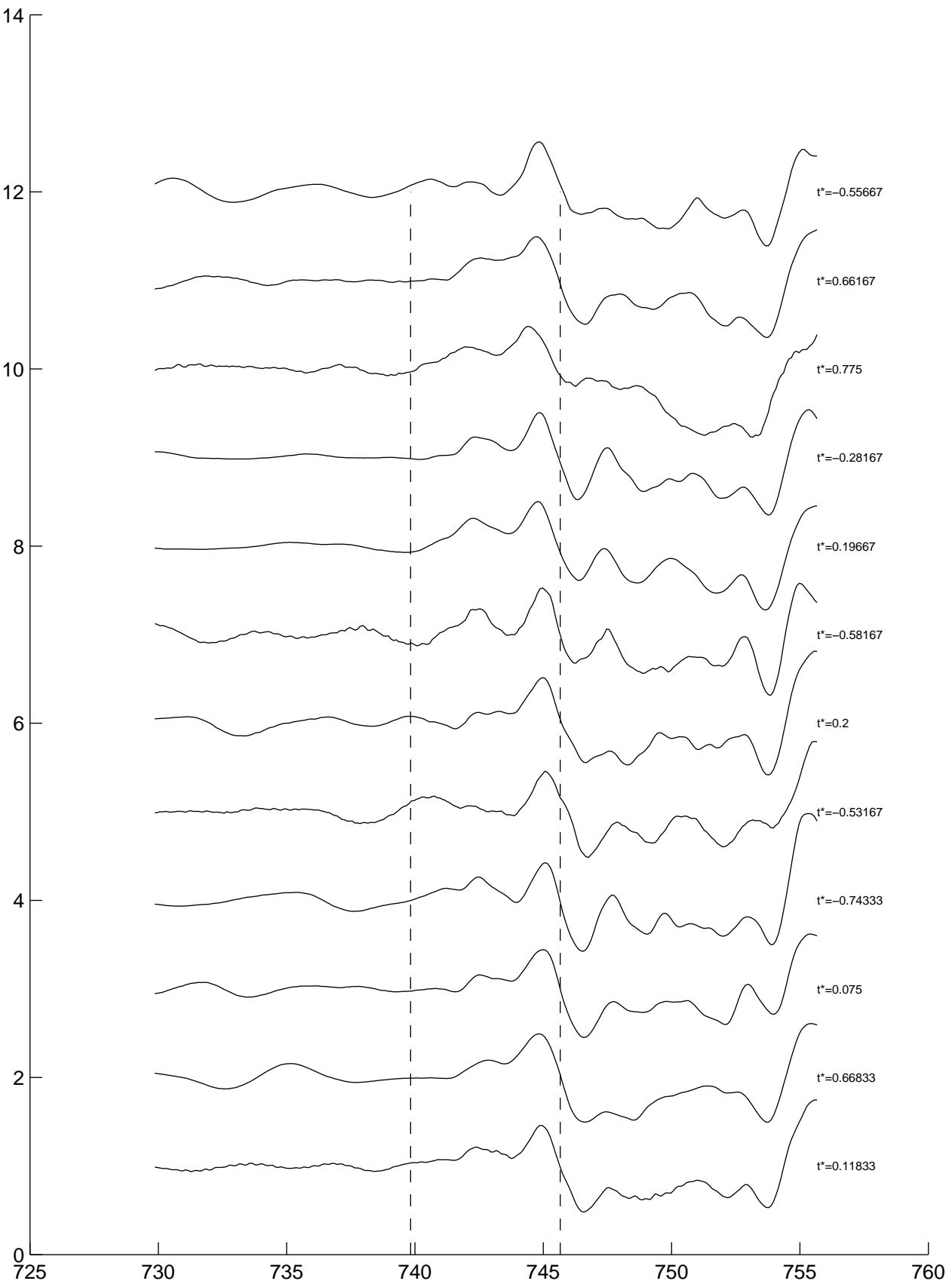


$t^*$  values

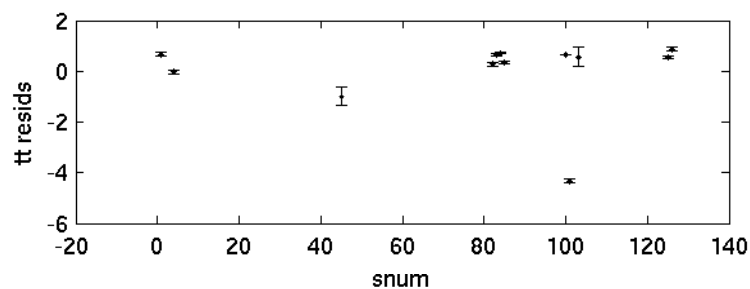
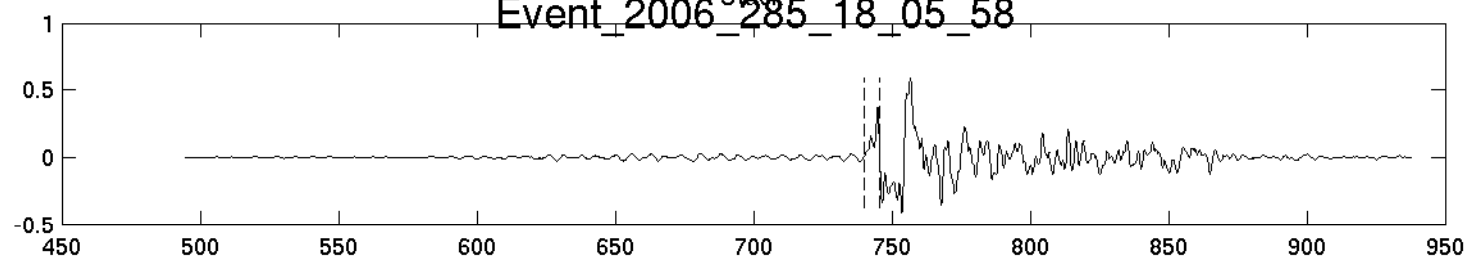




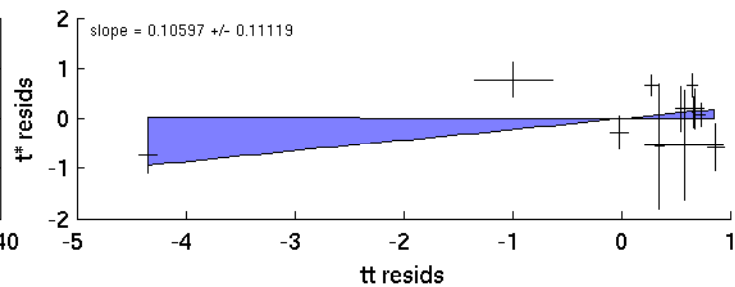
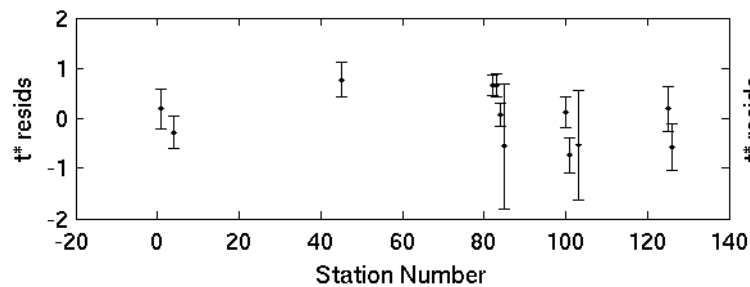
# Event\_2006\_285\_18\_05\_58



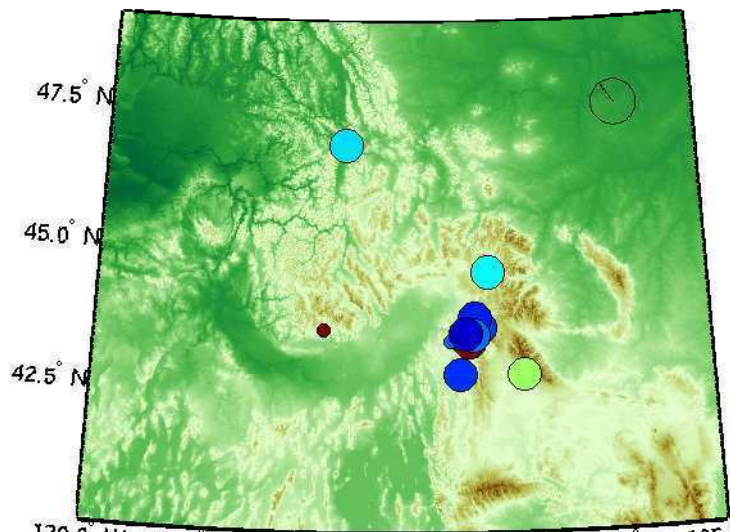
# Event\_2006\_285\_18\_05\_58



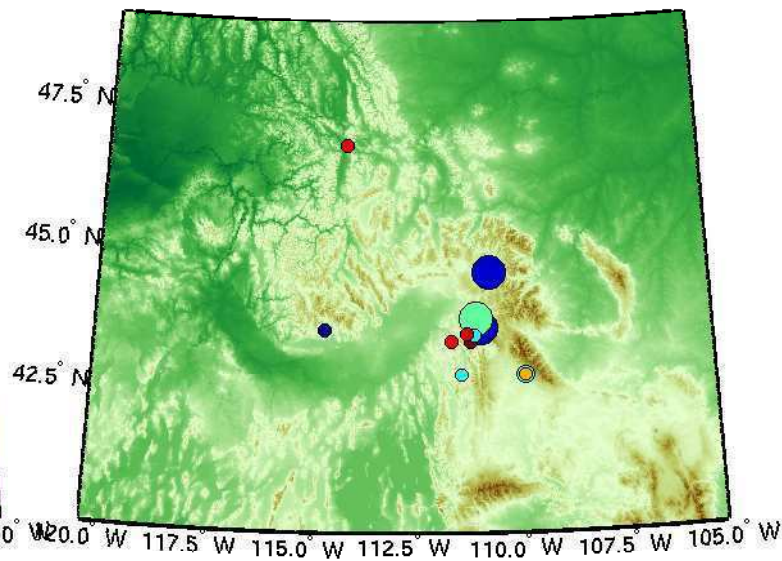
Baz = 146.6656  
Mean xcor value = 0.8275  
Range of  $t^*$  values is 1.5183  
Median  $t^*$  err is 0.35577



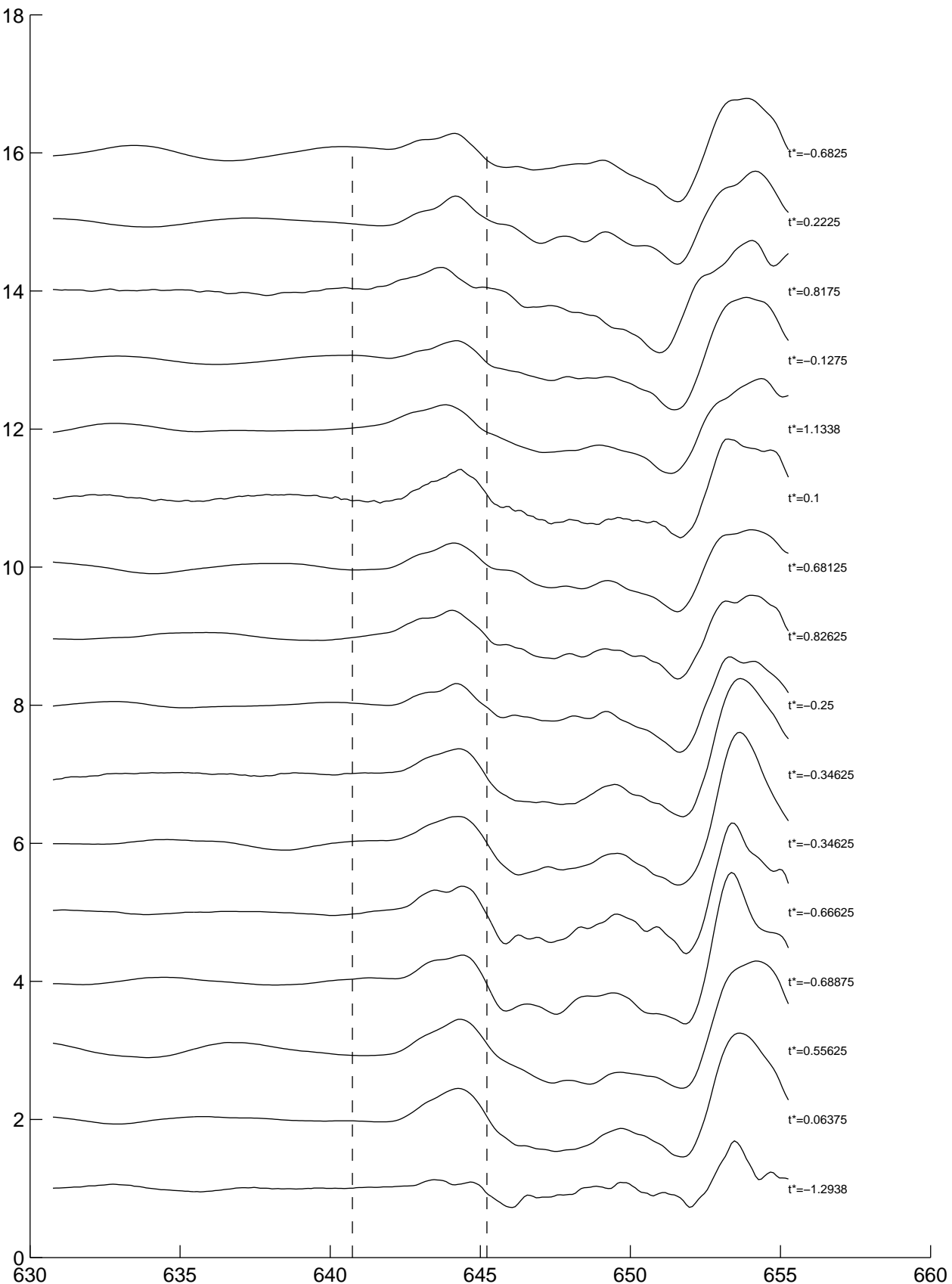
travel time residuals



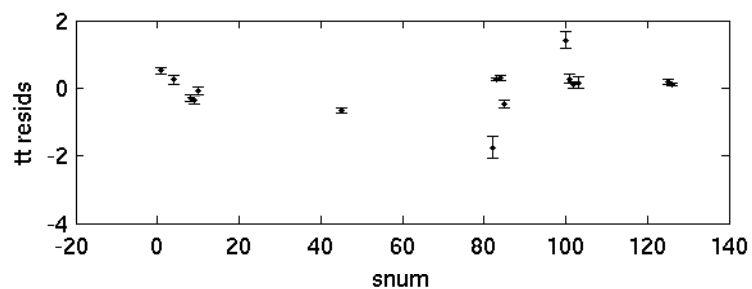
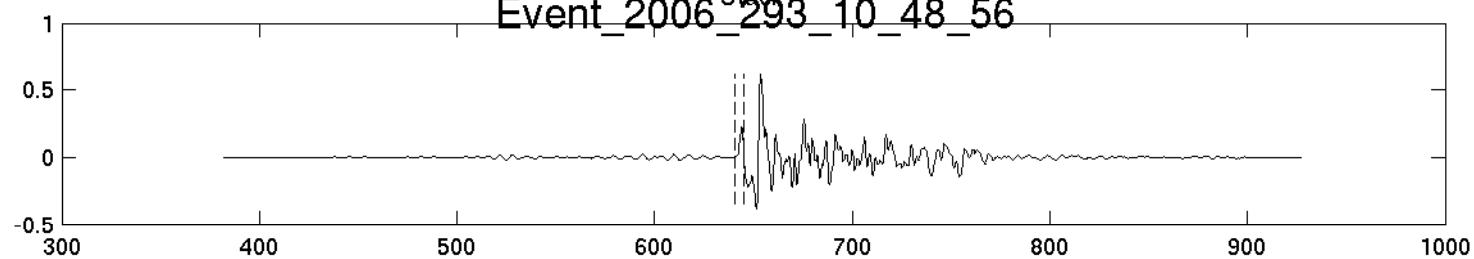
$t^*$  values



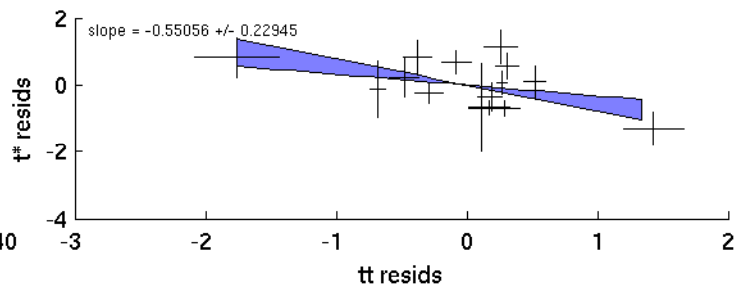
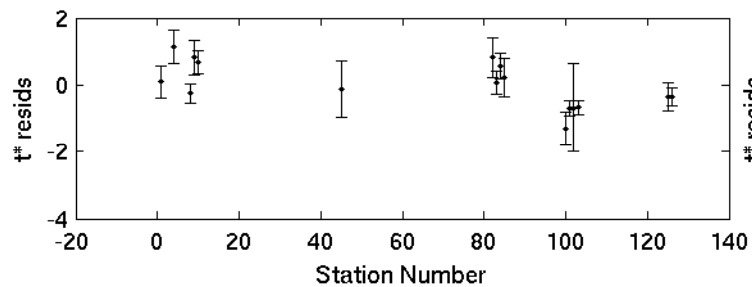
# Event\_2006\_293\_10\_48\_56



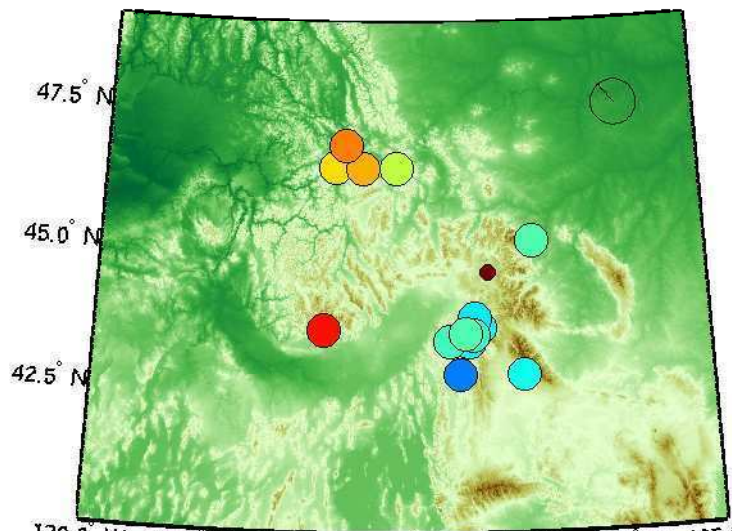
# Event\_2006\_293\_10\_48\_56



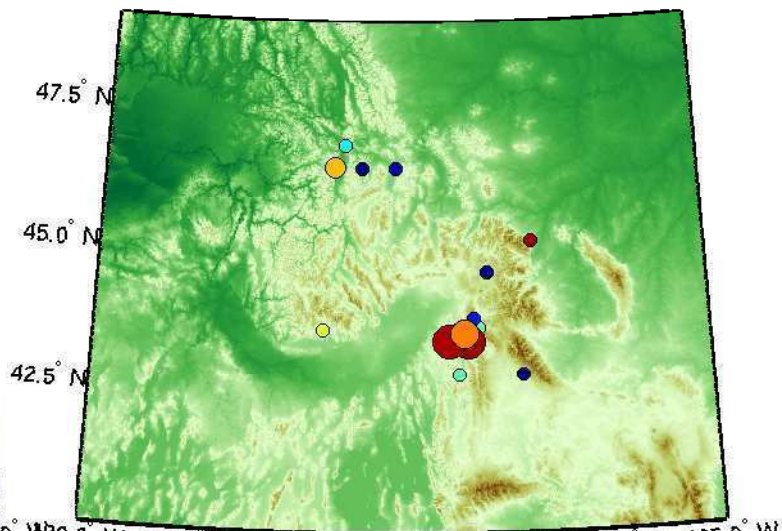
Baz = 142.5255  
 Mean xcor value = 0.86938  
 Range of  $t^*$  values is 2.4275  
 Median  $t^*$  err is 0.45622



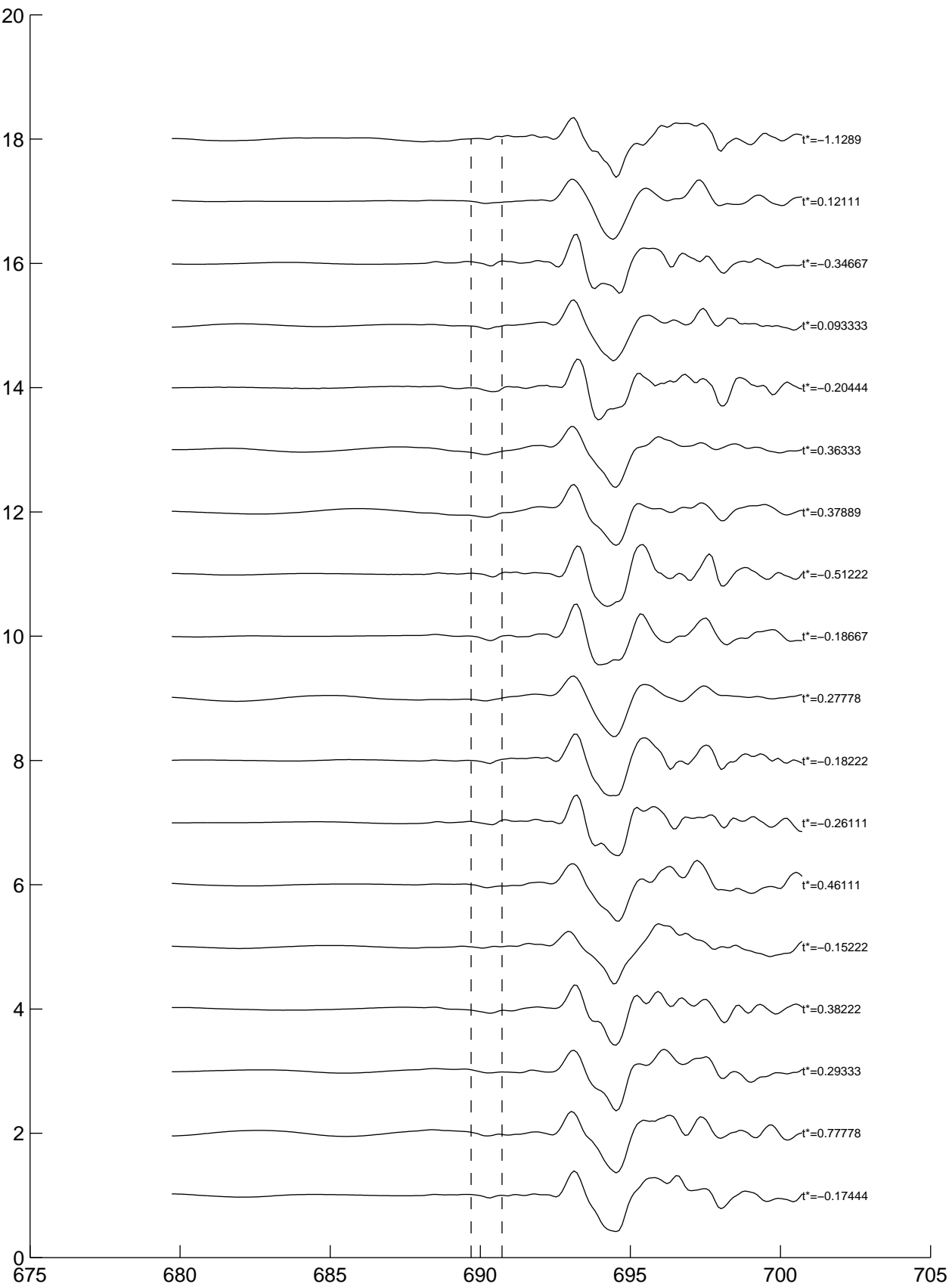
travel time residuals



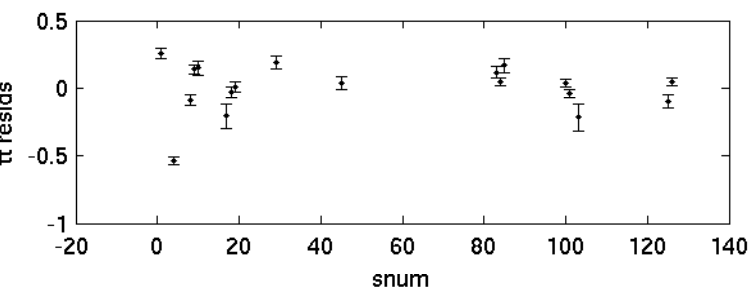
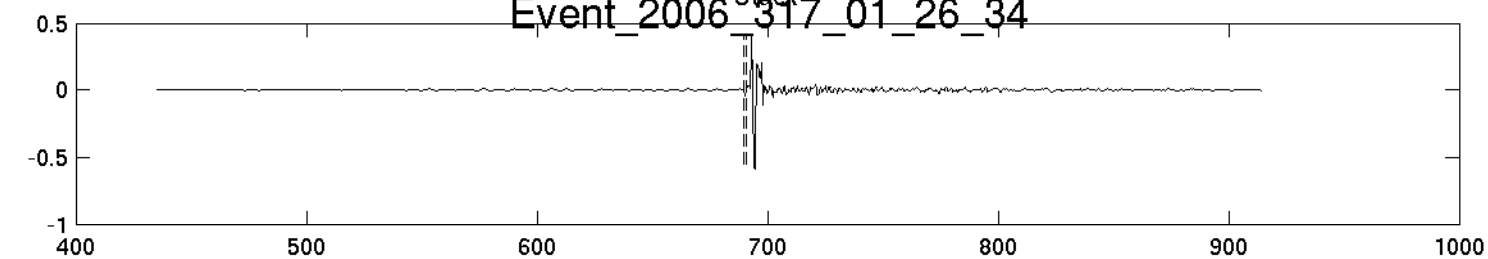
$t^*$  values



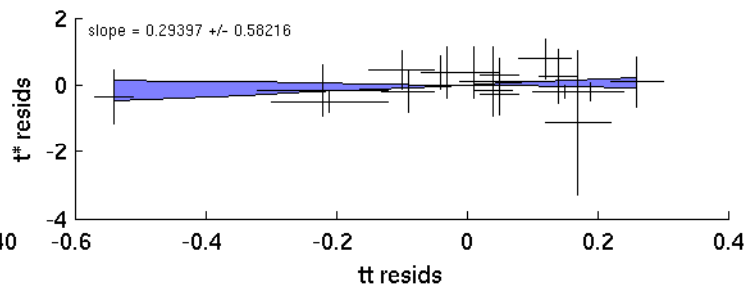
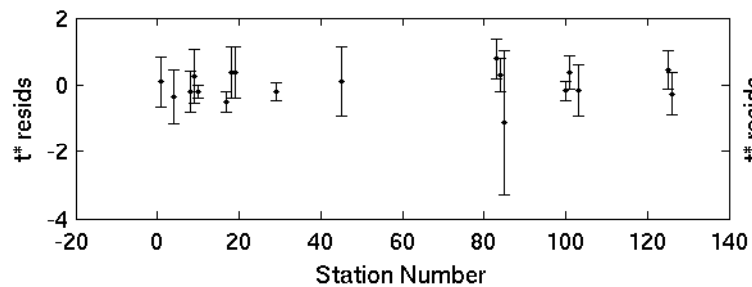
# Event\_2006\_317\_01\_26\_34



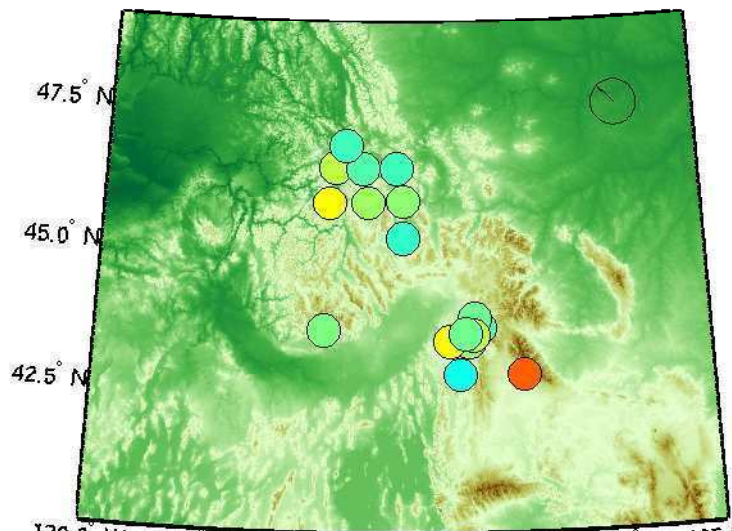
# Event\_2006\_317\_01\_26\_34



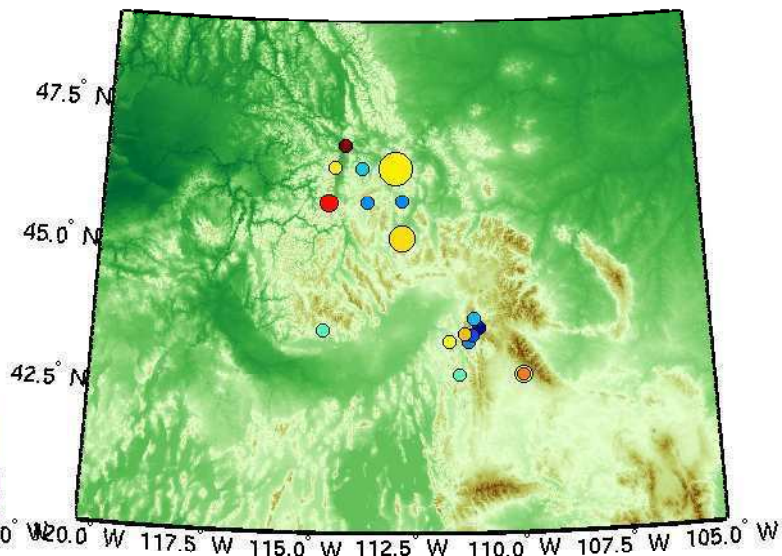
Baz = 137.2063  
 Mean xcor value = 0.77278  
 Range of  $t^*$  values is 1.9067  
 Median  $t^*$  err is 0.62286



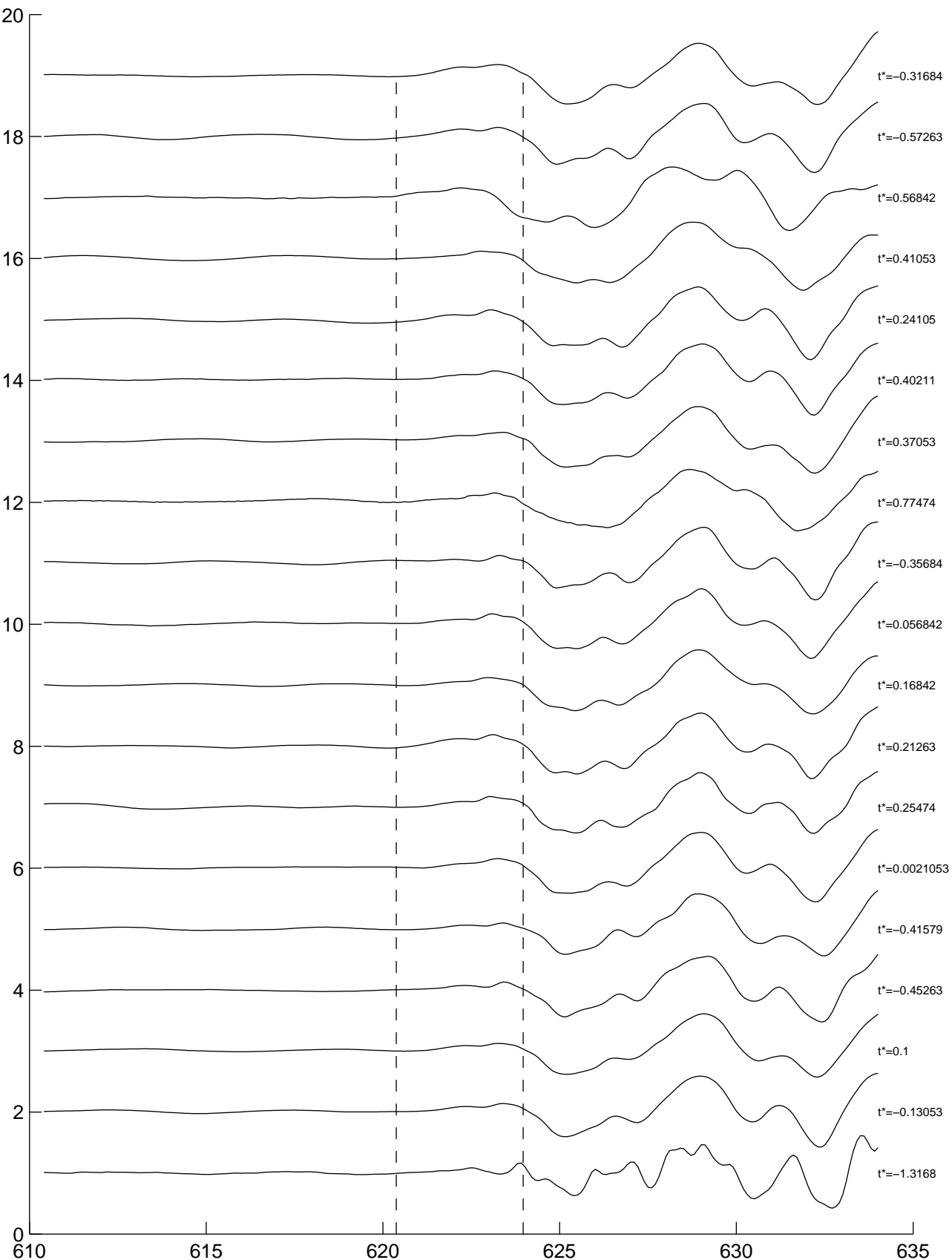
travel time residuals



$t^*$  values

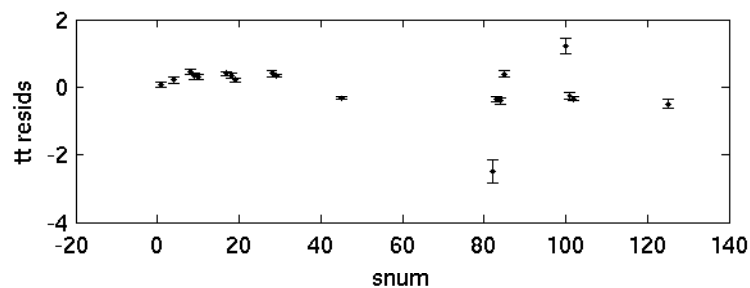
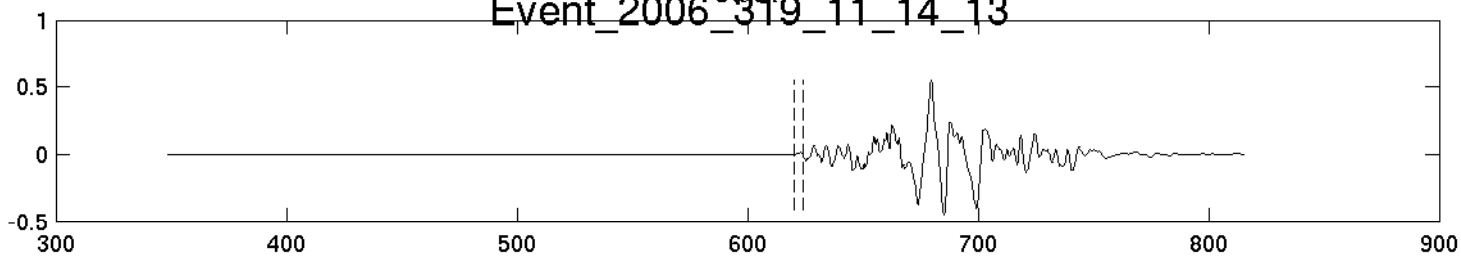


# Event\_2006\_319\_11\_14\_13

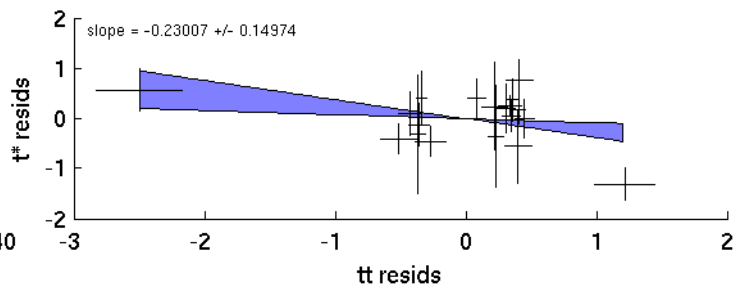
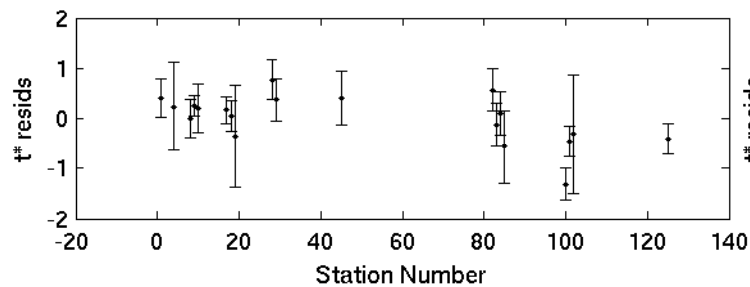




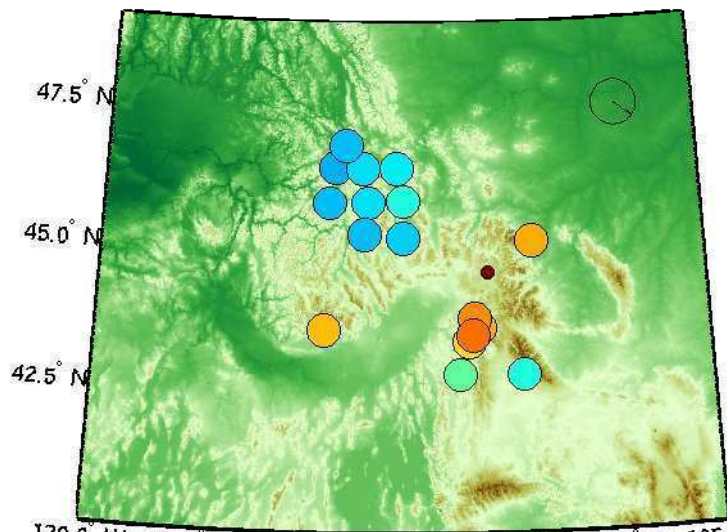
# Event\_2006\_319\_11\_14\_13



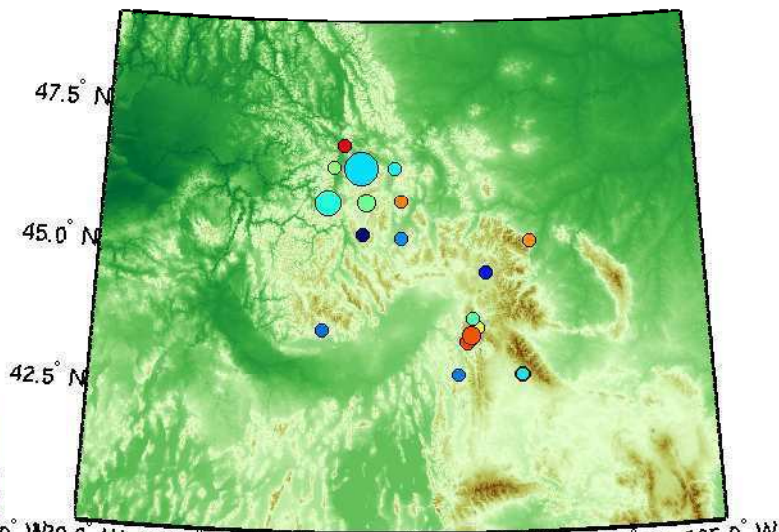
Baz = 309.0575  
Mean xcor value = 0.90105  
Range of  $t^*$  values is 2.0916  
Median  $t^*$  err is 0.41601



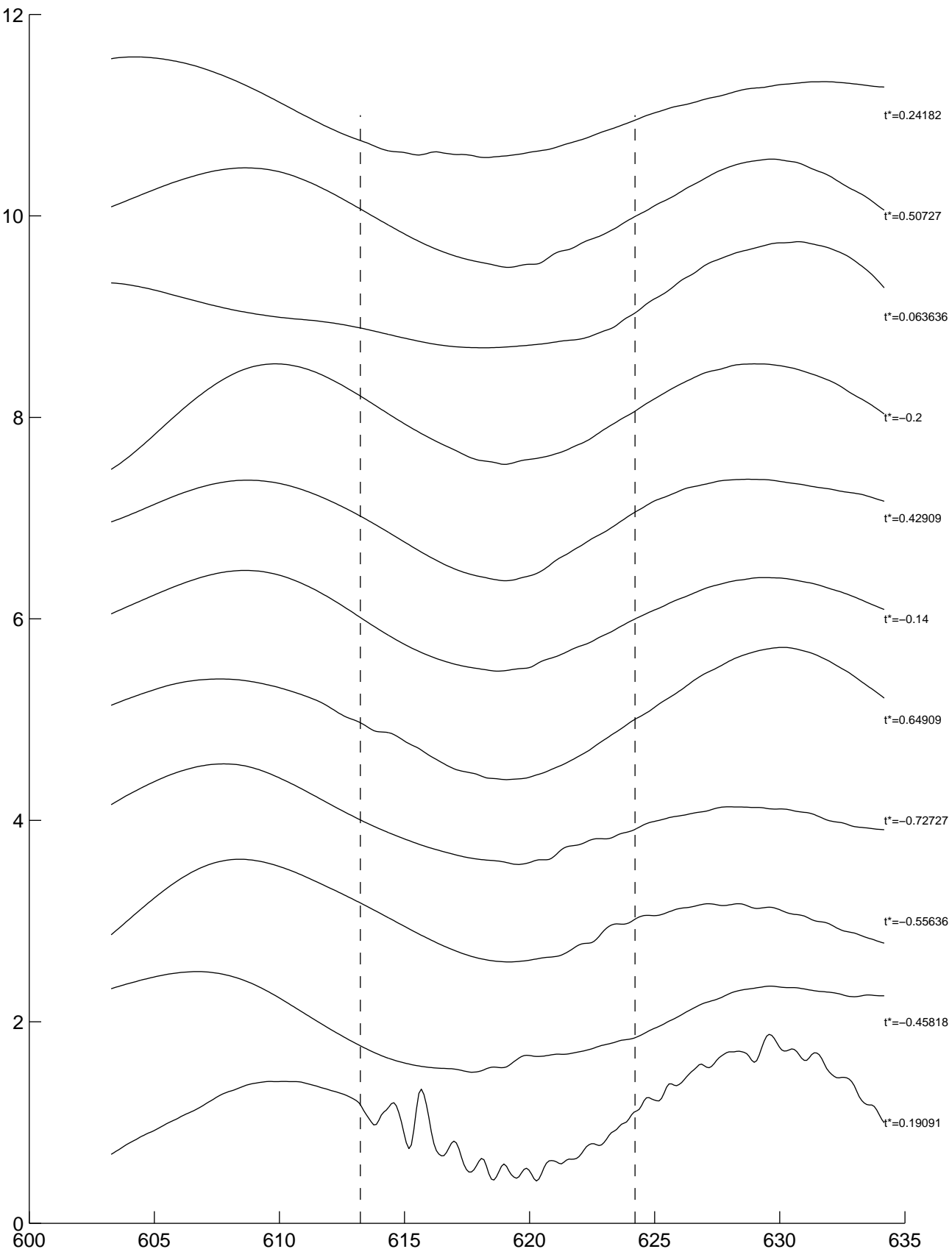
travel time residuals



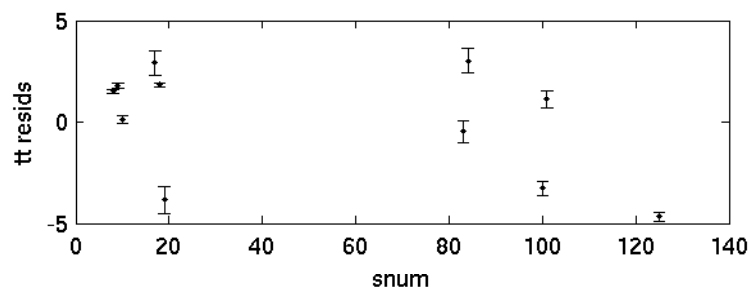
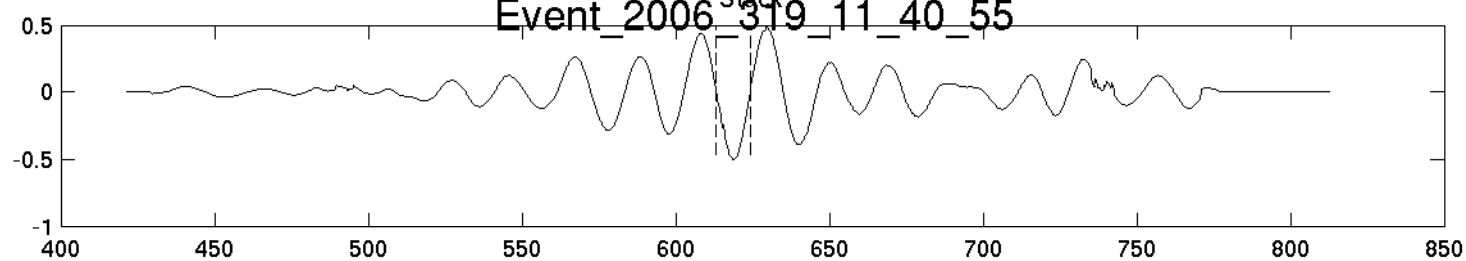
$t^*$  values



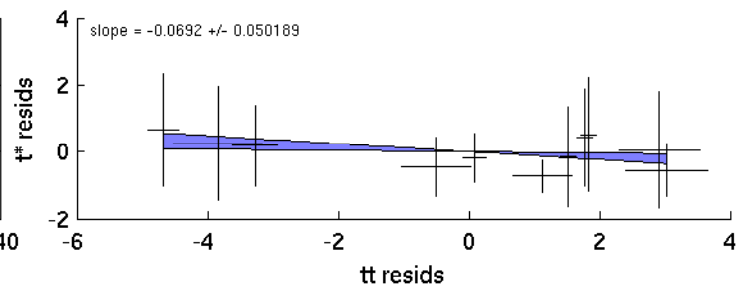
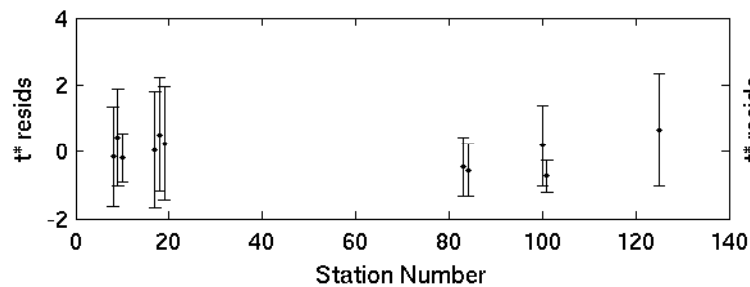
# Event\_2006\_319\_11\_40\_55



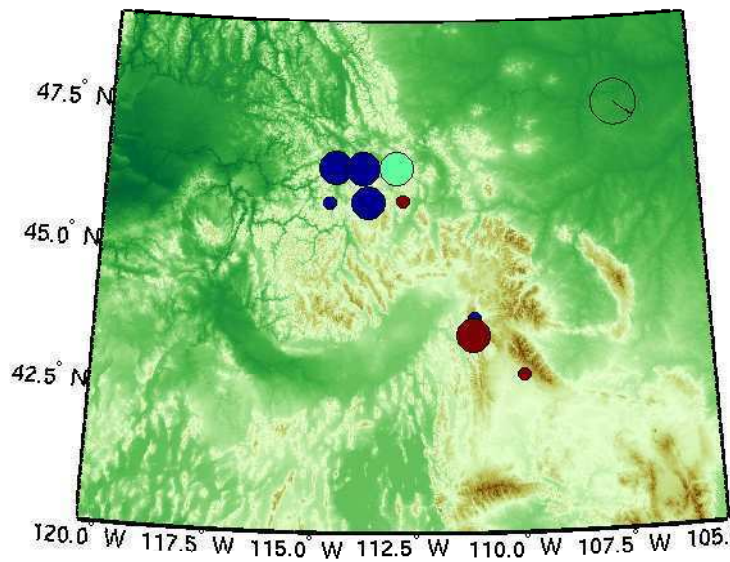
# Event\_2006\_319\_11\_40\_55



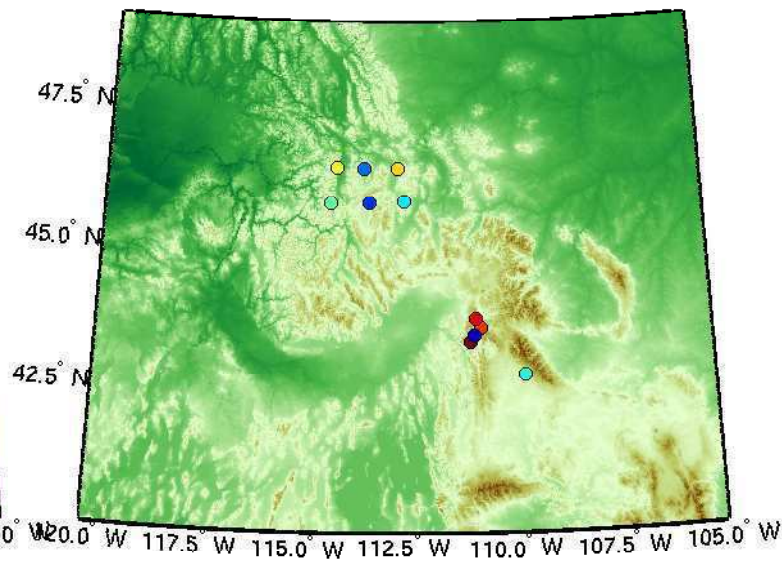
Baz = 308.2808  
 Mean xcor value = 0.67182  
 Range of  $t^*$  values is 1.3764  
 Median  $t^*$  err is 1.4576



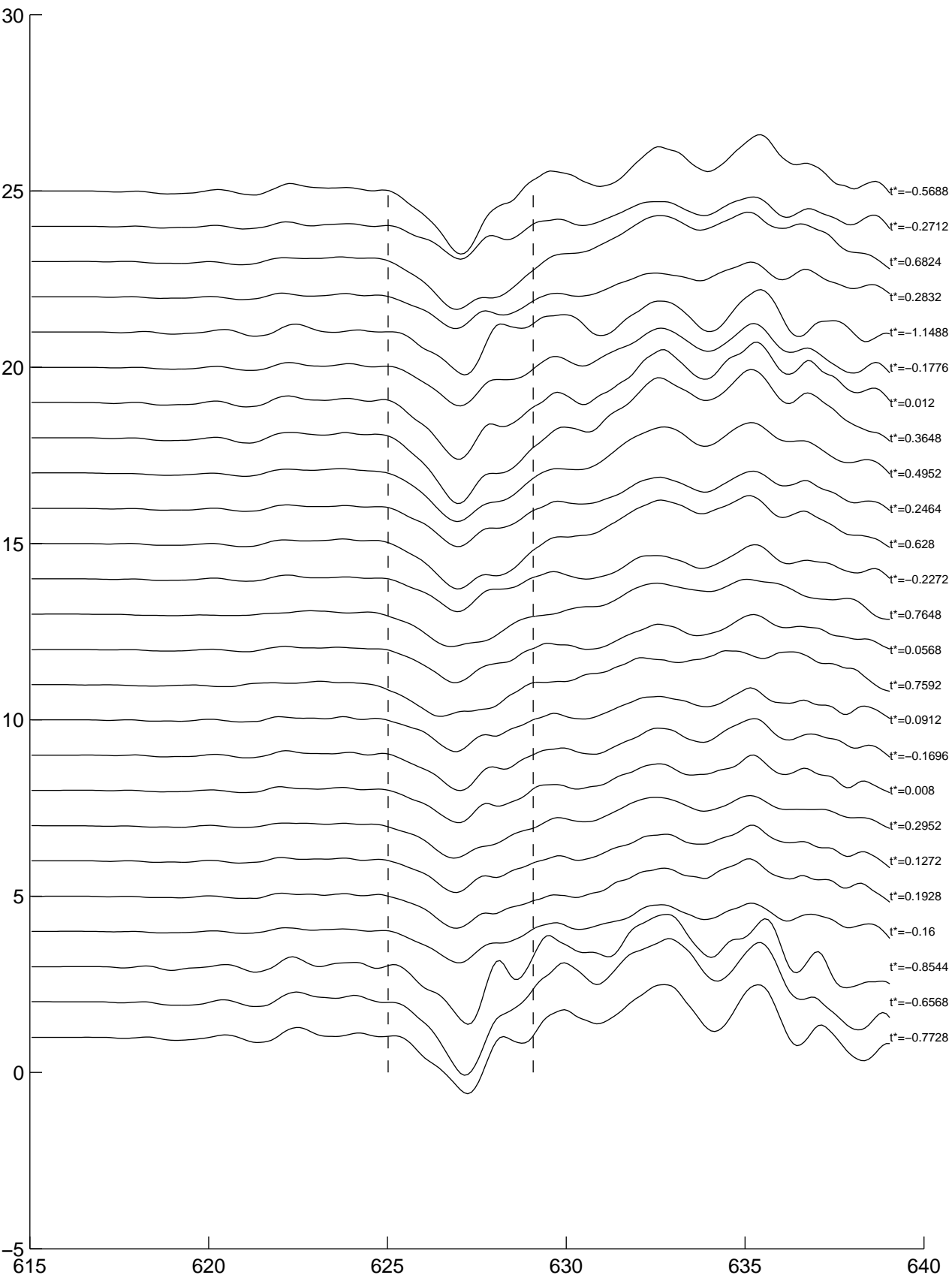
travel time residuals



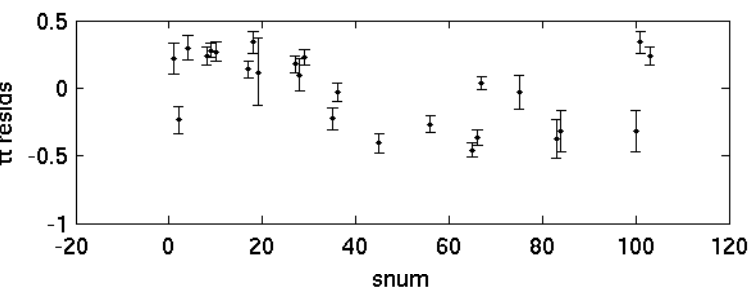
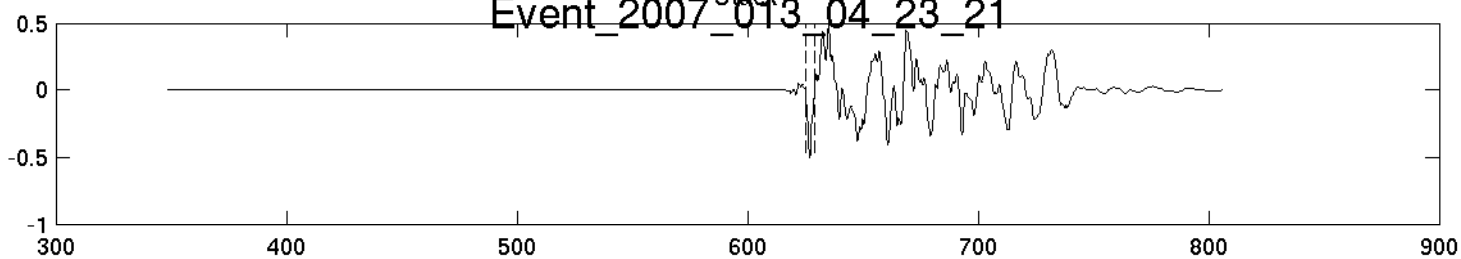
$t^*$  values



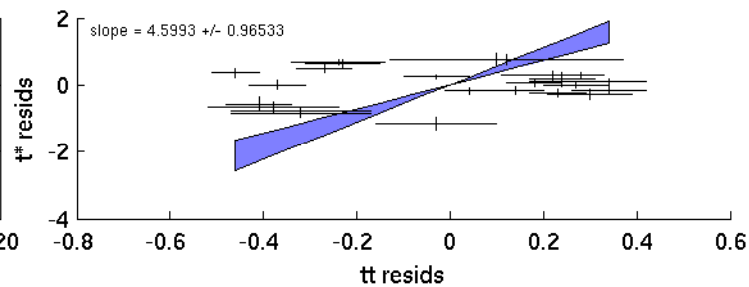
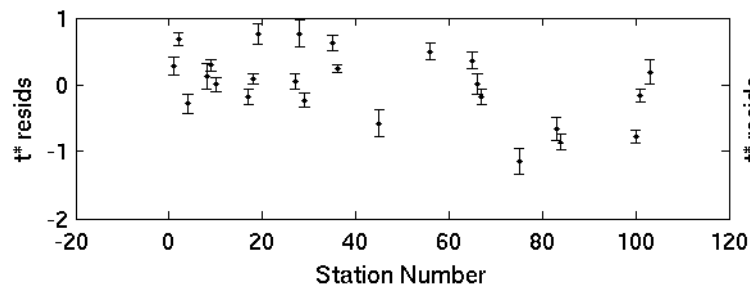
# Event\_2007\_013\_04\_23\_21



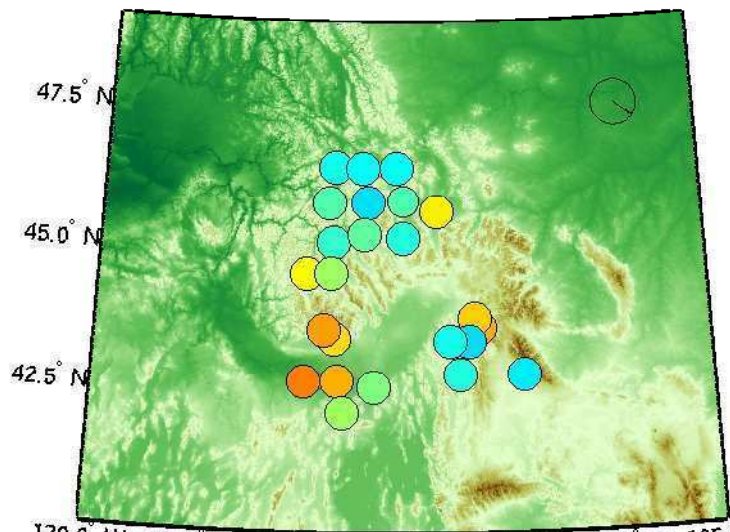
Event\_2007\_013\_04\_23\_21



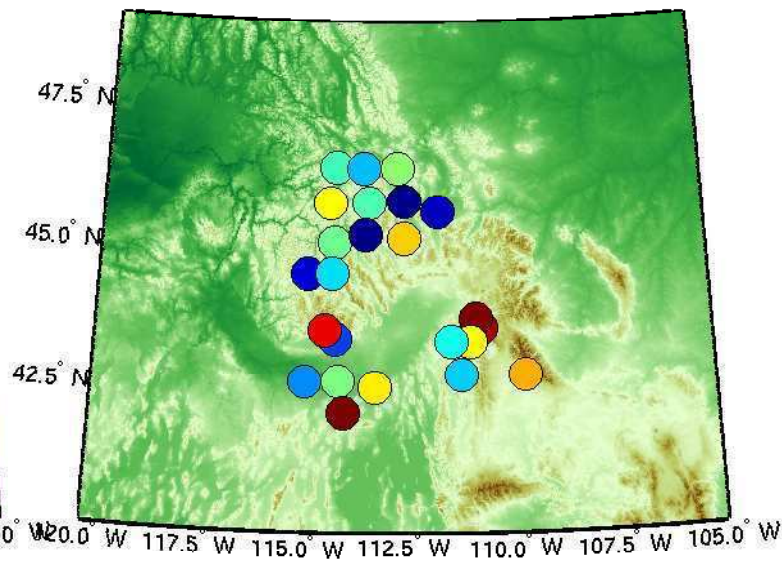
Baz = 307.9791  
Mean xcor value = 0.9124  
Range of  $t^*$  values is 1.9136  
Median  $t^*$  err is 0.11852



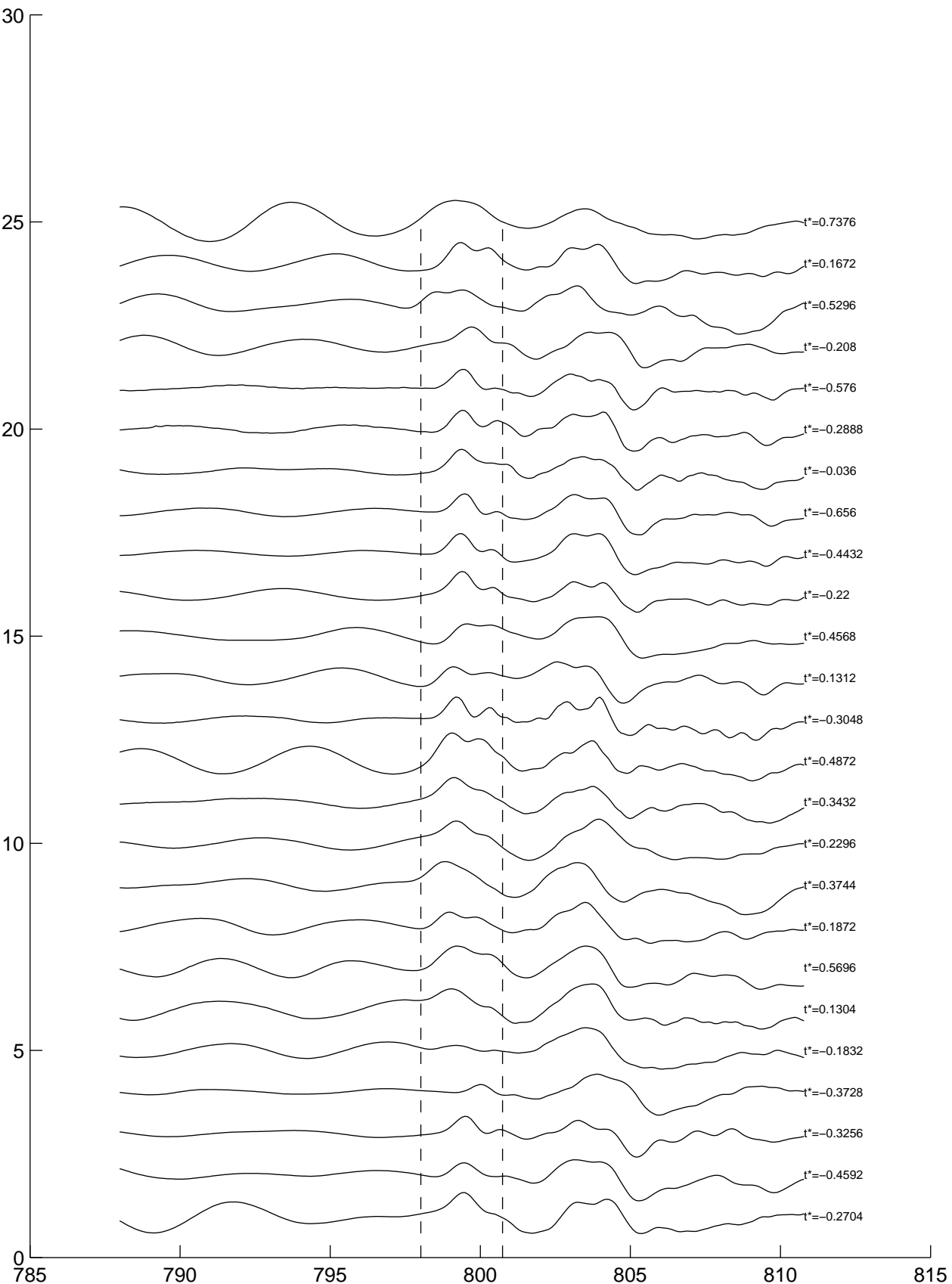
travel time residuals



$t^*$  values

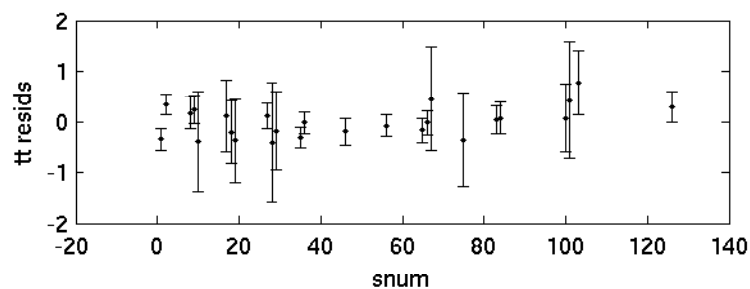
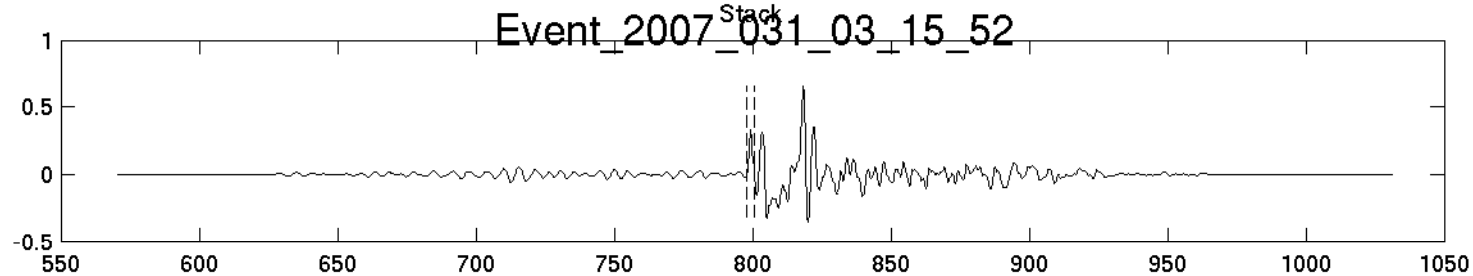


# Event\_2007\_031\_03\_15\_52

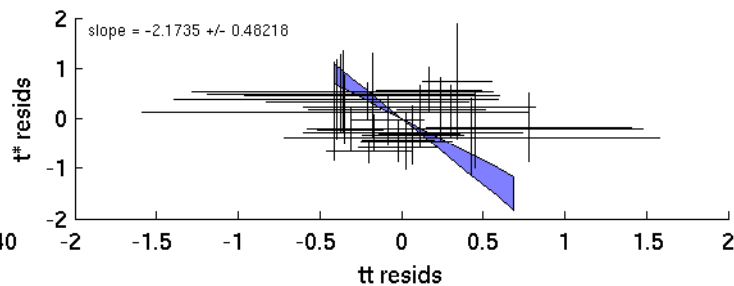
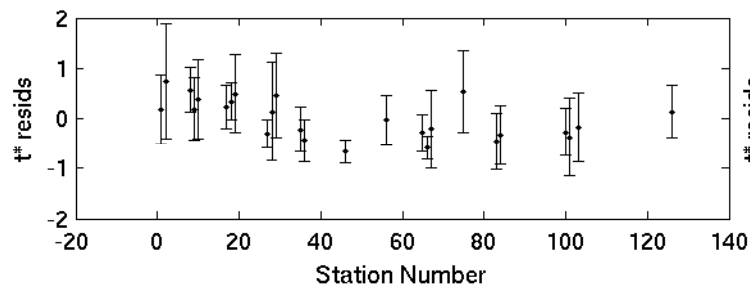




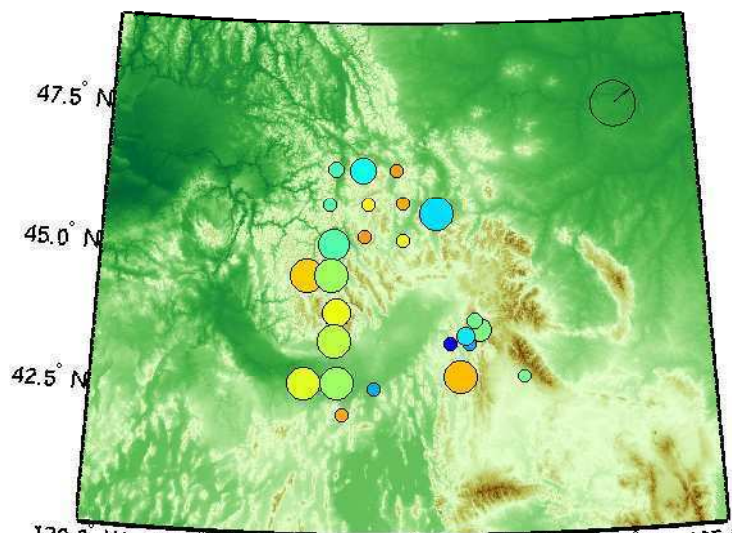
# Event\_2007\_03\_15\_52



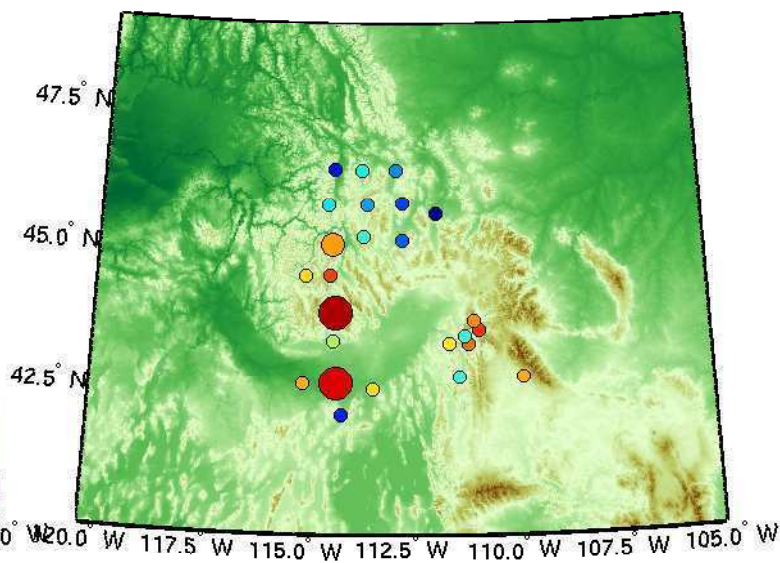
Baz = 232.3895  
 Mean xcor value = 0.6664  
 Range of  $t^*$  values is 1.3936  
 Median  $t^*$  err is 0.54929



travel time residuals

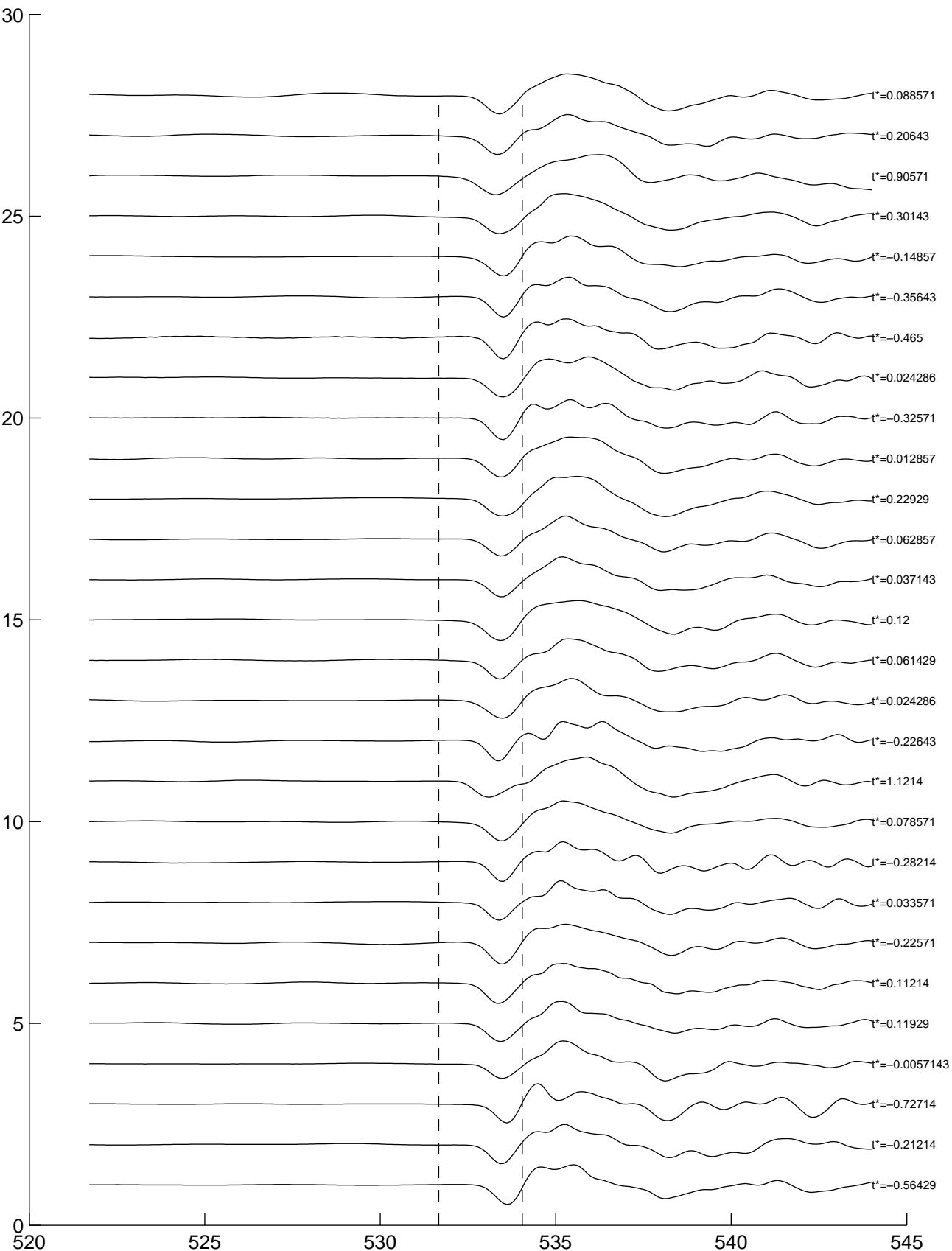


$t^*$  values

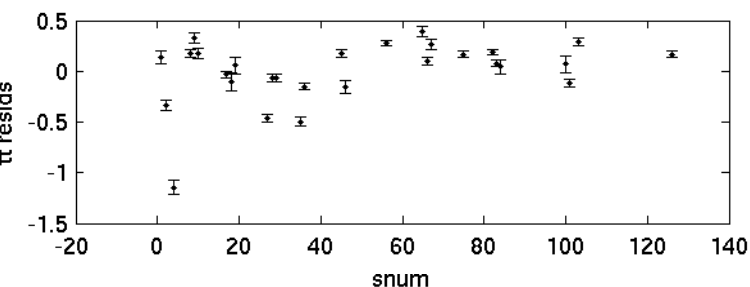
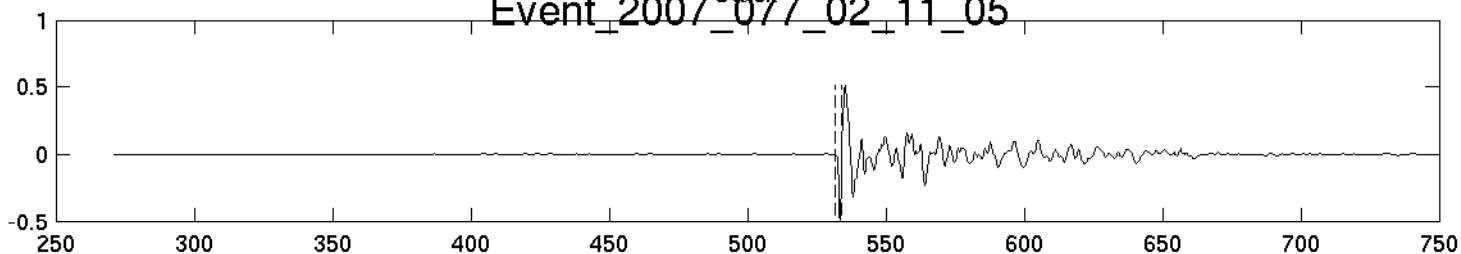




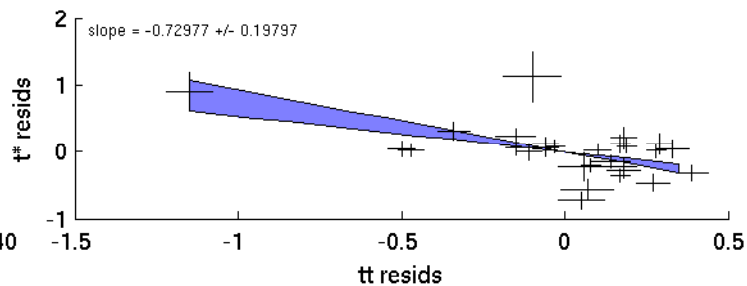
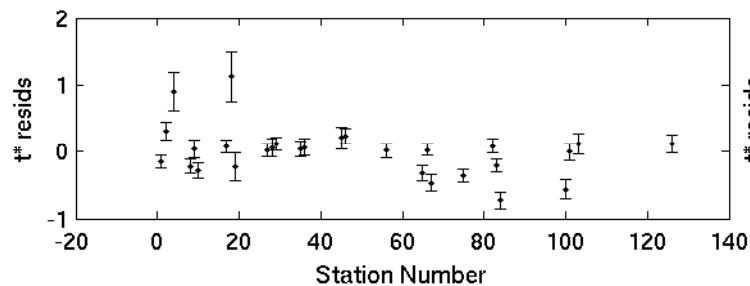
# Event\_2007\_077\_02\_11\_05



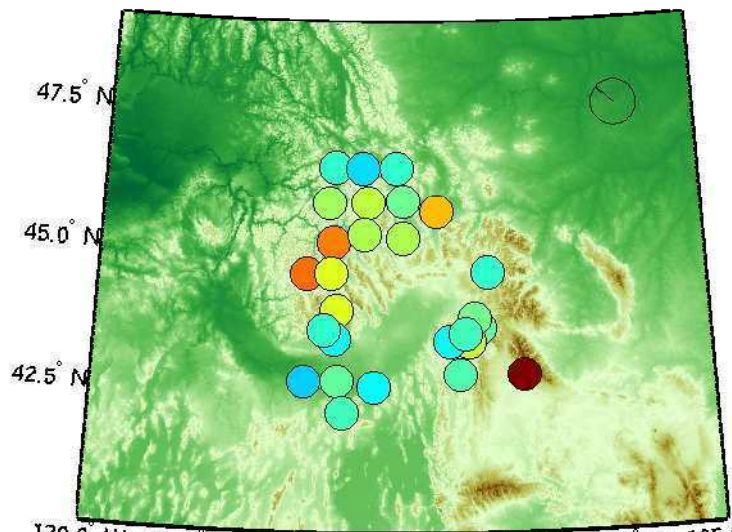
# Event\_2007\_077\_02\_11\_05



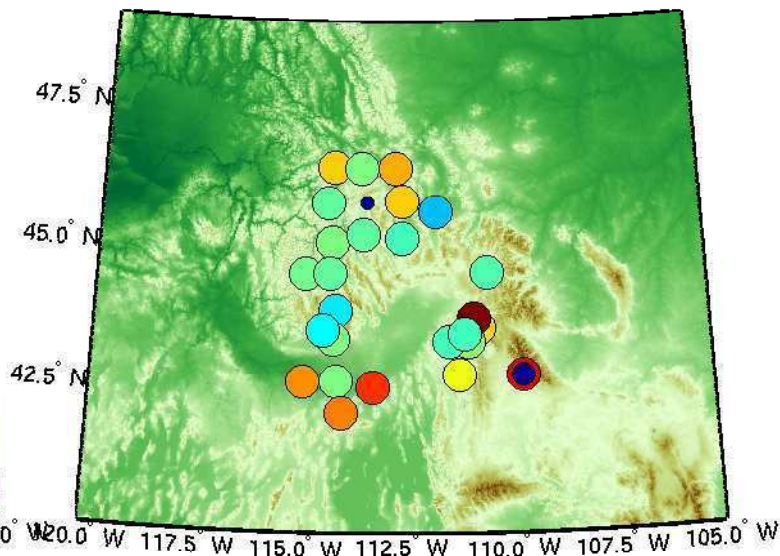
Baz = 132.9086  
 Mean xcor value = 0.84143  
 Range of  $t^*$  values is 1.8486  
 Median  $t^*$  err is 0.1171



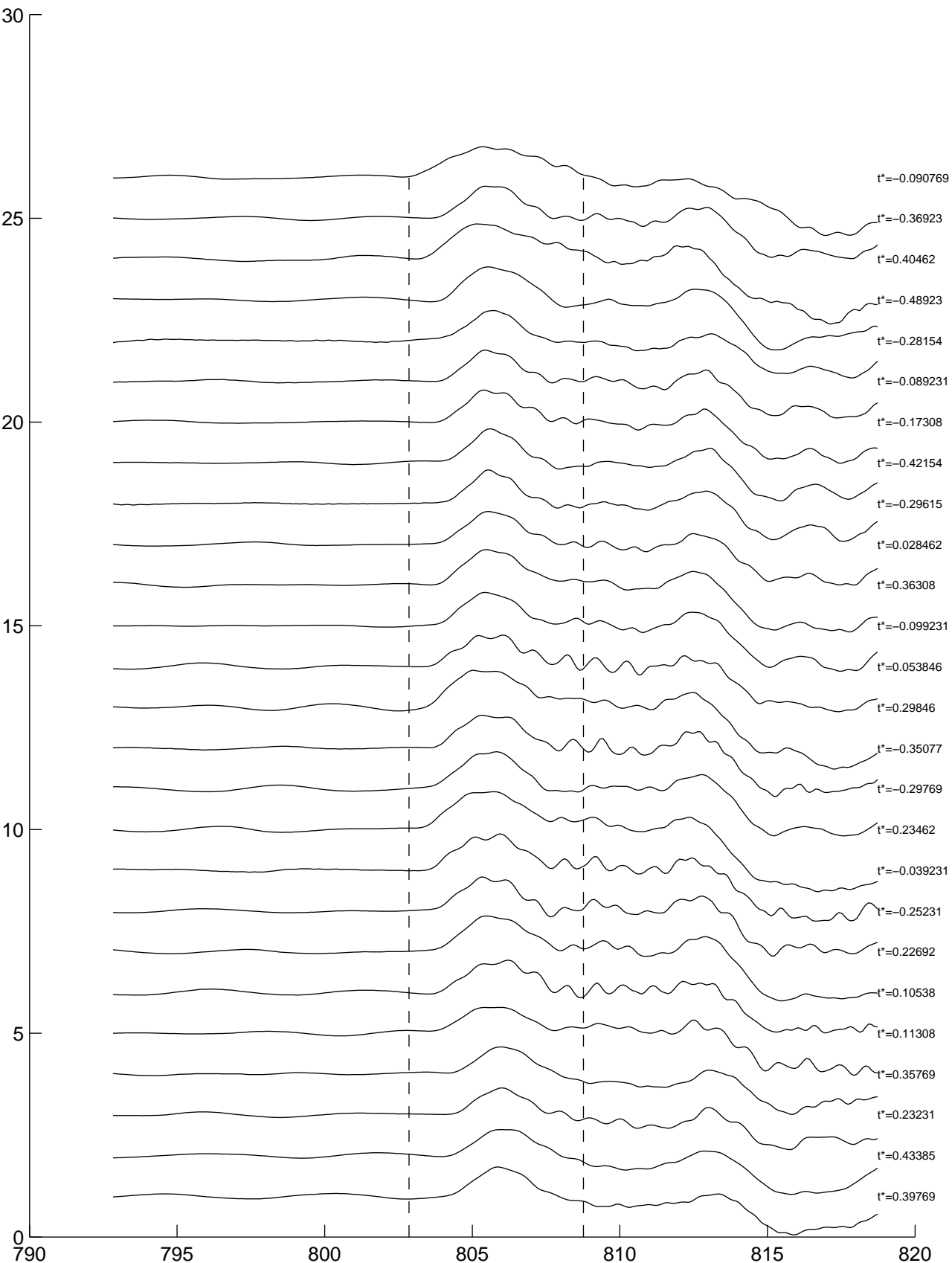
travel time residuals



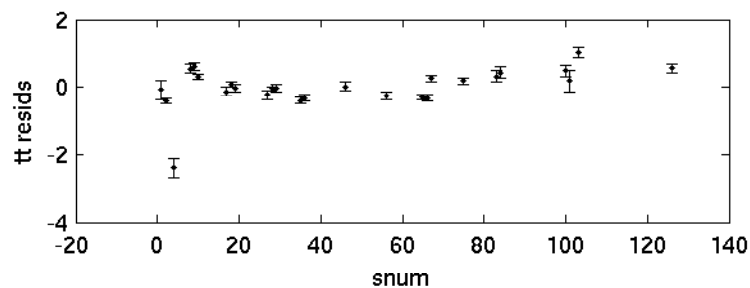
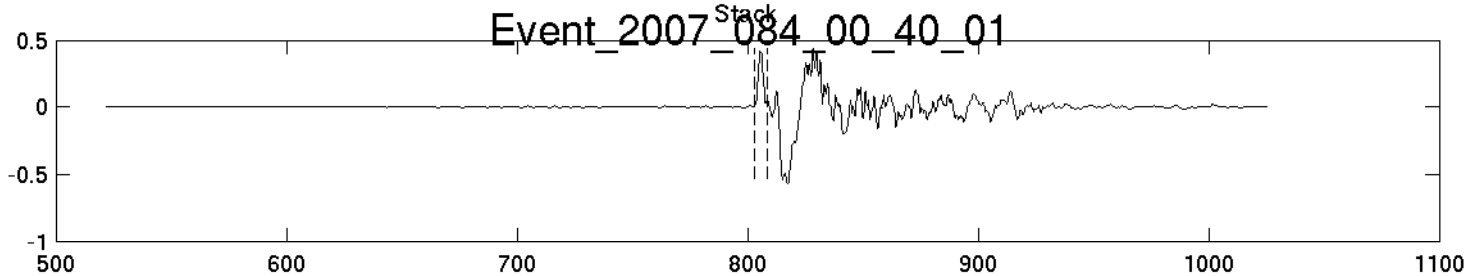
$t^*$  values



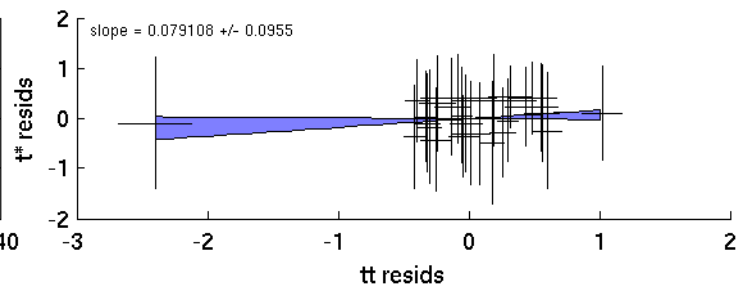
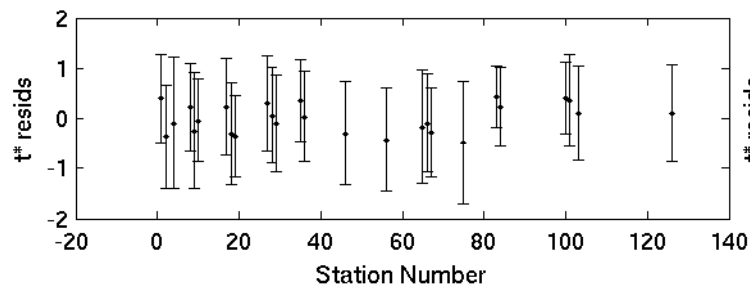
# Event\_2007\_084\_00\_40\_01



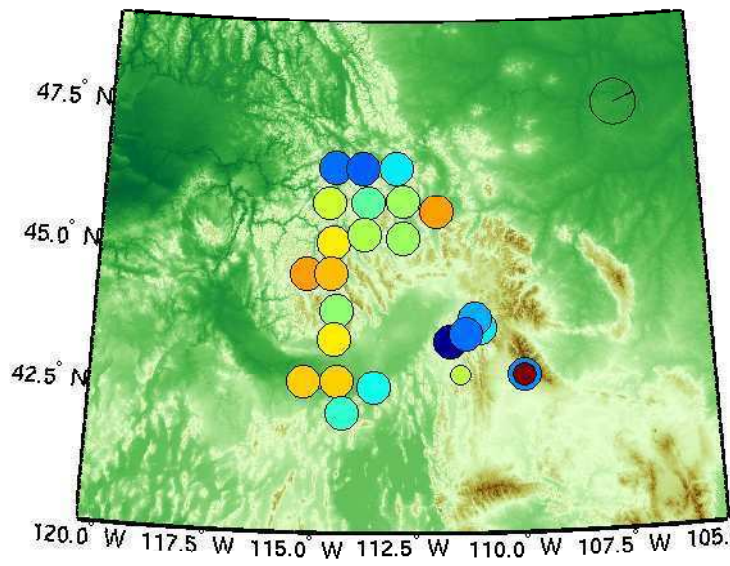
Event\_2007\_084\_00\_40\_01



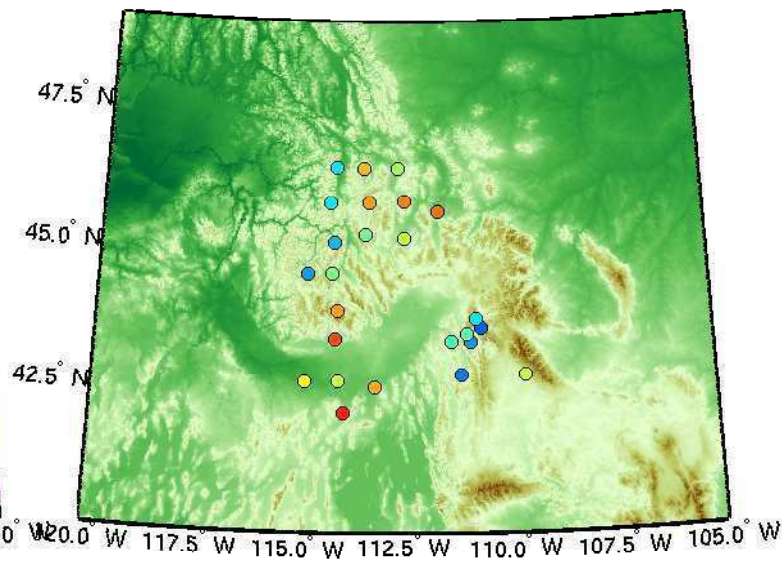
Baz = 246.973  
Mean xcor value = 0.85077  
Range of  $t^*$  values is 0.92308  
Median  $t^*$  err is 0.95462



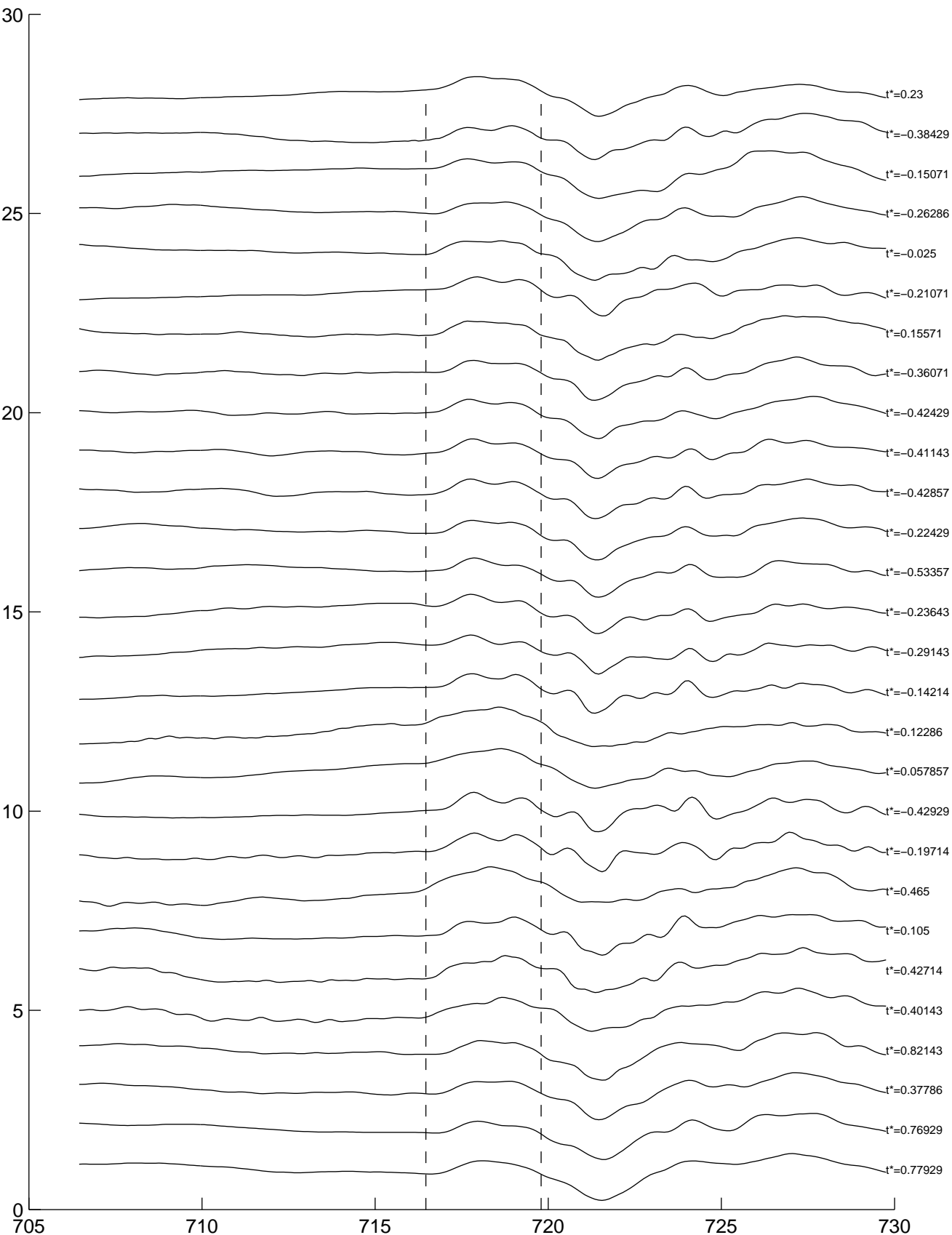
travel time residuals



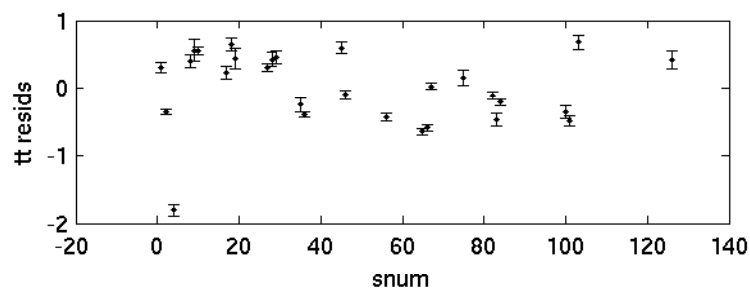
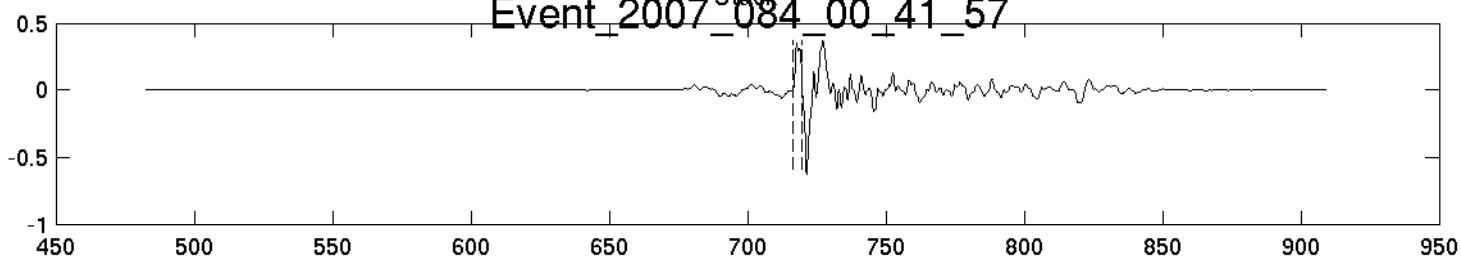
$t^*$  values



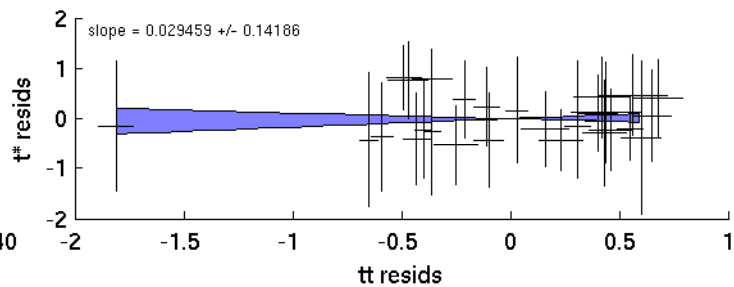
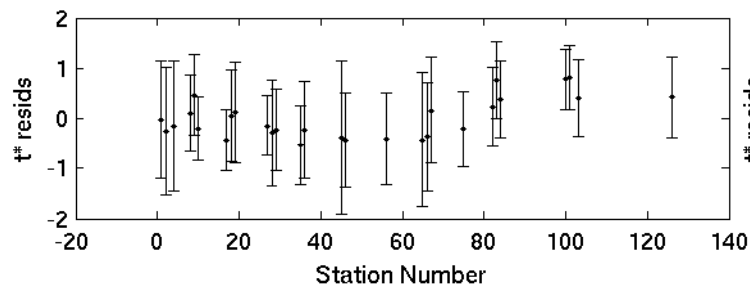
# Event\_2007\_084\_00\_41\_57



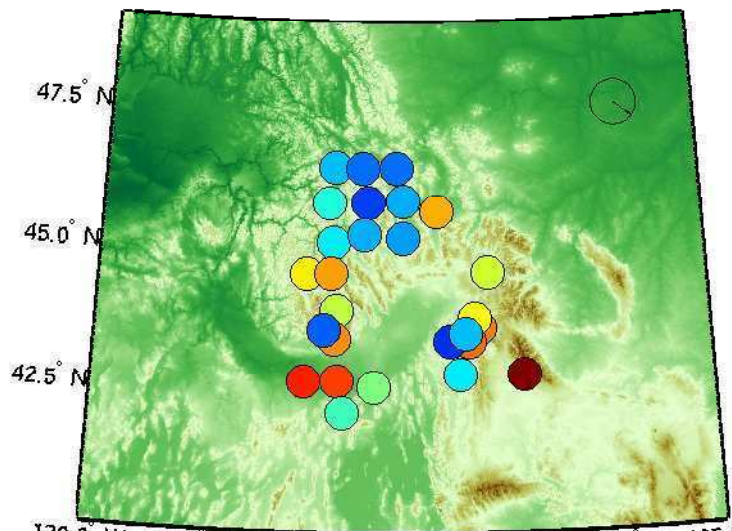
Event\_2007\_084\_00\_41\_57



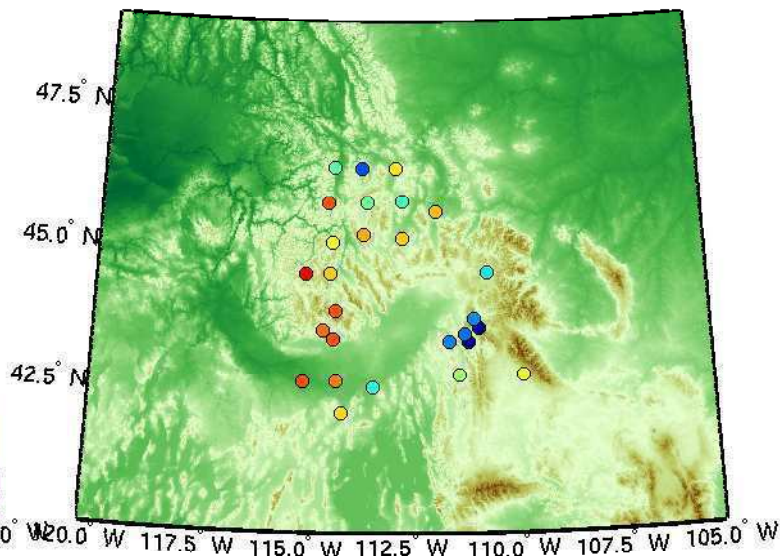
Baz = 310.3219  
Mean xcor value = 0.75107  
Range of  $t^*$  values is 1.355  
Median  $t^*$  err is 0.61024



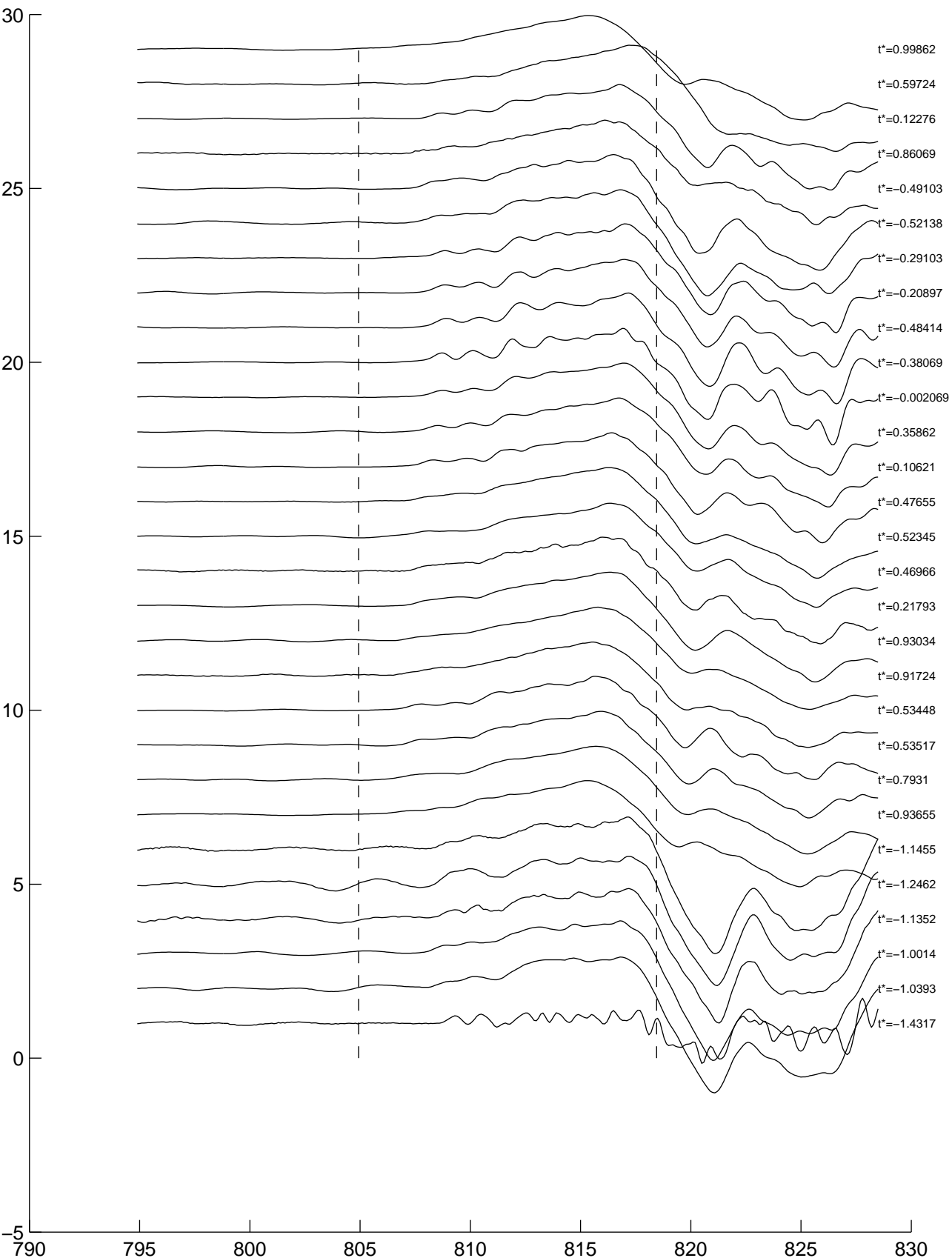
travel time residuals



$t^*$  values

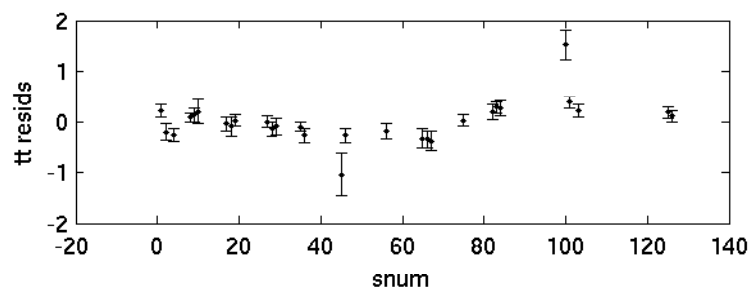
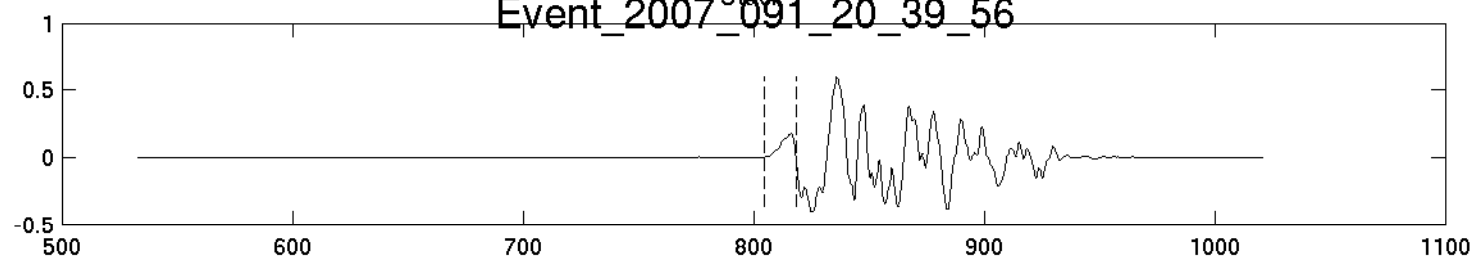


# Event\_2007\_091\_20\_39\_56

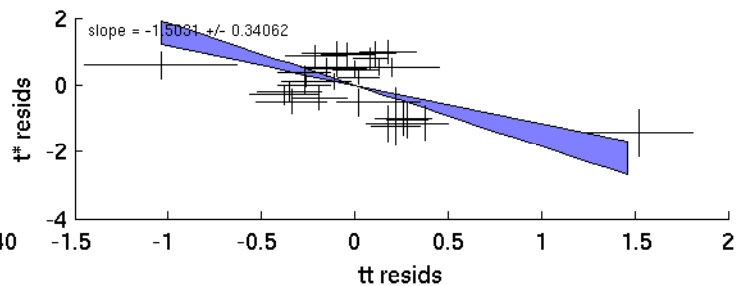
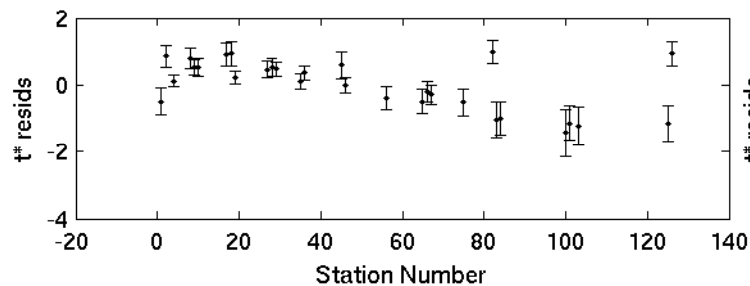




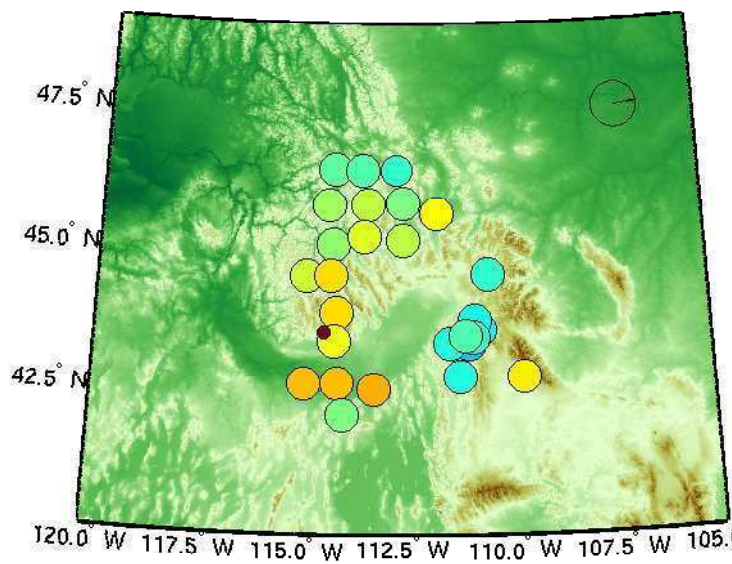
# Event\_2007\_091\_20\_39\_56



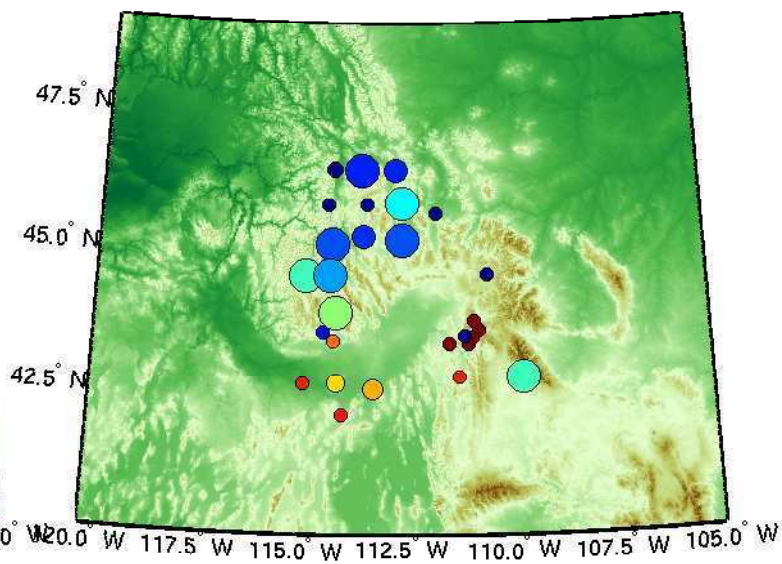
Baz = 264.1145  
 Mean xcor value = 0.90724  
 Range of  $t^*$  values is 2.4303  
 Median  $t^*$  err is 0.33991



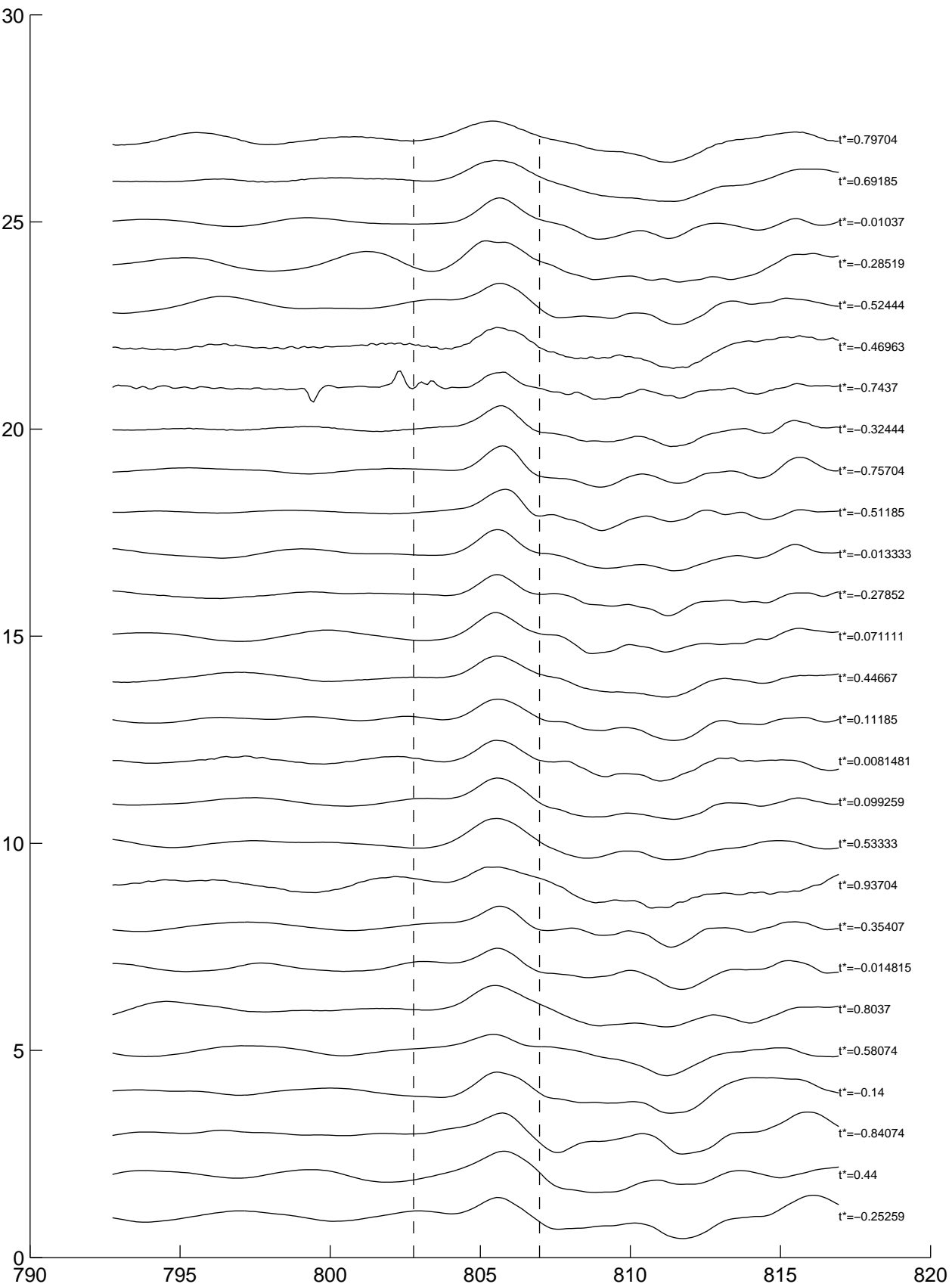
travel time residuals



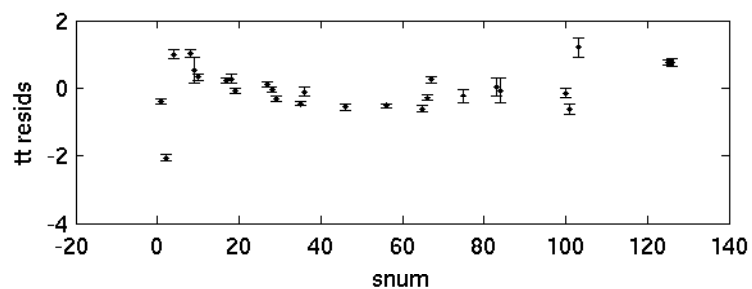
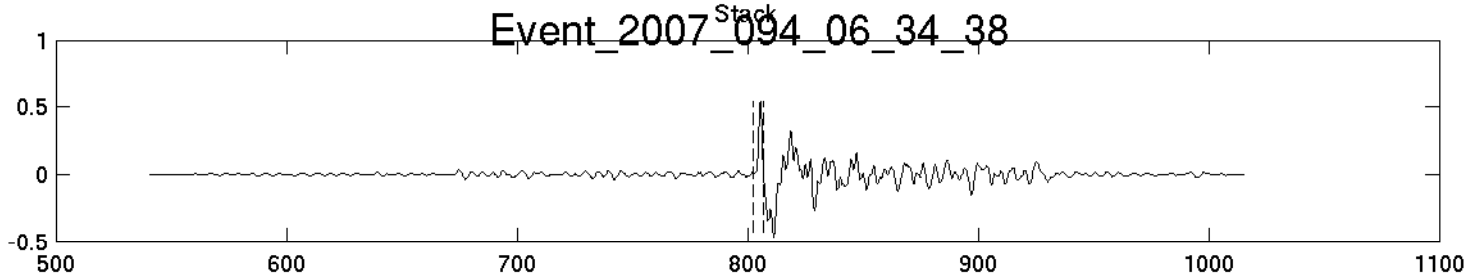
$t^*$  values



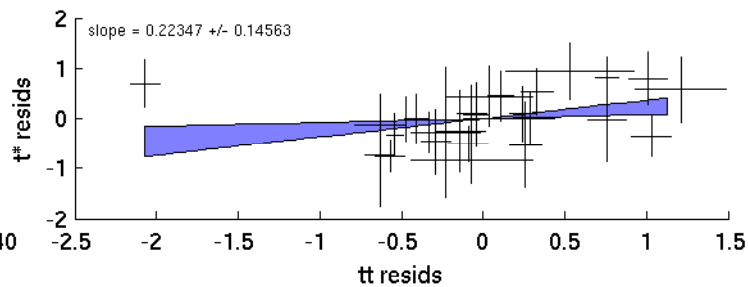
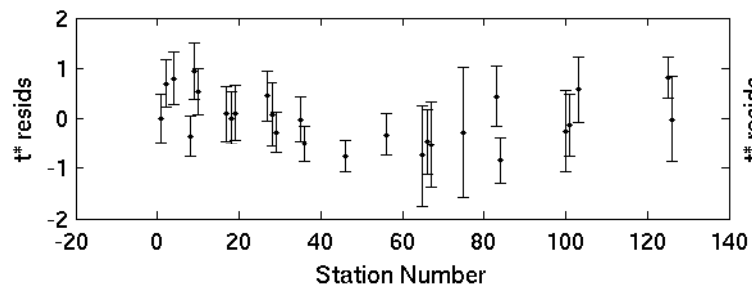
# Event\_2007\_094\_06\_34\_38



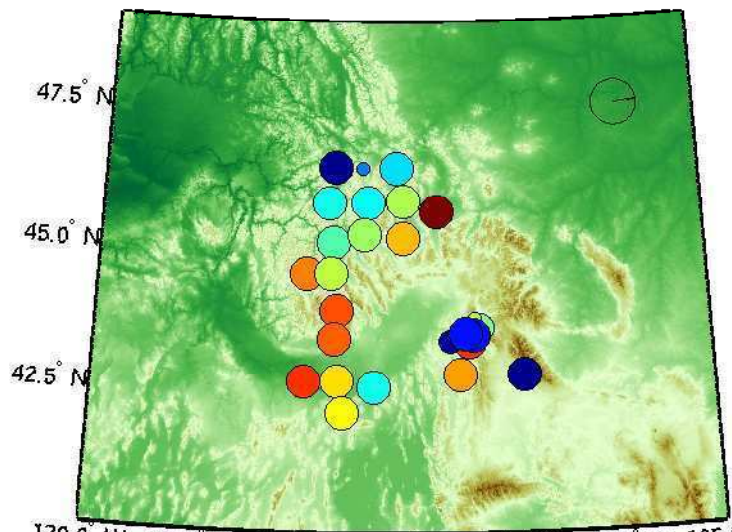
# Event\_2007\_094\_06\_34\_38



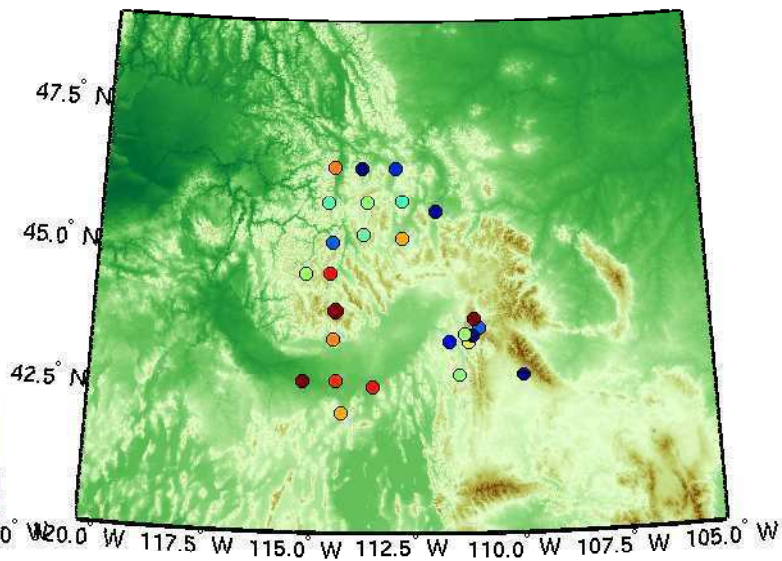
Baz = 264.989  
 Mean xcor value = 0.77111  
 Range of  $t^*$  values is 1.7778  
 Median  $t^*$  err is 0.51808



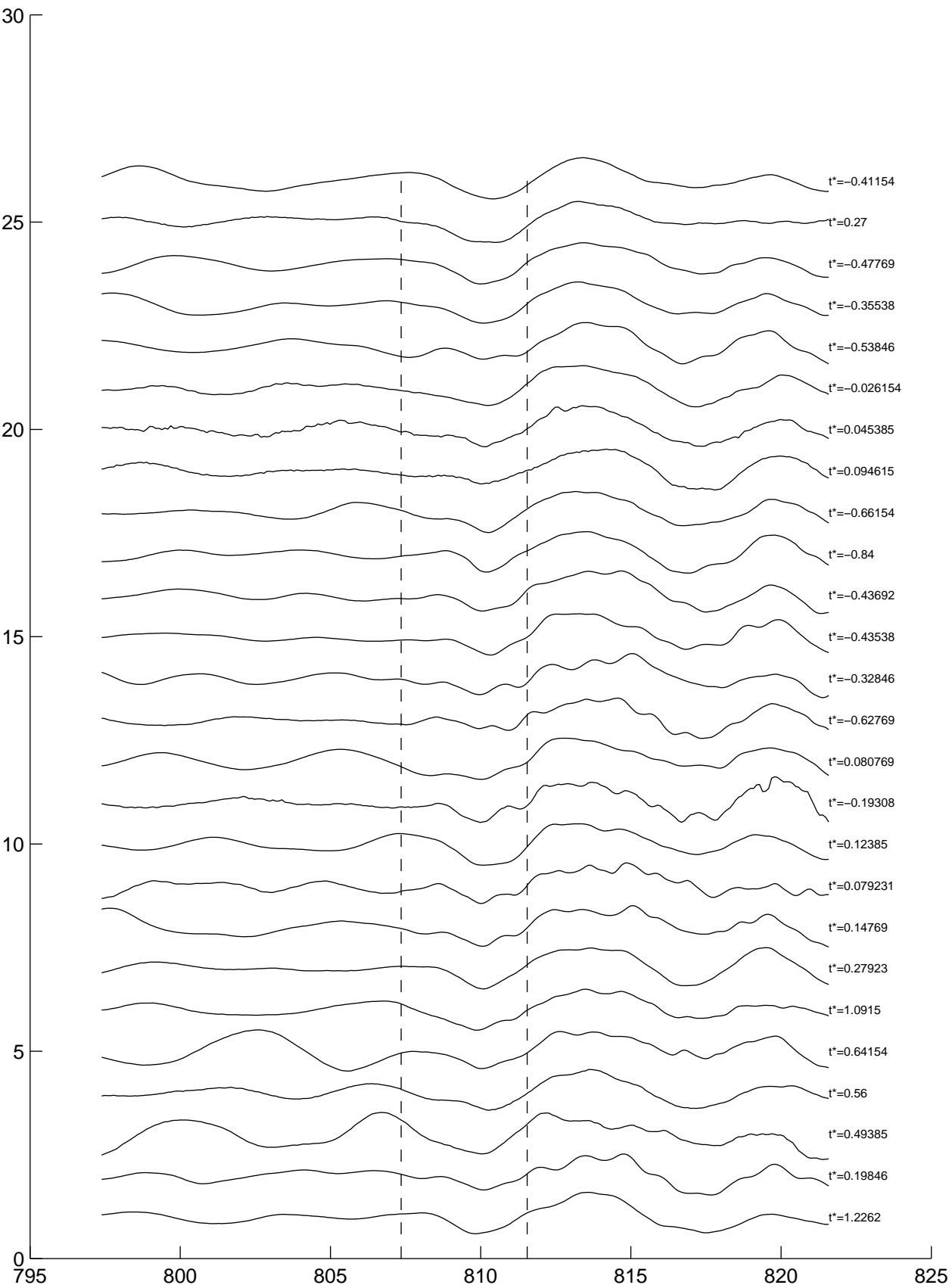
travel time residuals



$t^*$  values

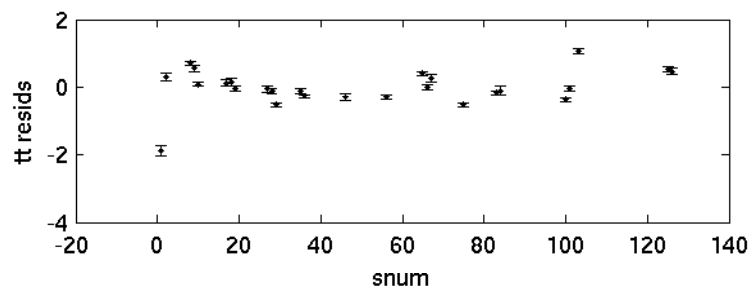
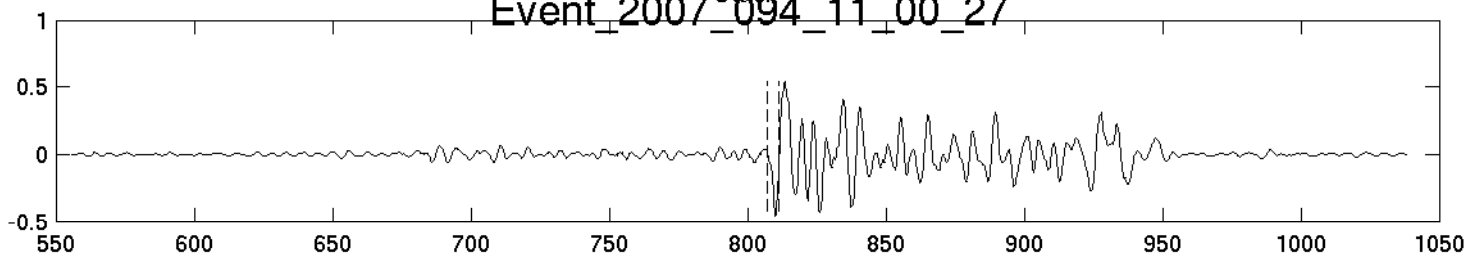


# Event\_2007\_094\_11\_00\_27

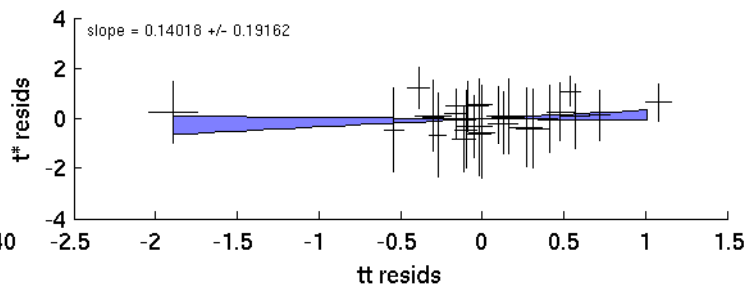
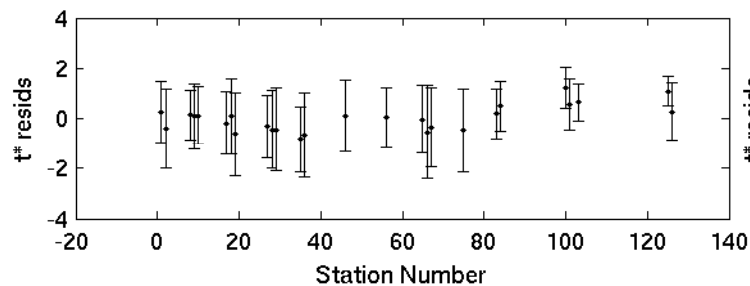


Event\_2007\_094\_11\_00\_27

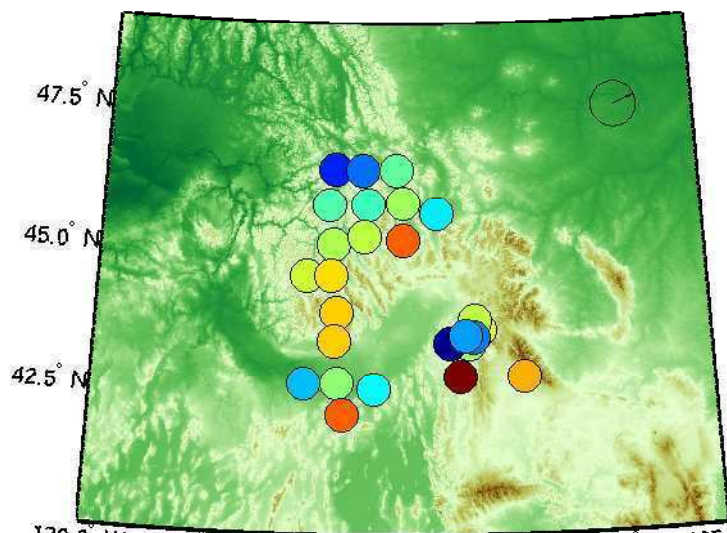
Stack



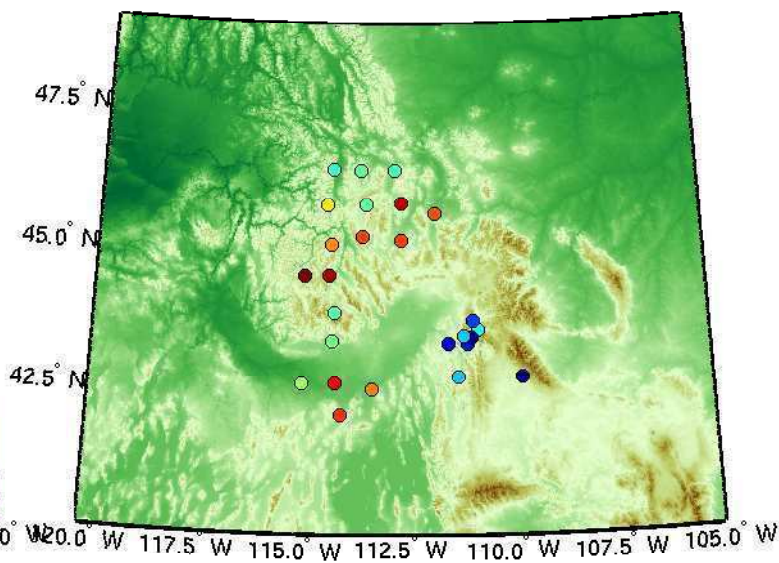
Baz = 247.3002  
Mean xcor value = 0.76538  
Range of  $t^*$  values is 2.0662  
Median  $t^*$  err is 1.2702



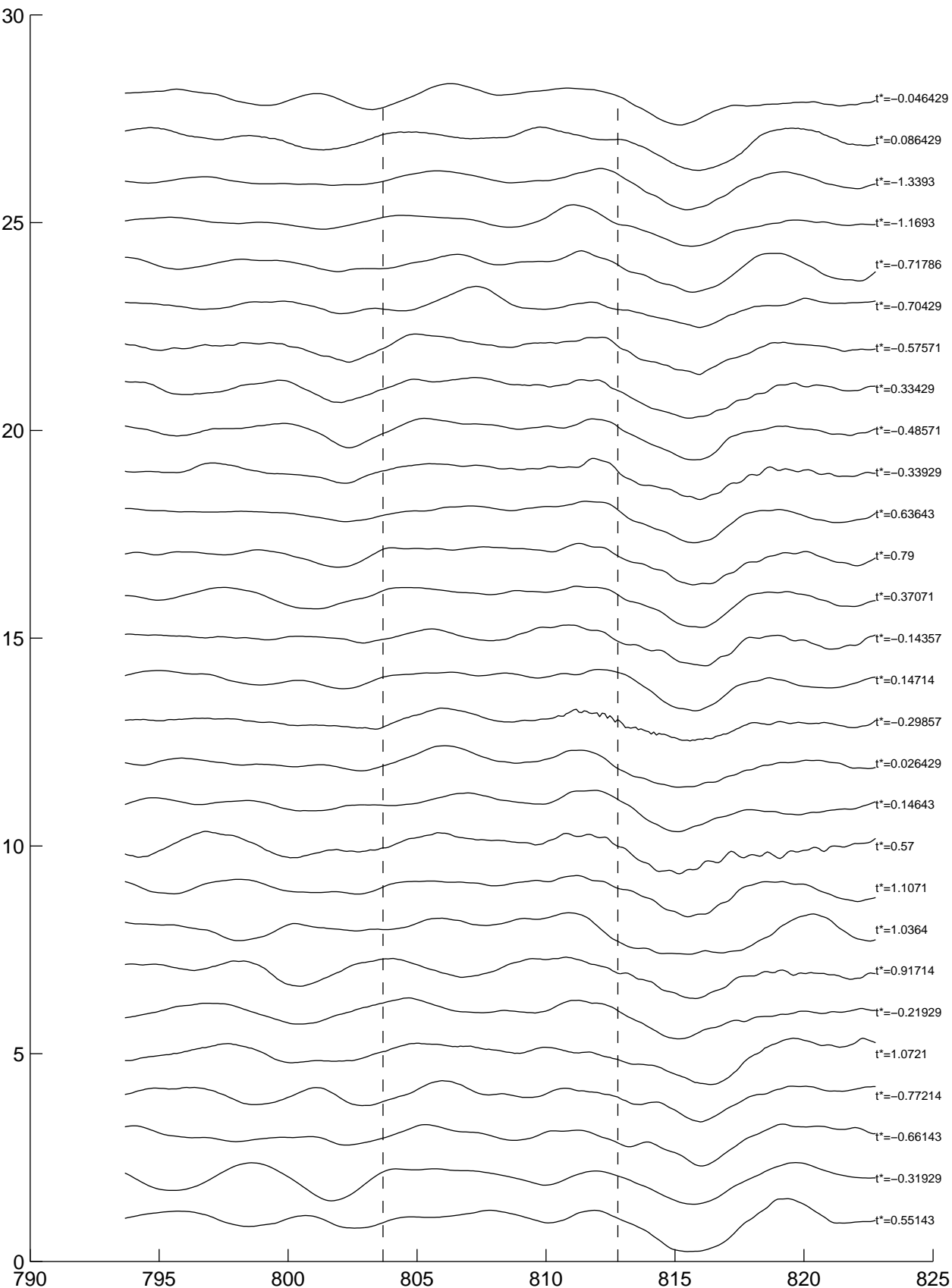
travel time residuals



$t^*$  values



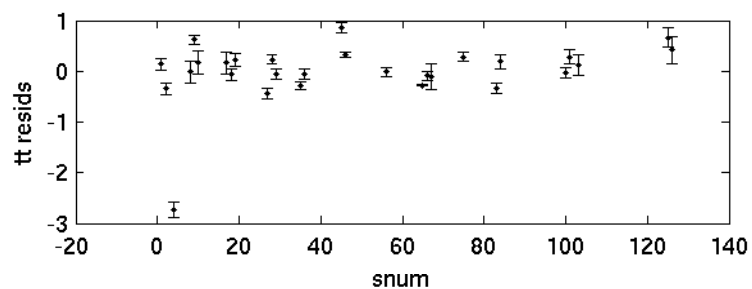
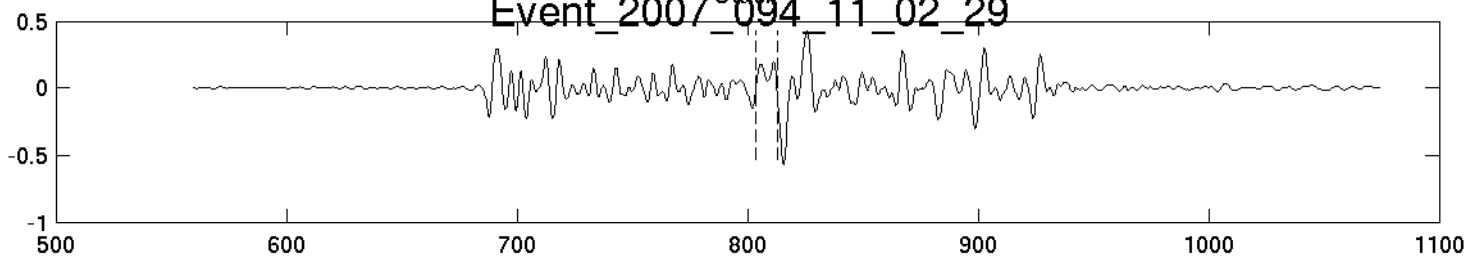
# Event\_2007\_094\_11\_02\_29



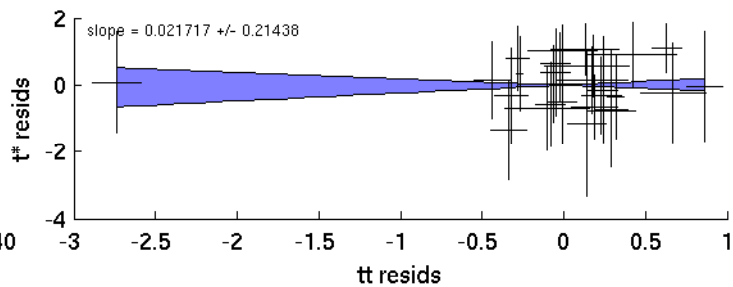
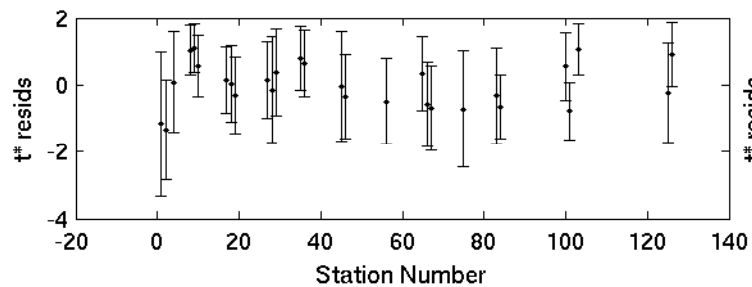


Event\_2007\_094\_11\_02\_29

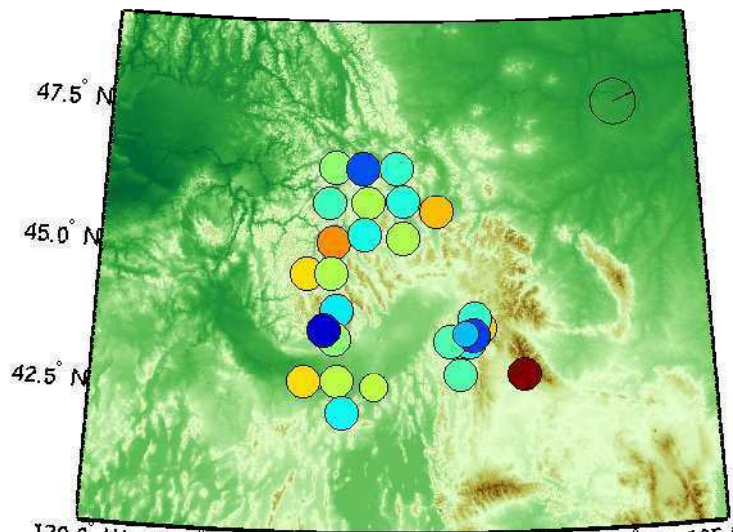
Stack



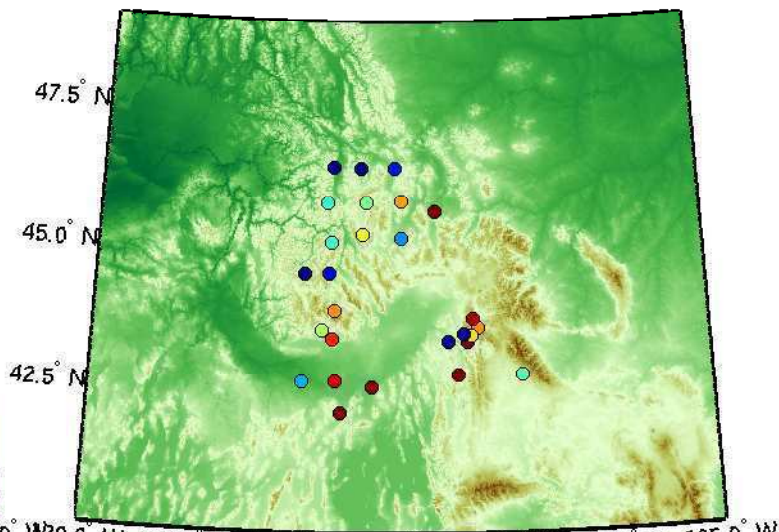
Baz = 247.1644  
Mean xcor value = 0.8275  
Range of  $t^*$  values is 2.4464  
Median  $t^*$  err is 1.1536



travel time residuals

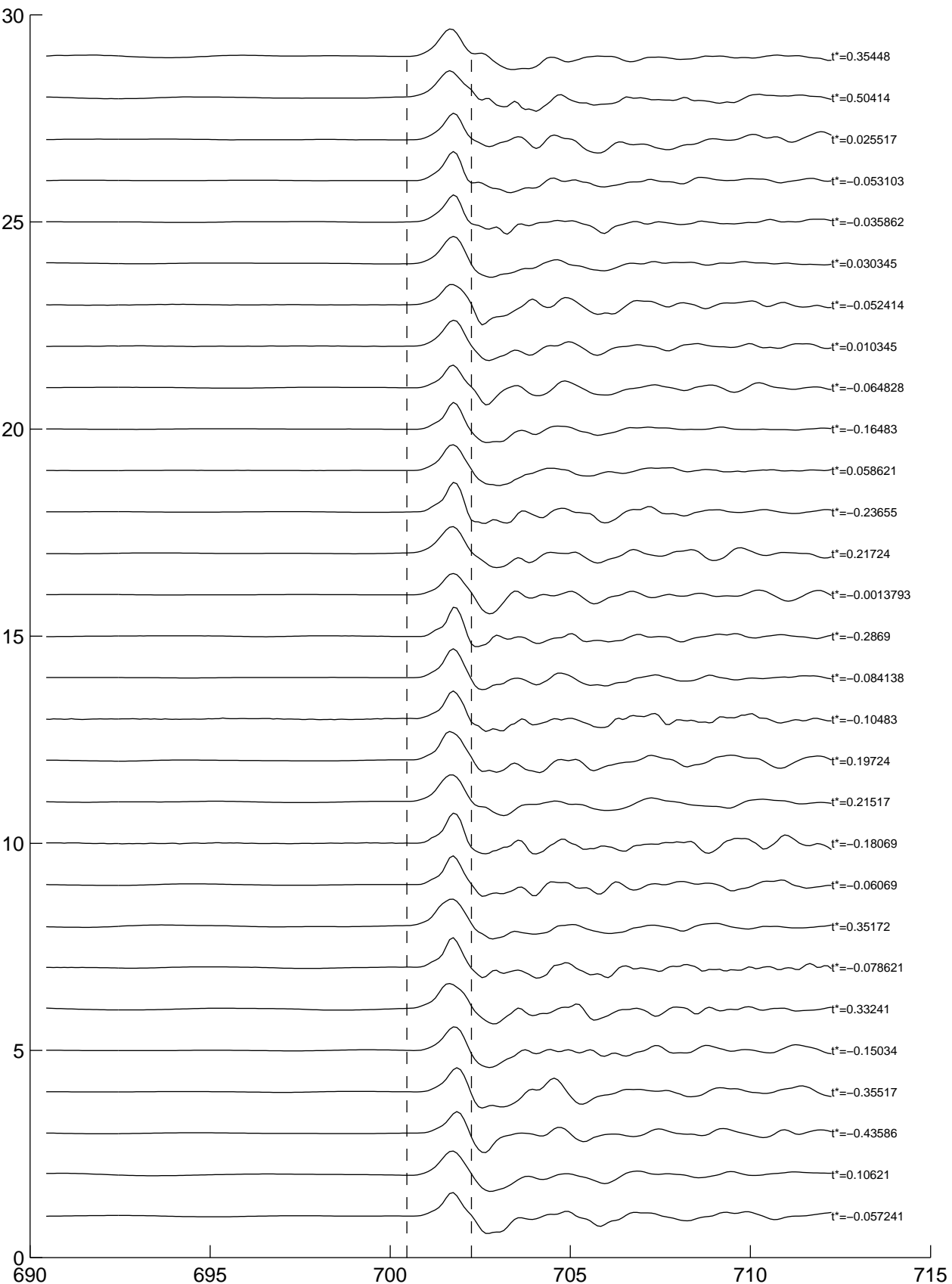


$t^*$  values

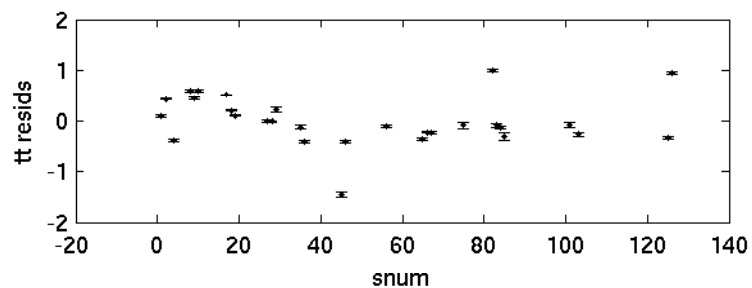
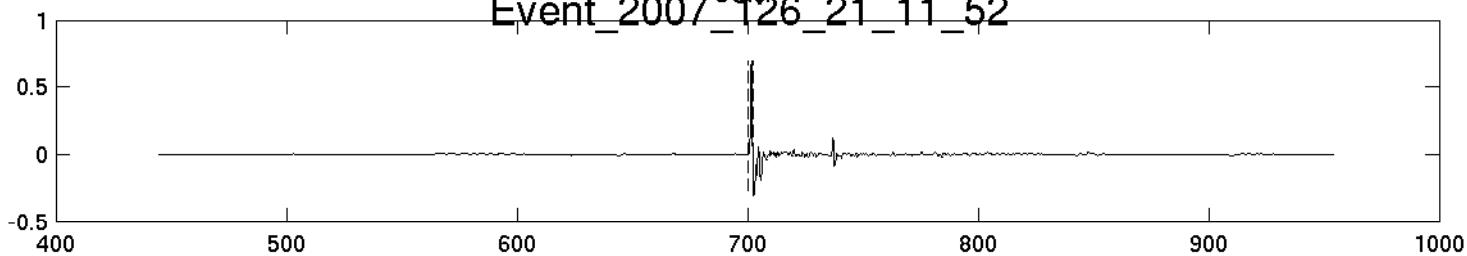




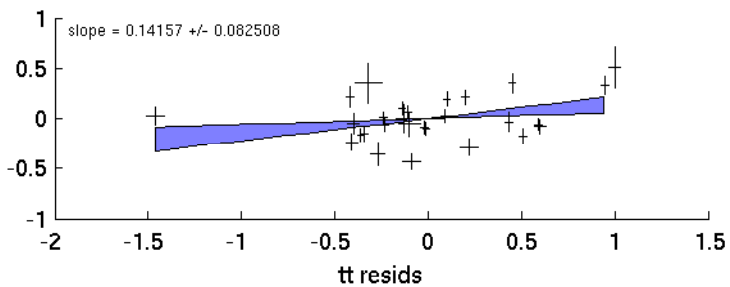
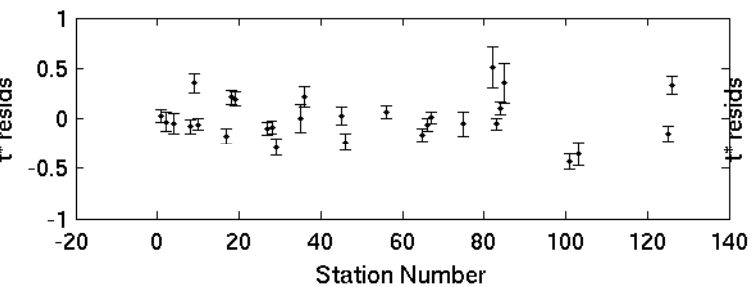
# Event\_2007\_126\_21\_11\_52



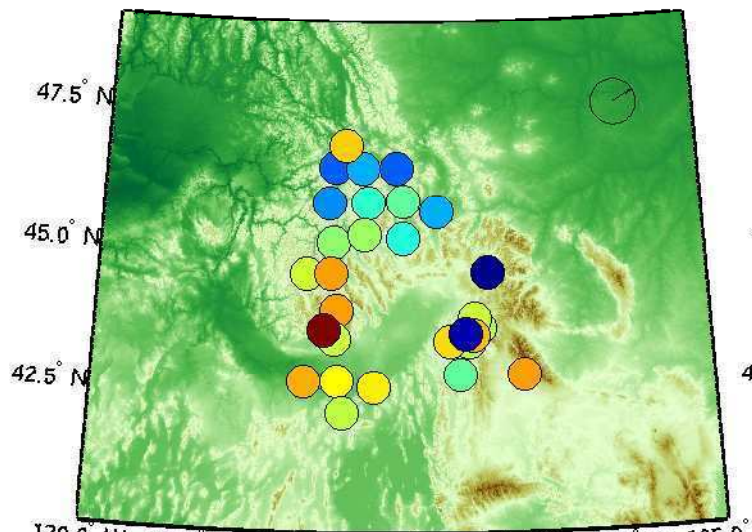
# Event\_2007\_Stack



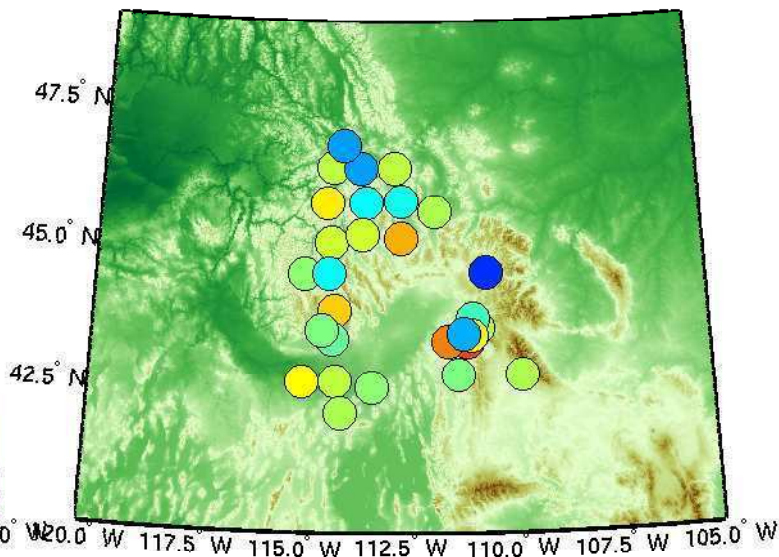
Baz = 240.0845  
 Mean xcor value = 0.77069  
 Range of  $t^*$  values is 0.94  
 Median  $t^*$  err is 0.07614



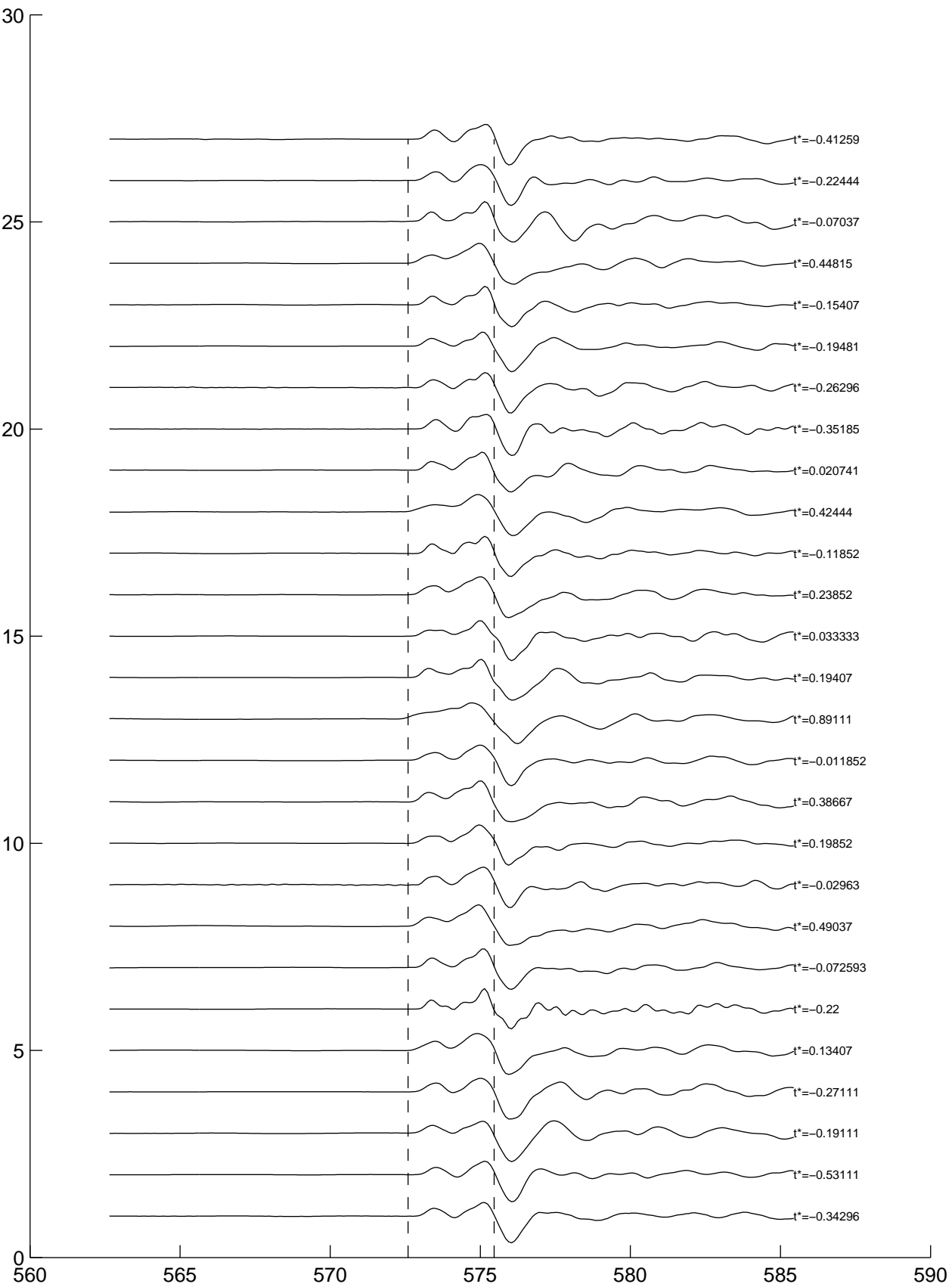
travel time residuals



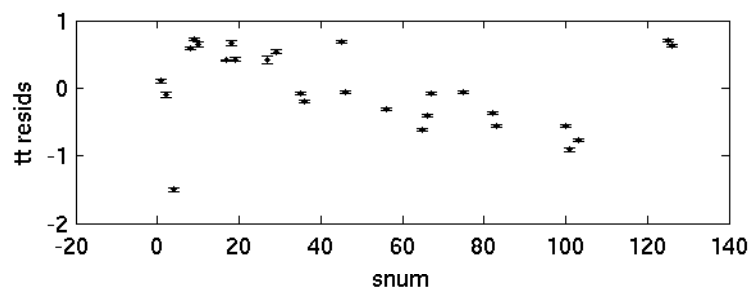
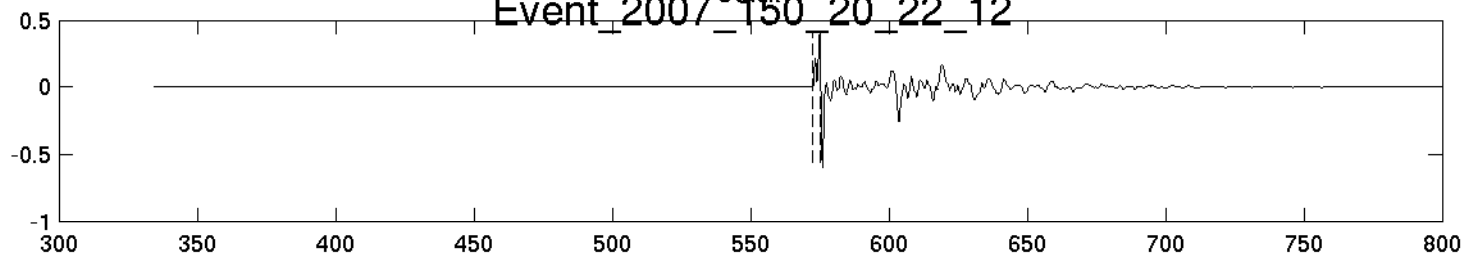
$t^*$  values



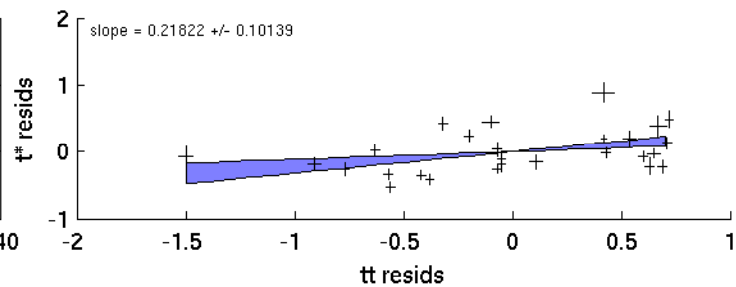
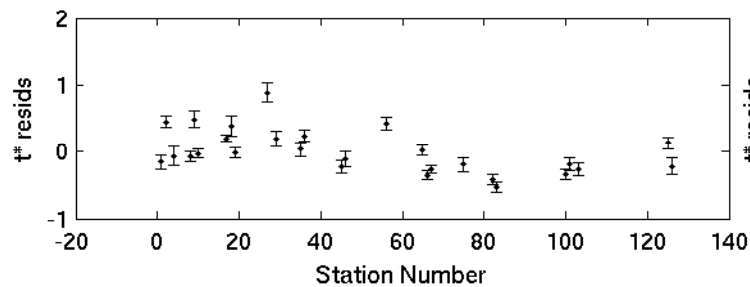
# Event\_2007\_150\_20\_22\_12



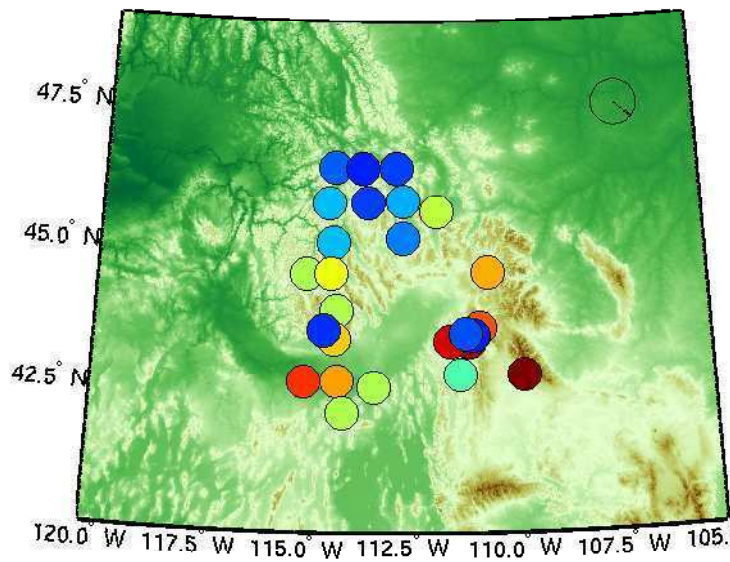
# Event\_2007\_150\_20\_22\_12



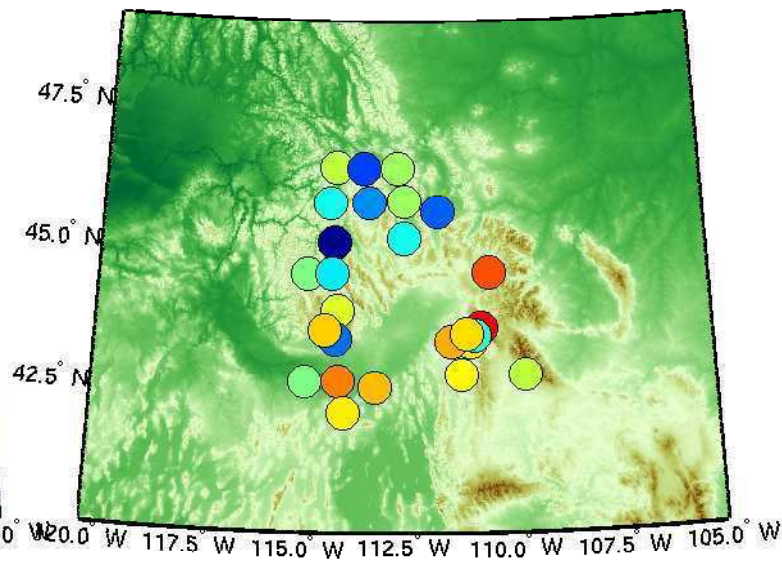
Baz = 312.6613  
 Mean xcor value = 0.79296  
 Range of  $t^*$  values is 1.4222  
 Median  $t^*$  err is 0.086125



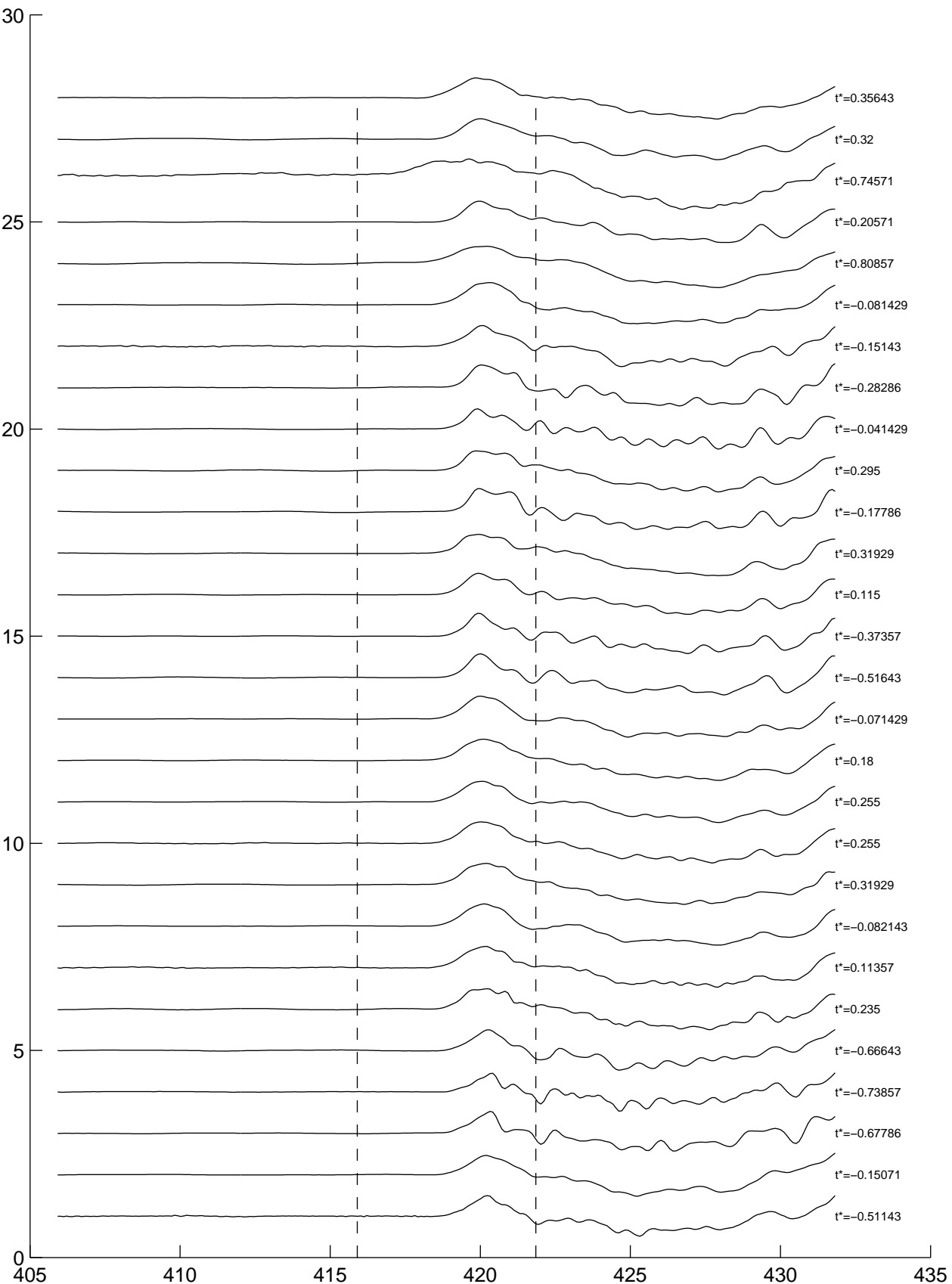
travel time residuals



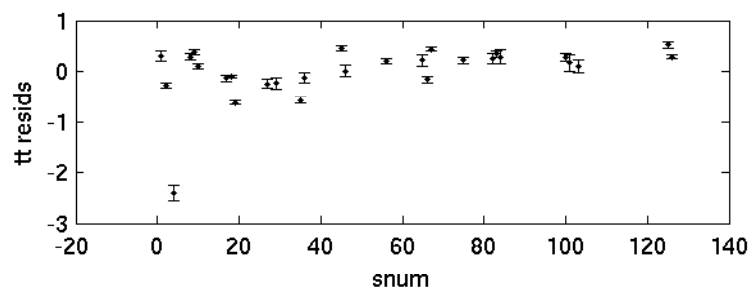
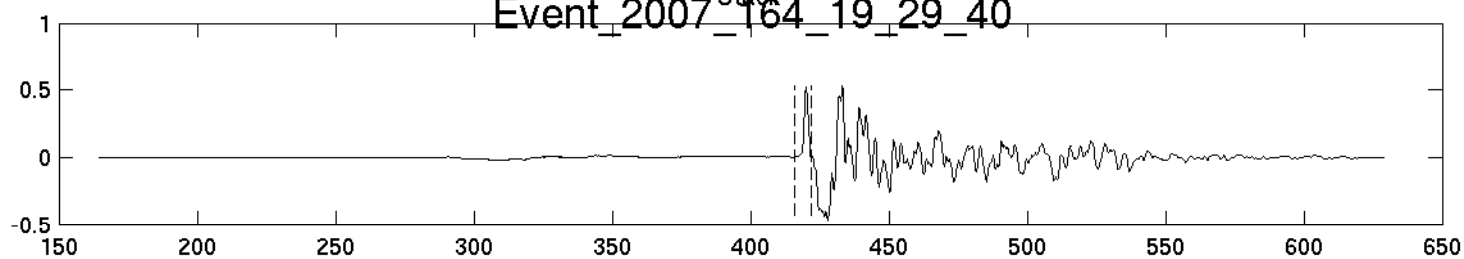
$t^*$  values



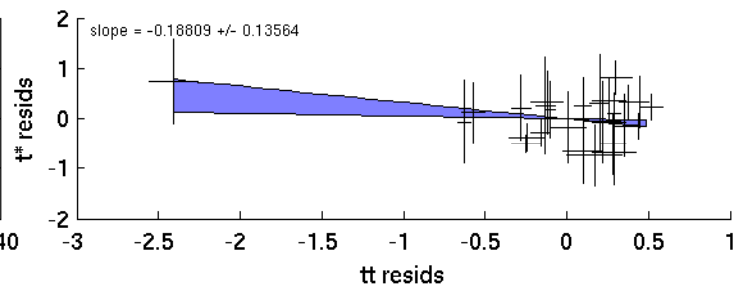
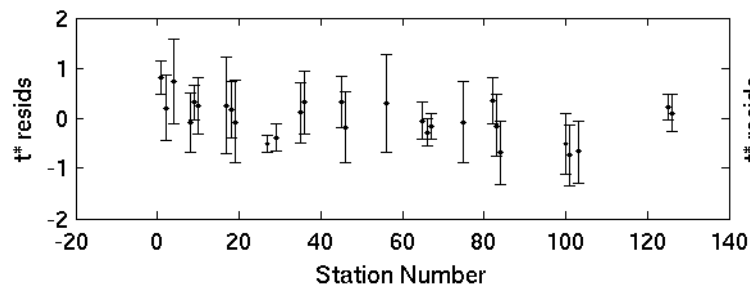
# Event\_2007\_164\_19\_29\_40



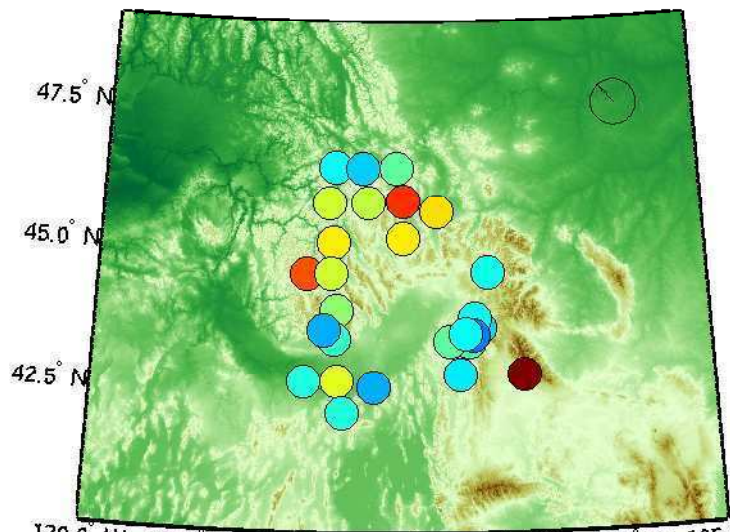
# Event\_2007\_164\_19\_29\_40



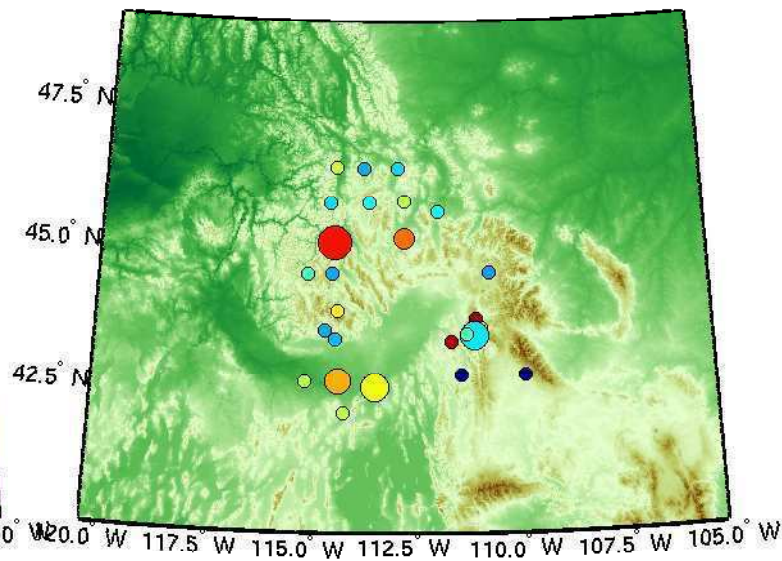
Baz = 141.8697  
 Mean xcor value = 0.85786  
 Range of  $t^*$  values is 1.5471  
 Median  $t^*$  err is 0.59634



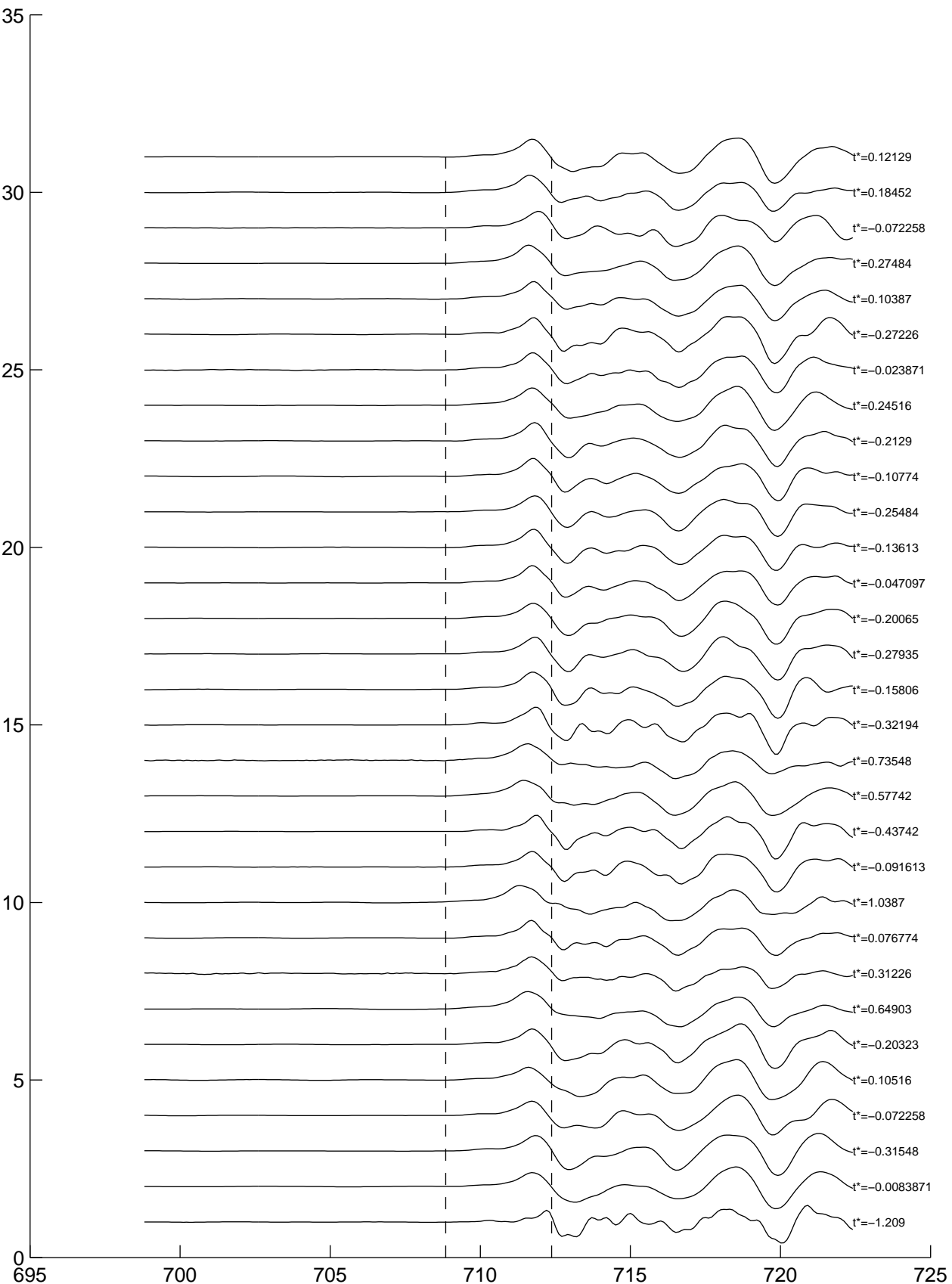
travel time residuals



$t^*$  values

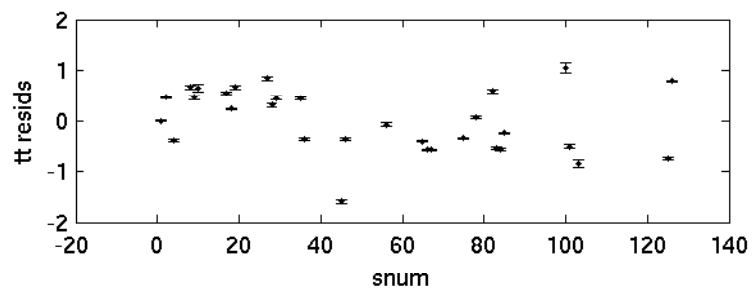
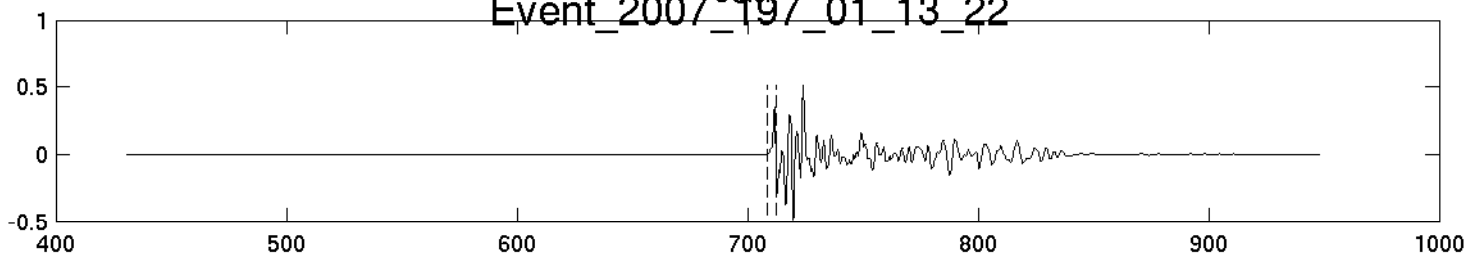


# Event\_2007\_197\_01\_13\_22

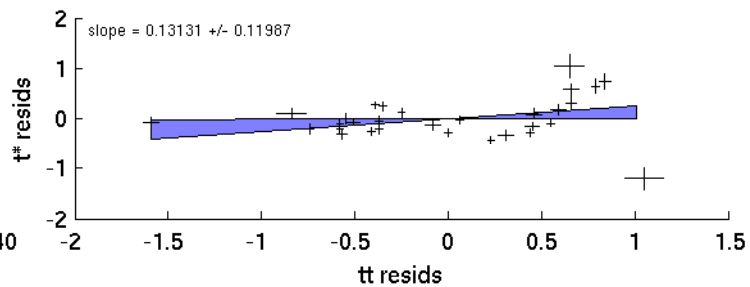
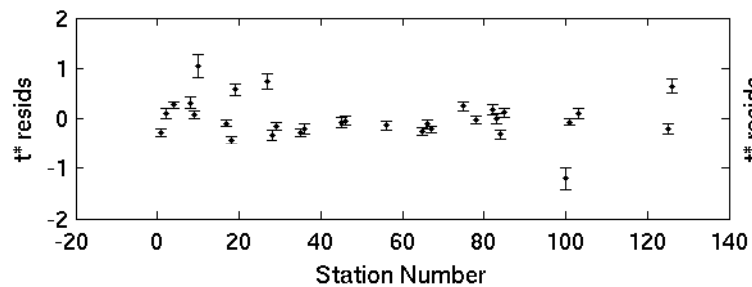




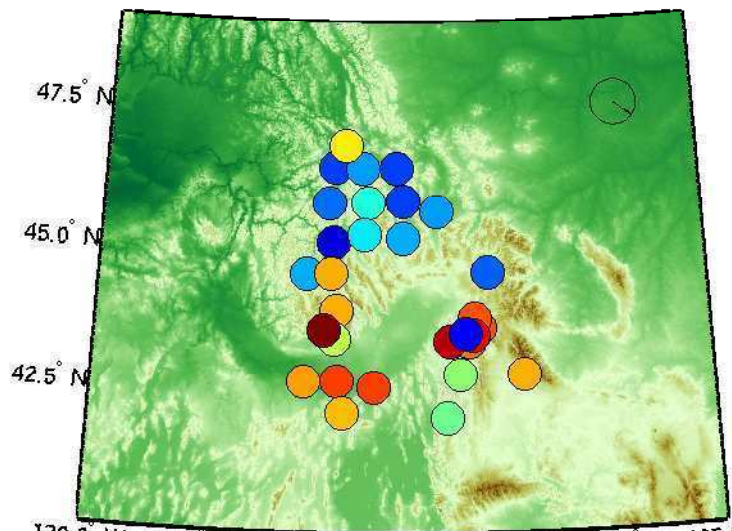
# Event\_2007\_197\_01\_13\_22



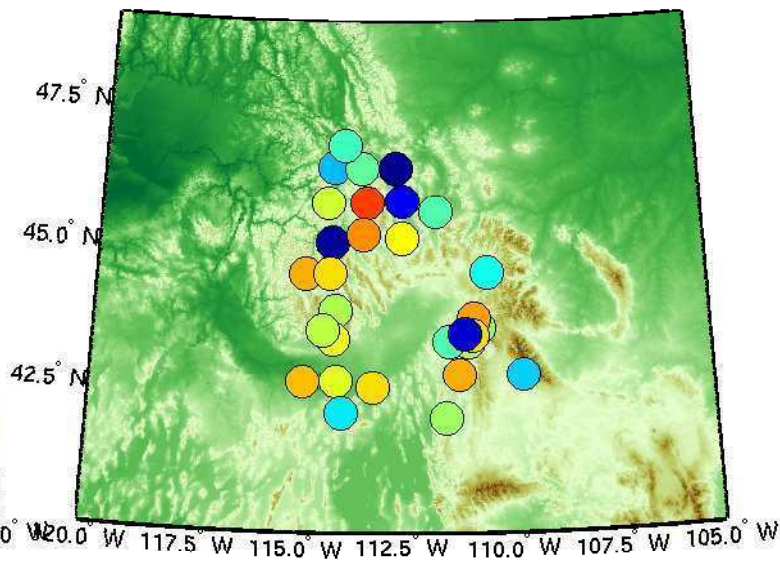
Baz = 309.441  
Mean xcor value = 0.84613  
Range of  $t^*$  values is 2.2477  
Median  $t^*$  err is 0.089165



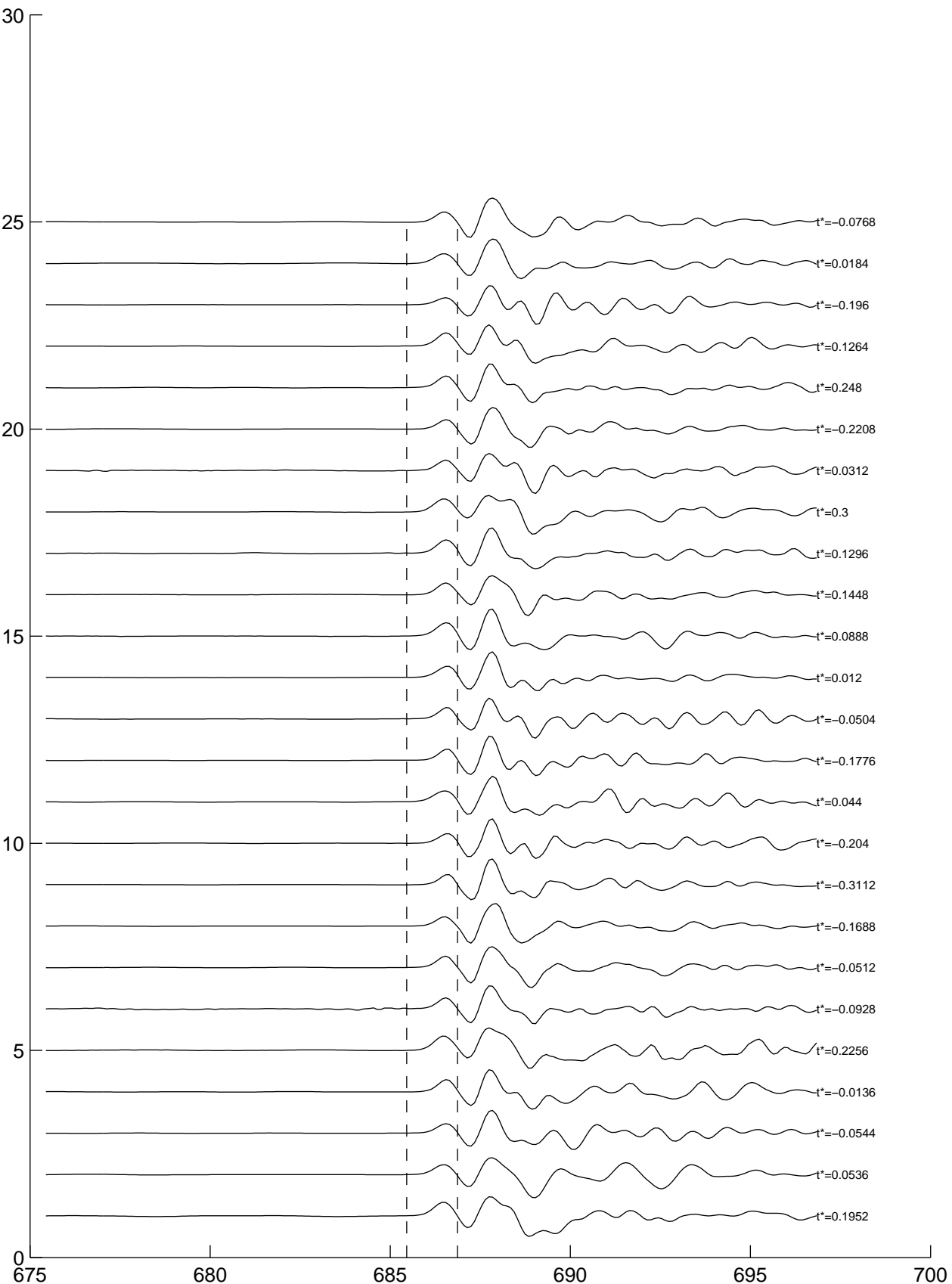
travel time residuals



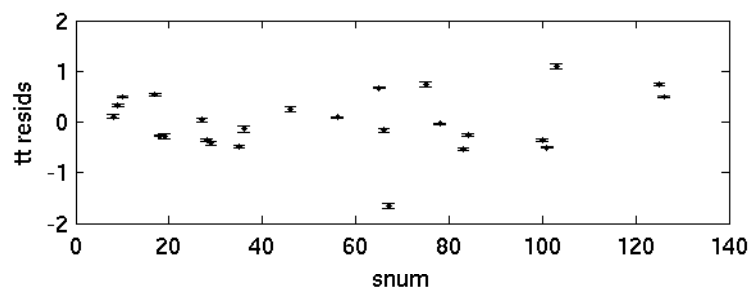
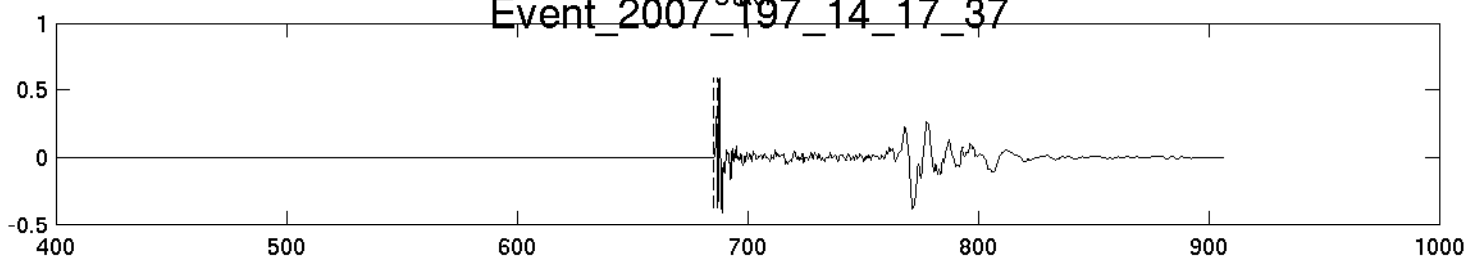
$t^*$  values



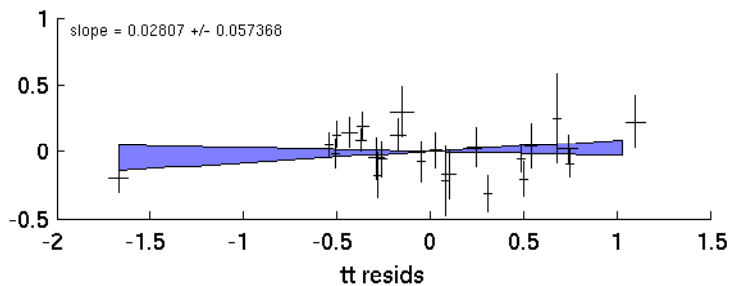
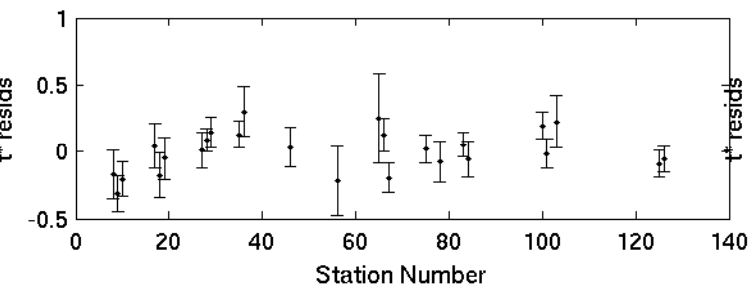
# Event\_2007\_197\_14\_17\_37



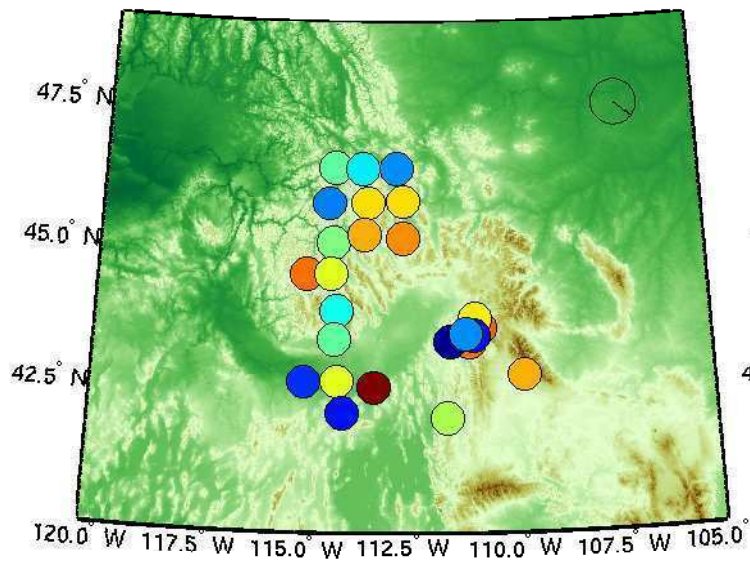
# Event\_2007\_197\_14\_17\_37



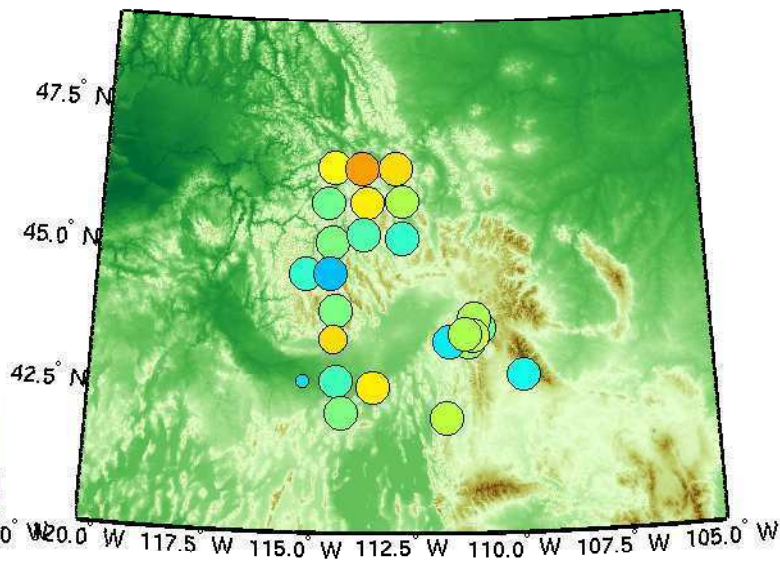
Baz = 311.0668  
 Mean xcor value = 0.6696  
 Range of  $t^*$  values is 0.6112  
 Median  $t^*$  err is 0.13029



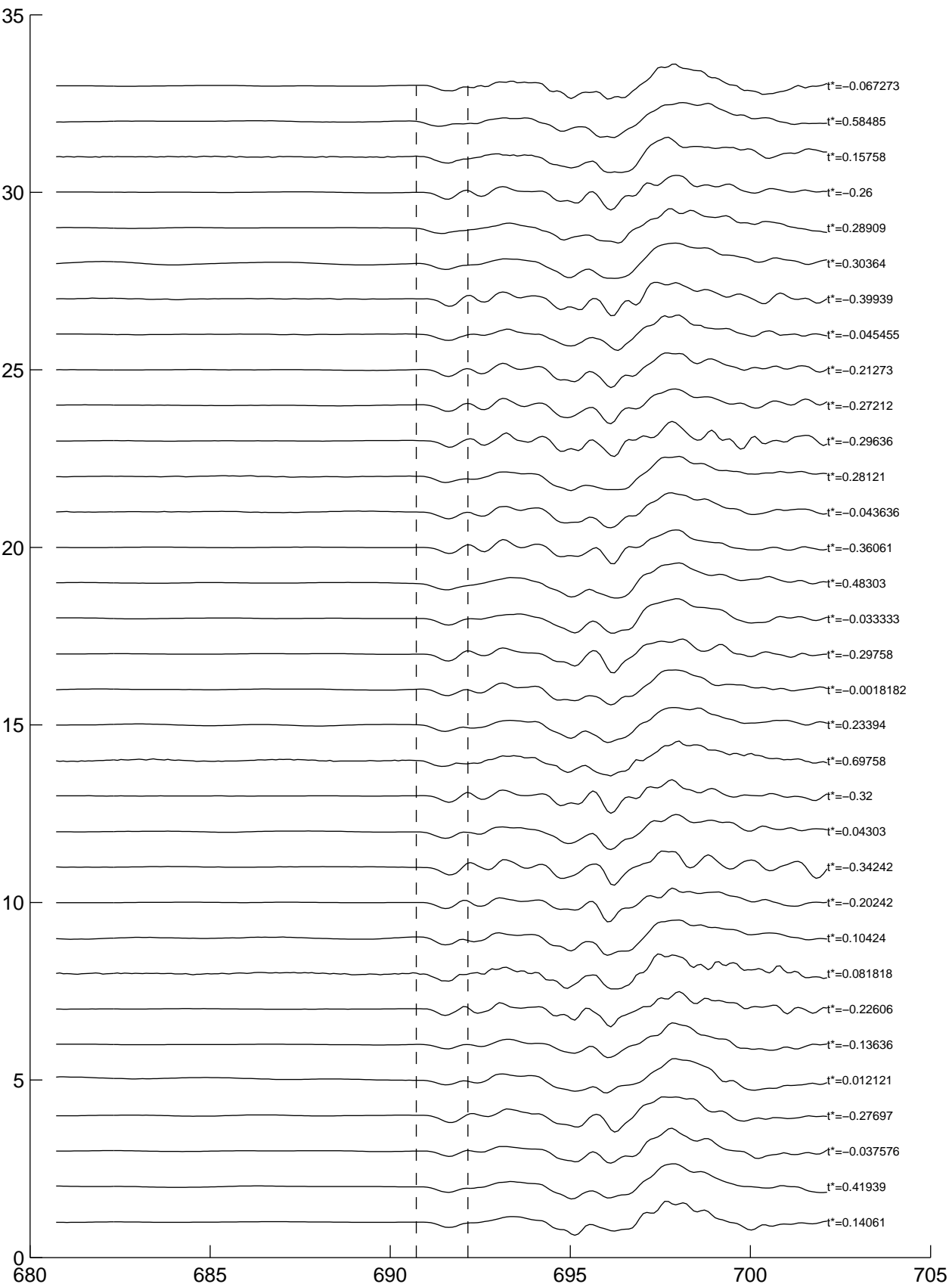
travel time residuals



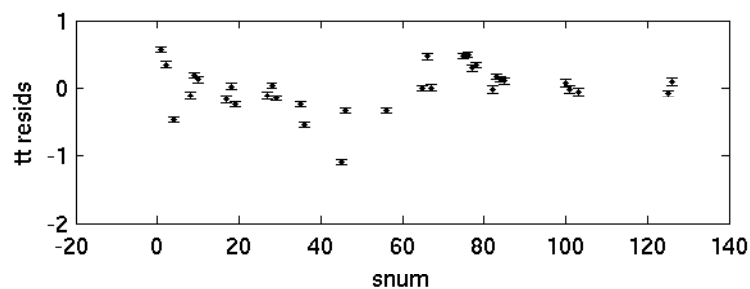
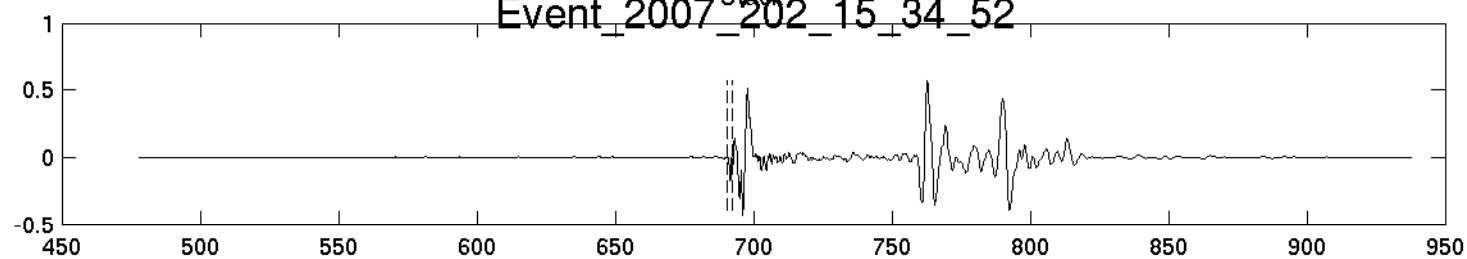
$t^*$  values



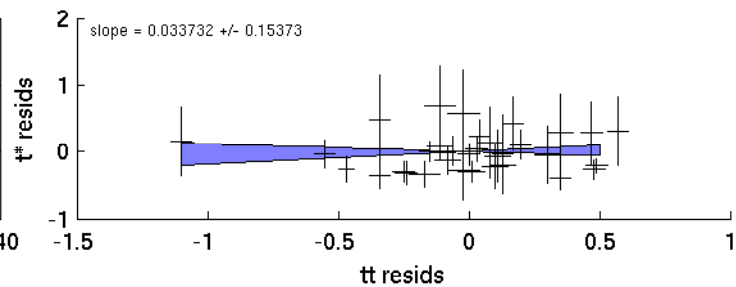
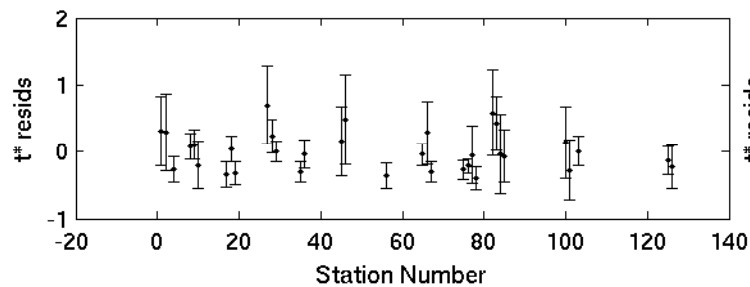
# Event\_2007\_202\_15\_34\_52



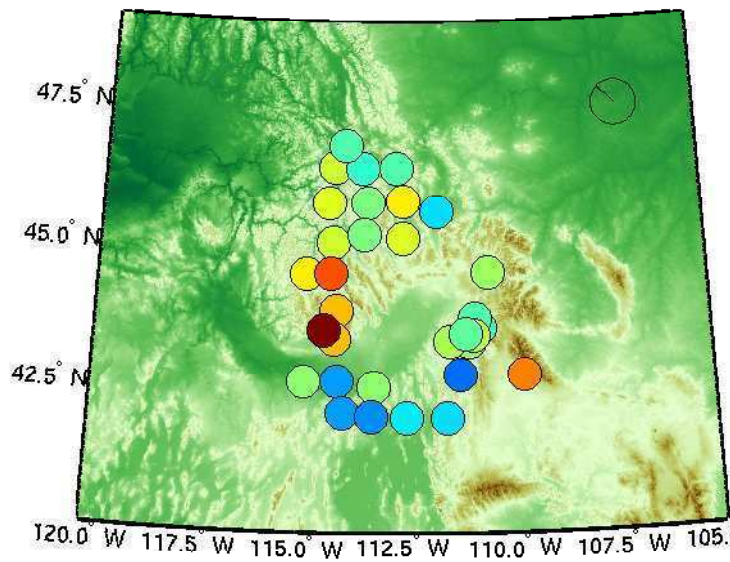
# Event\_2007\_202\_15\_34\_52



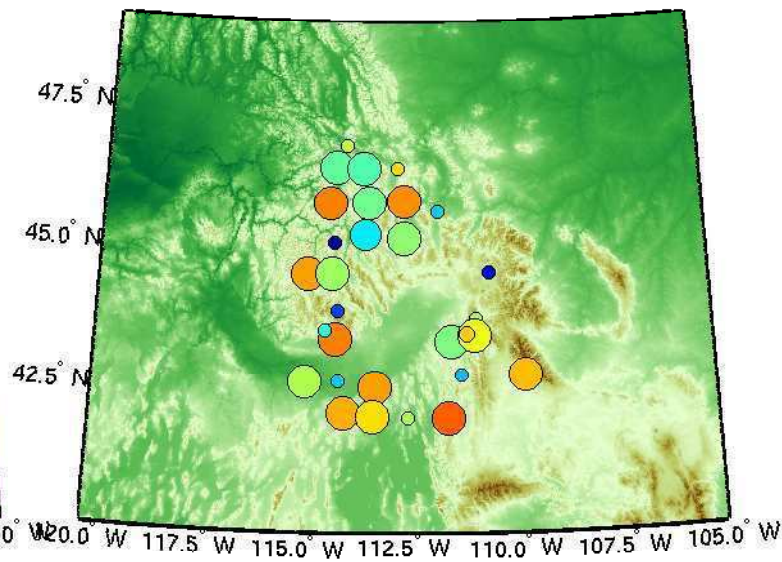
Baz = 136.5478  
 Mean xcor value = 0.82333  
 Range of  $t^*$  values is 1.097  
 Median  $t^*$  err is 0.22152



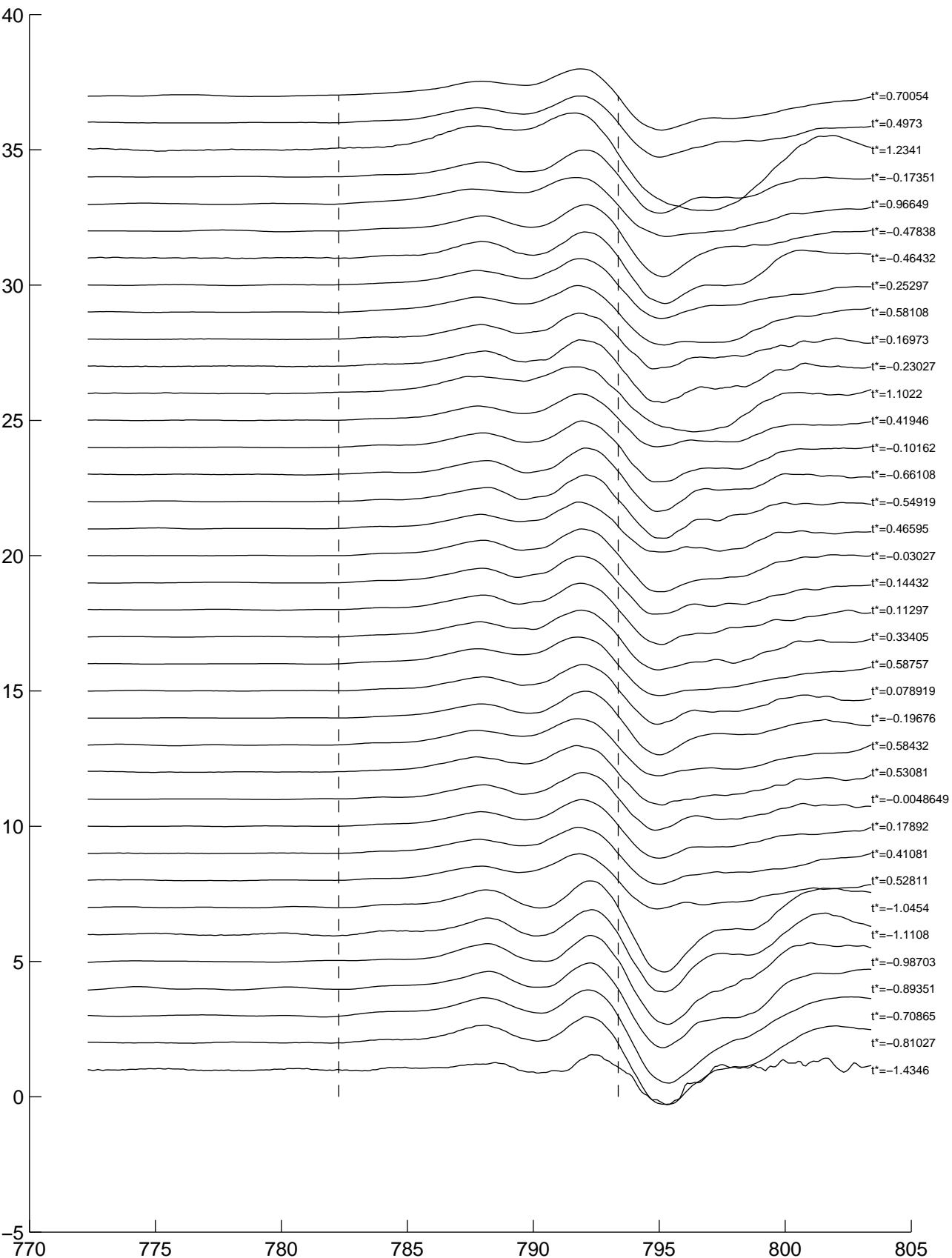
travel time residuals



$t^*$  values

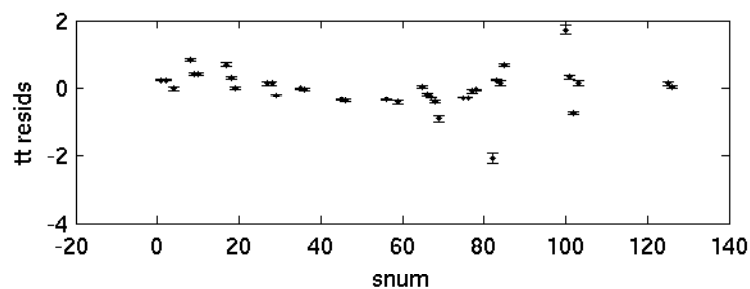
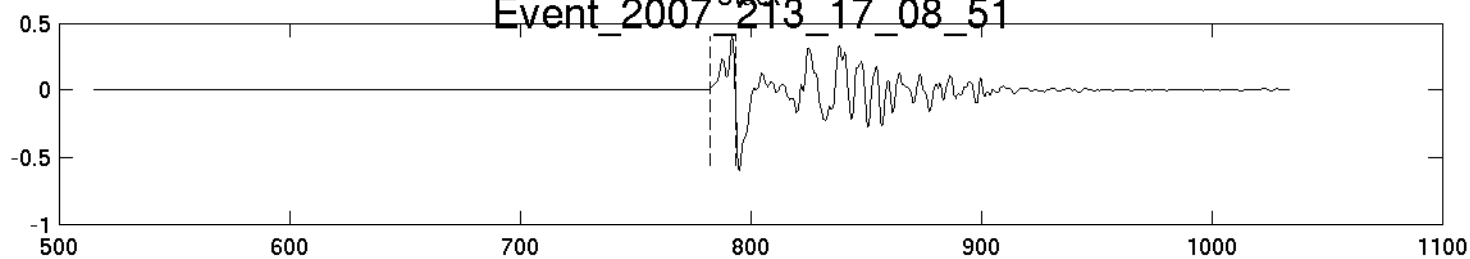


# Event\_2007\_213\_17\_08\_51

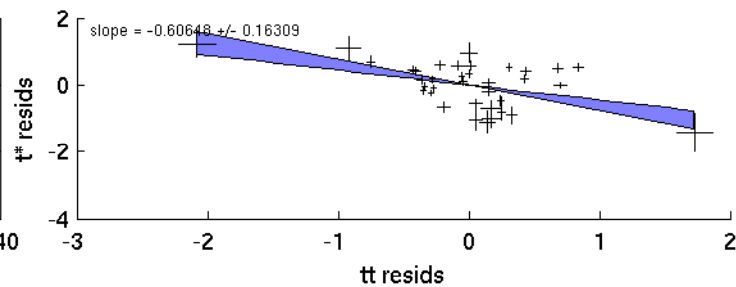
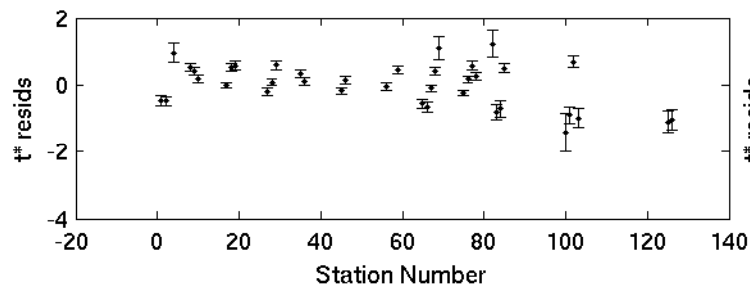




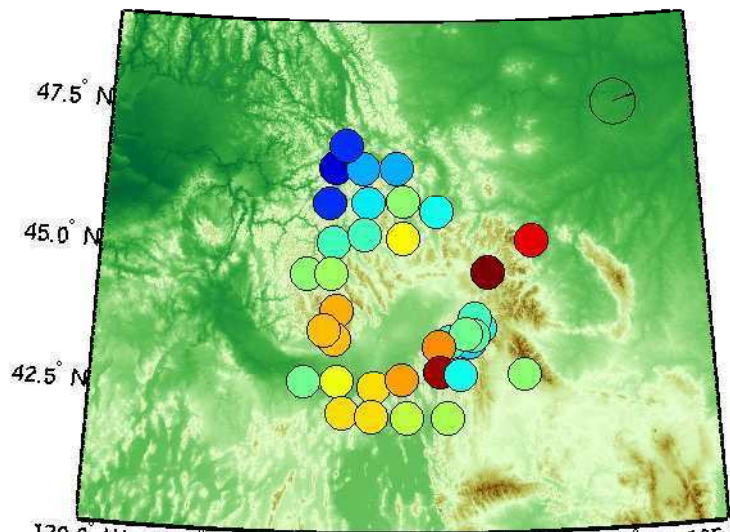
Event\_2007\_213\_17\_08\_51



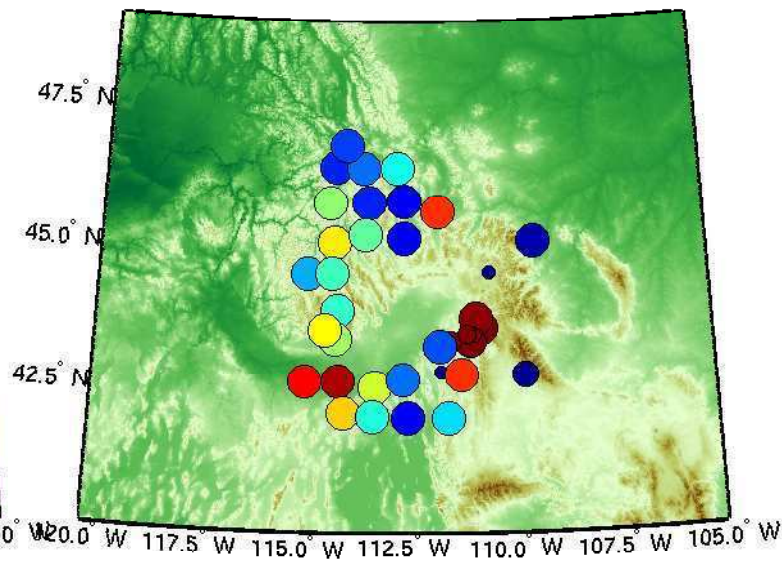
Baz = 251.8077  
Mean xcor value = 0.93378  
Range of  $t^*$  values is 2.6686  
Median  $t^*$  err is 0.13013



travel time residuals

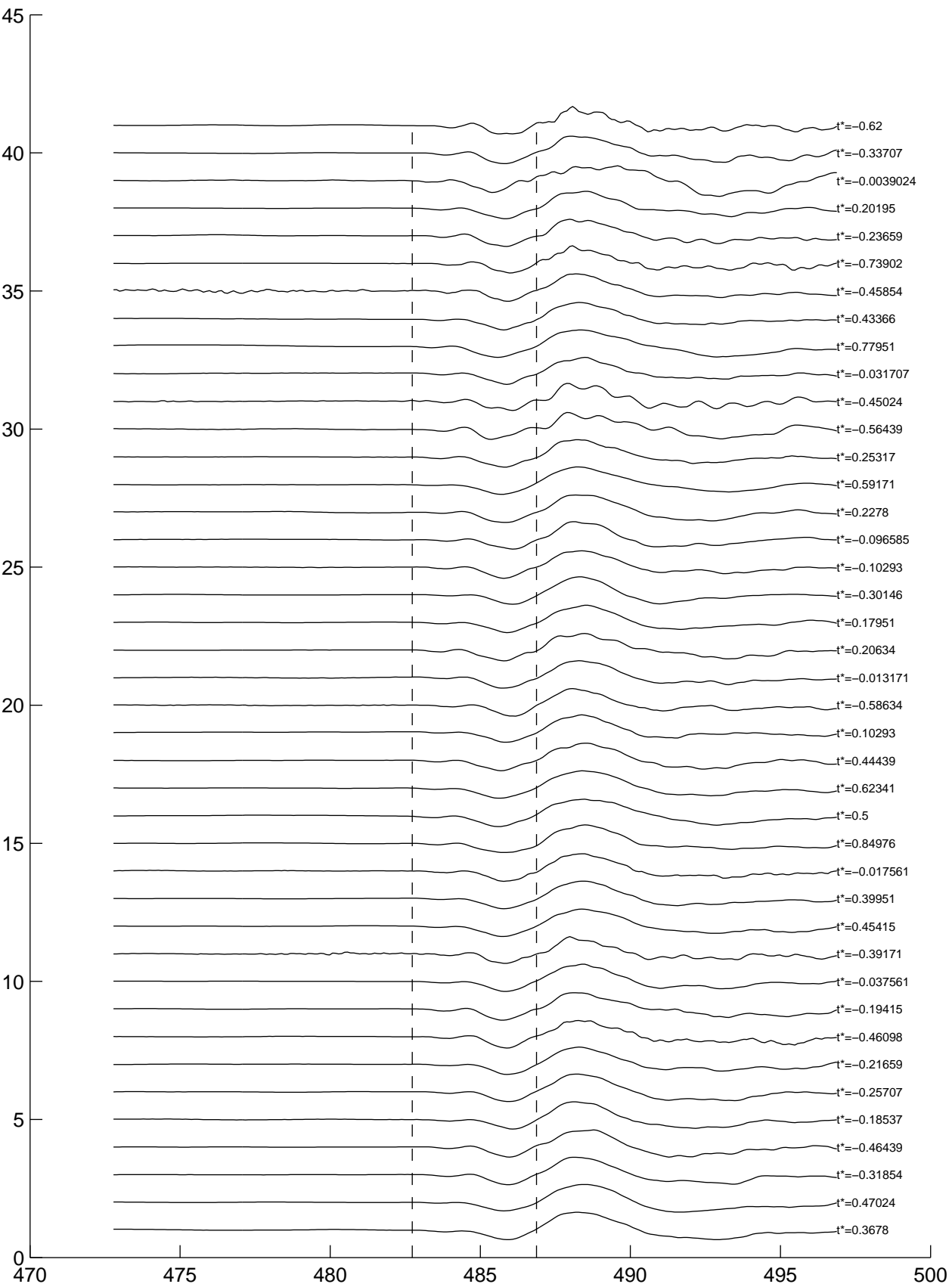


$t^*$  values

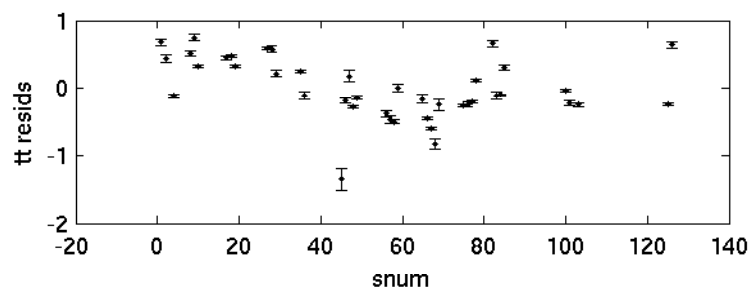
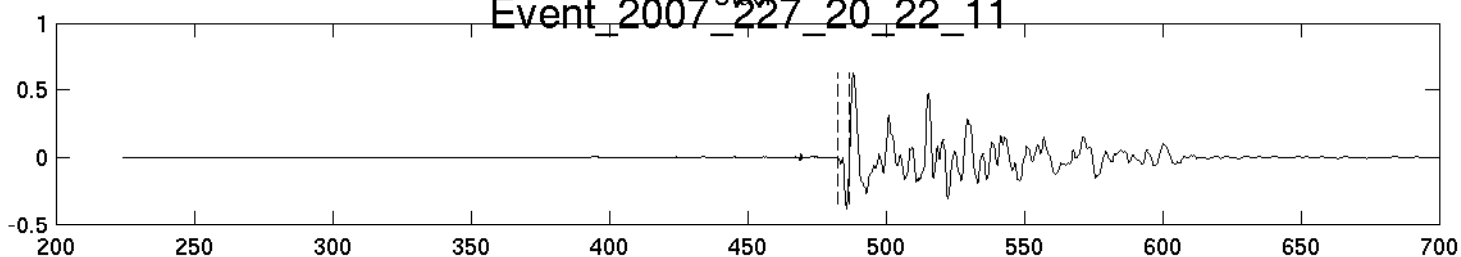




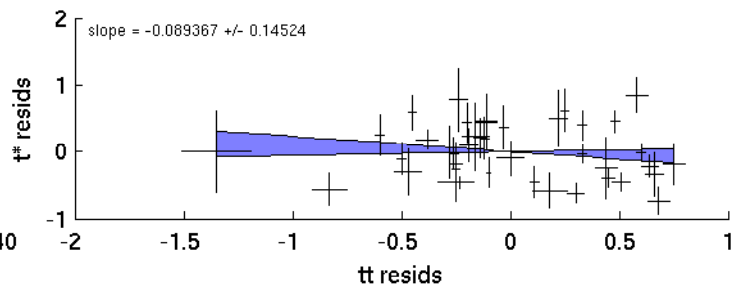
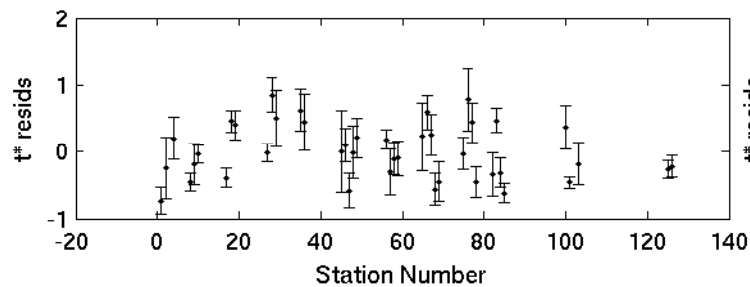
# Event\_2007\_227\_20\_22\_11



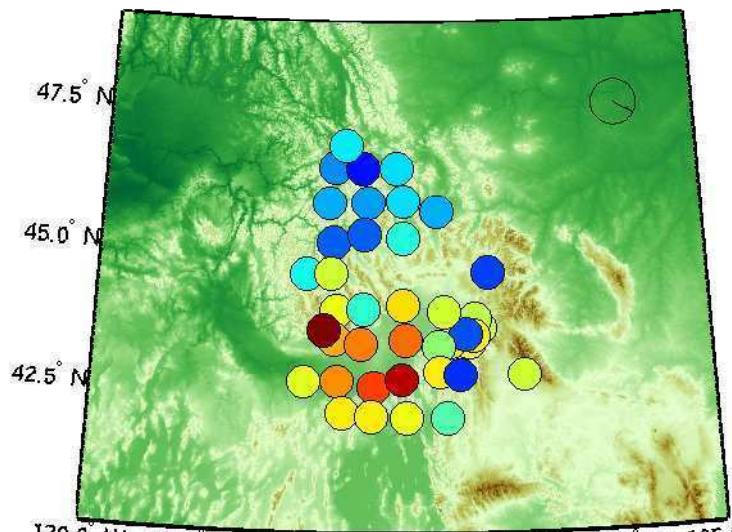
# Event\_2007\_227\_20\_22\_11



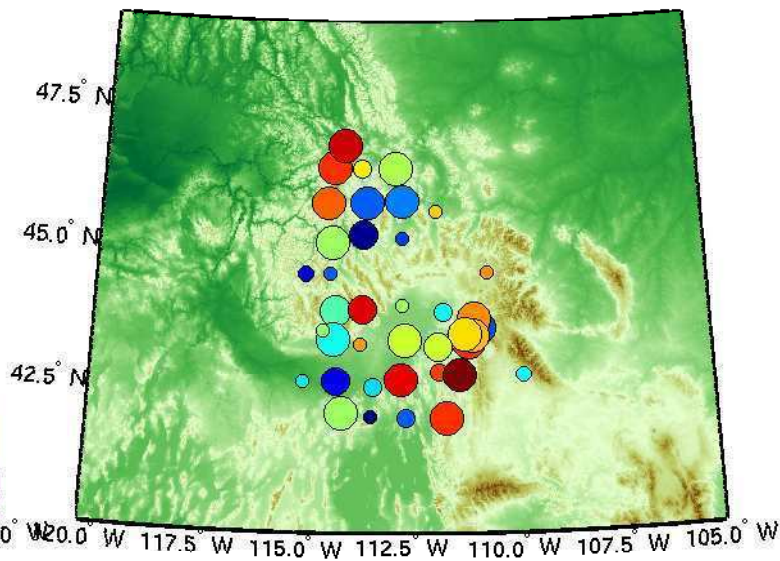
Baz = 302.332  
 Mean xcor value = 0.89463  
 Range of  $t^*$  values is 1.5888  
 Median  $t^*$  err is 0.25862



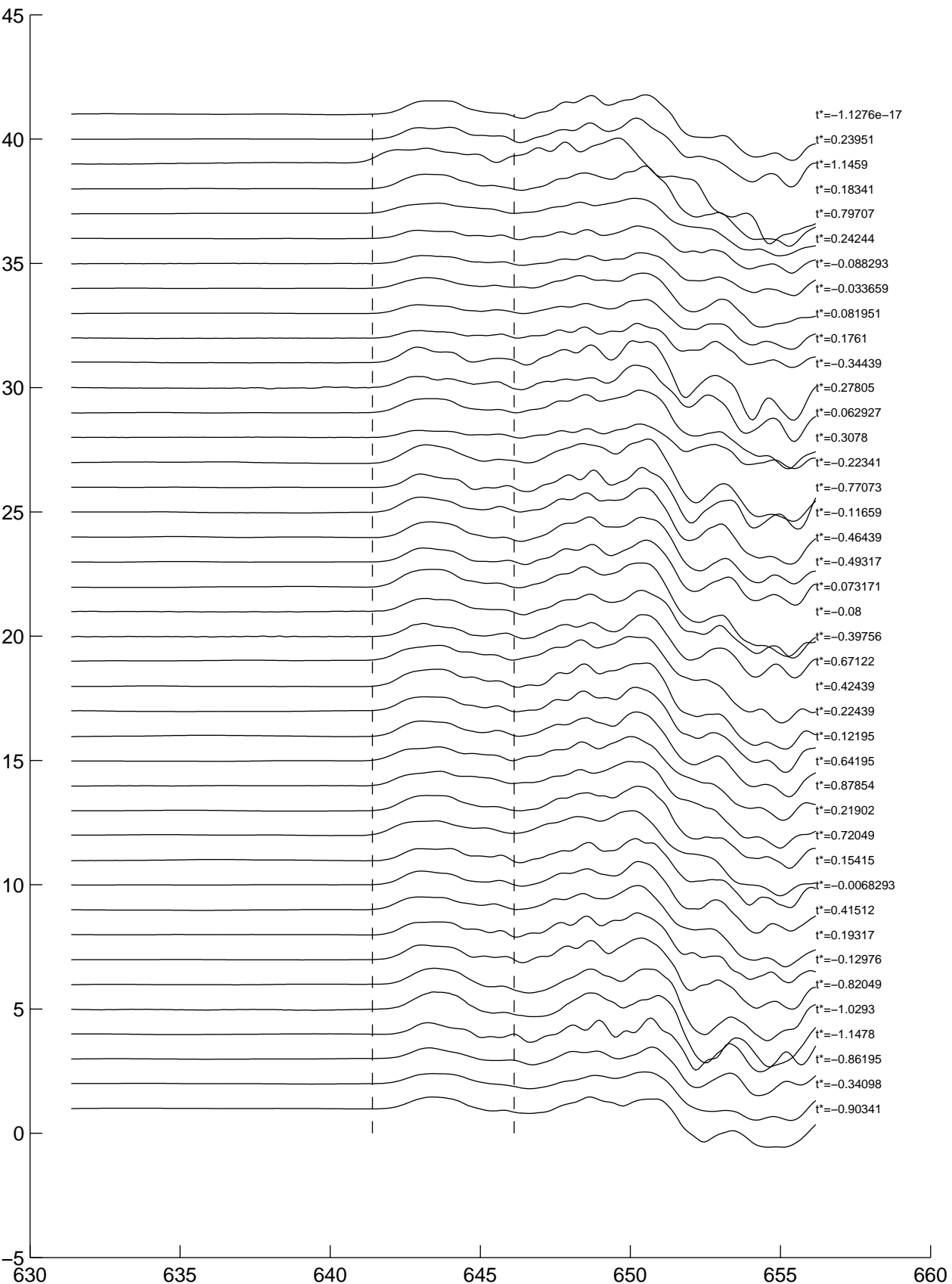
travel time residuals



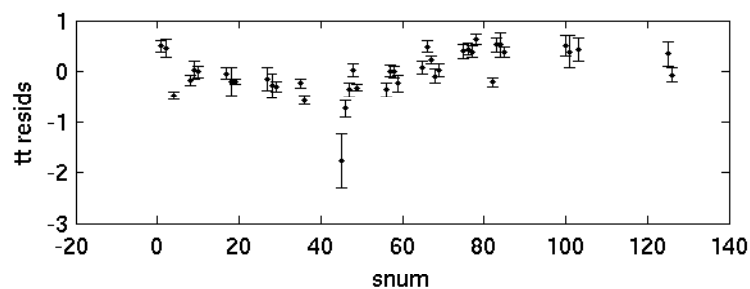
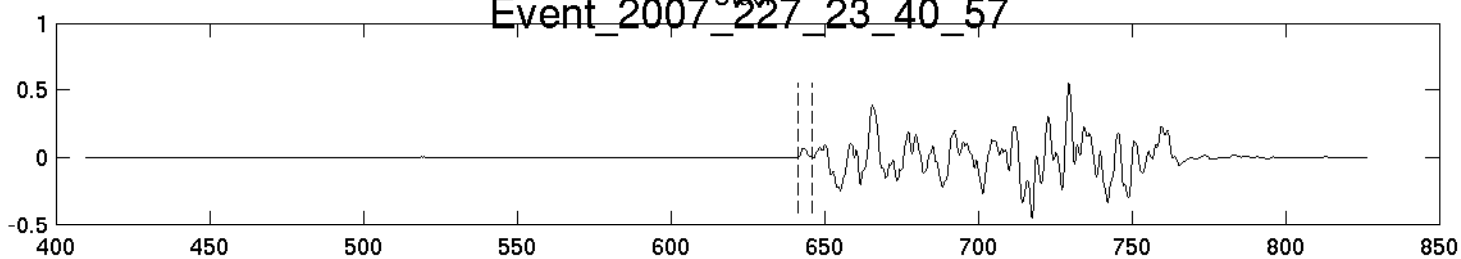
$t^*$  values



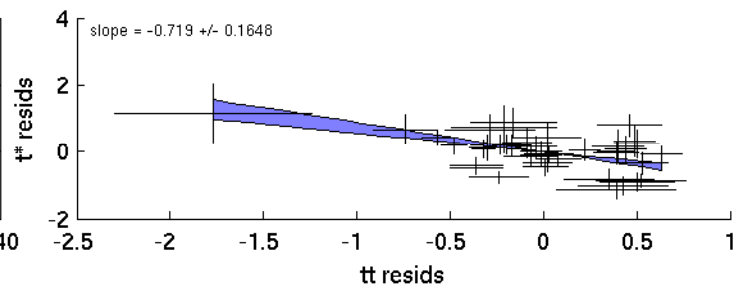
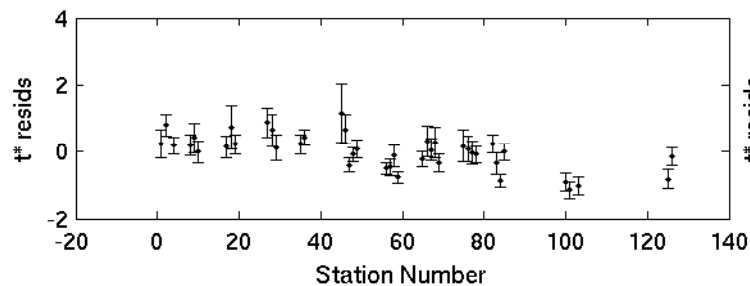
# Event\_2007\_227\_23\_40\_57



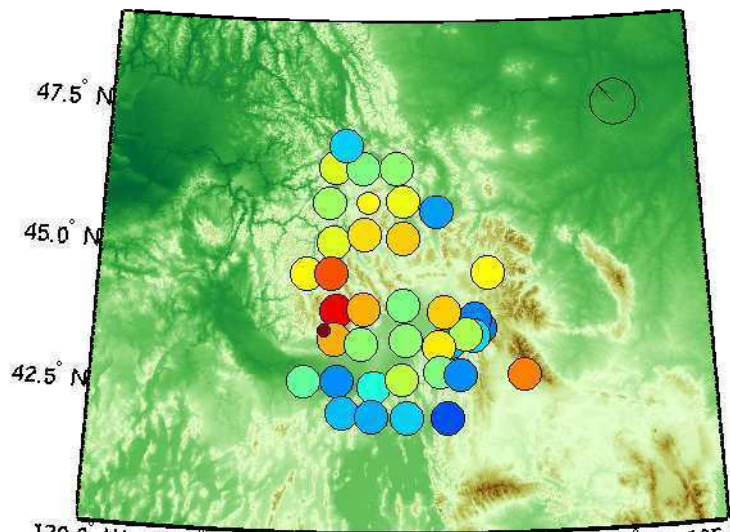
# Event\_2007\_227\_23\_40\_57



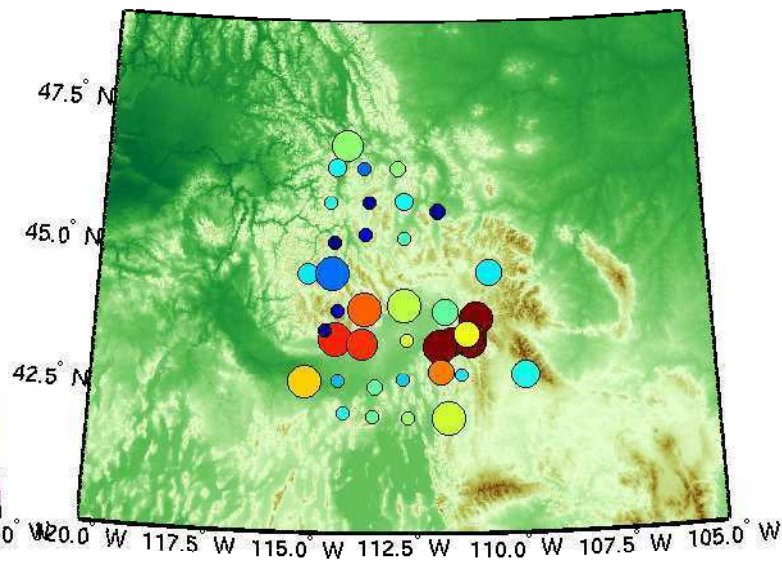
Baz = 141.3604  
 Mean xcor value = 0.90561  
 Range of  $t^*$  values is 2.2937  
 Median  $t^*$  err is 0.29757



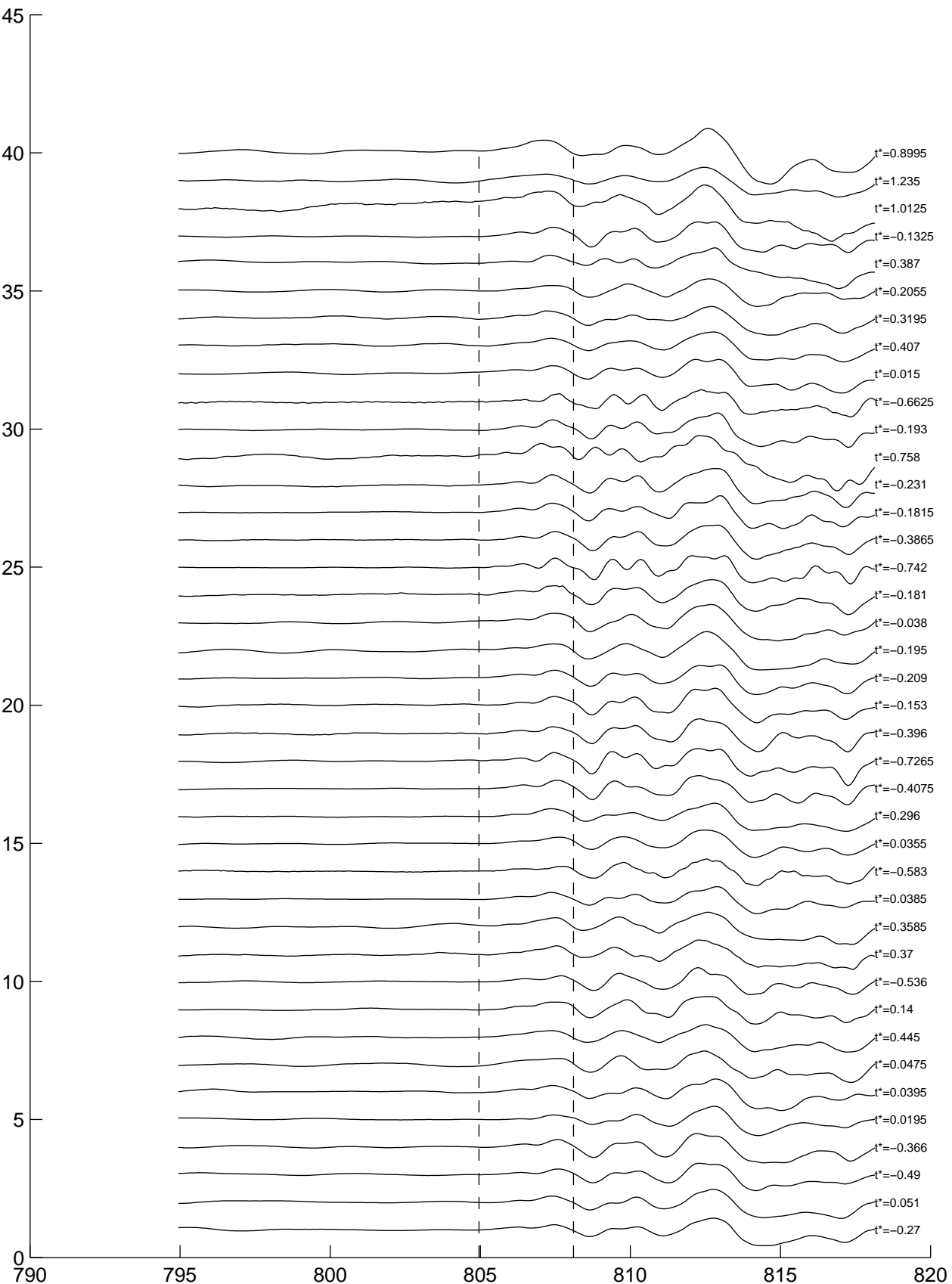
travel time residuals



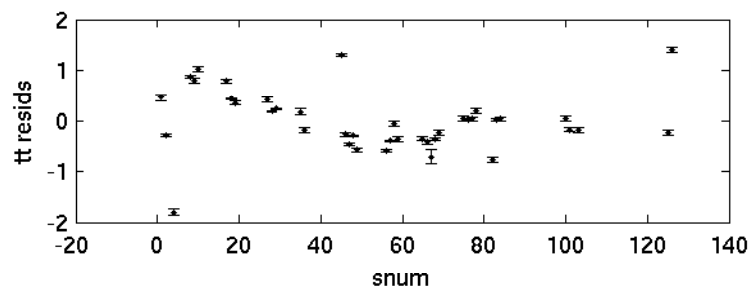
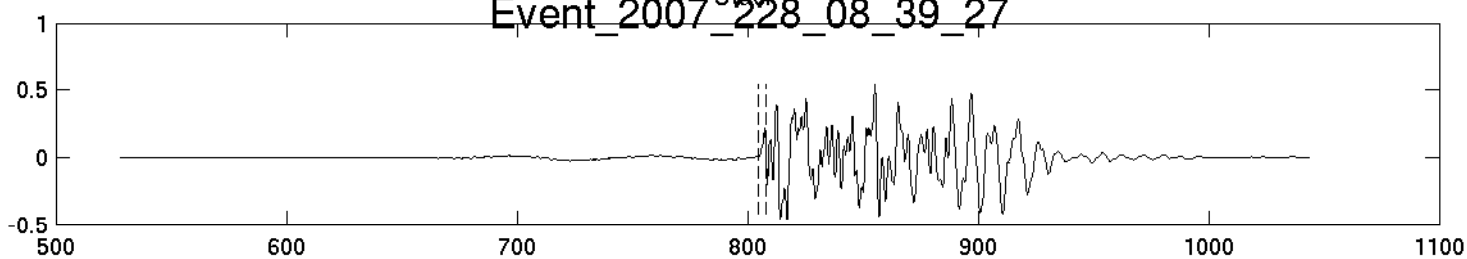
$t^*$  values



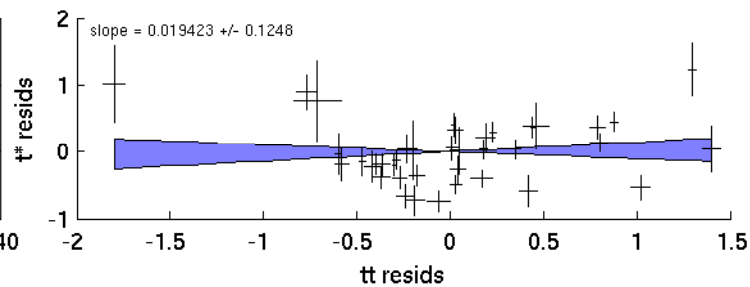
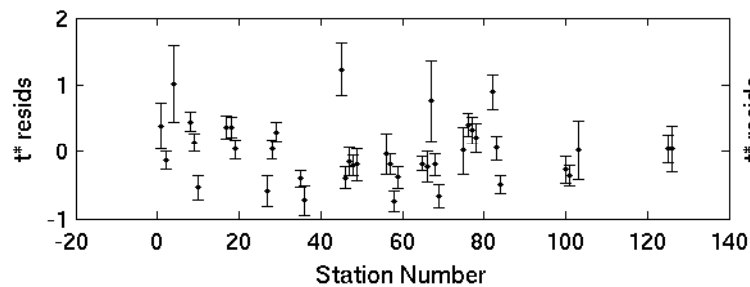
# Event\_2007\_228\_08\_39\_27



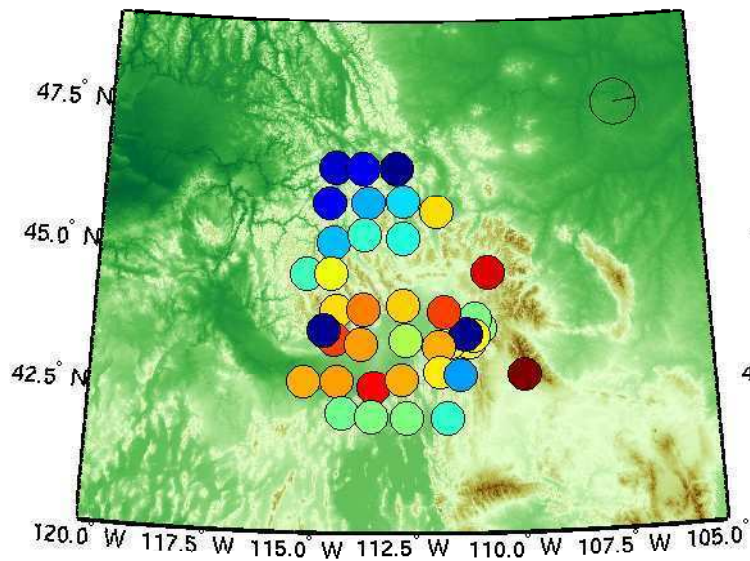
Event\_2007\_228\_08\_39\_27



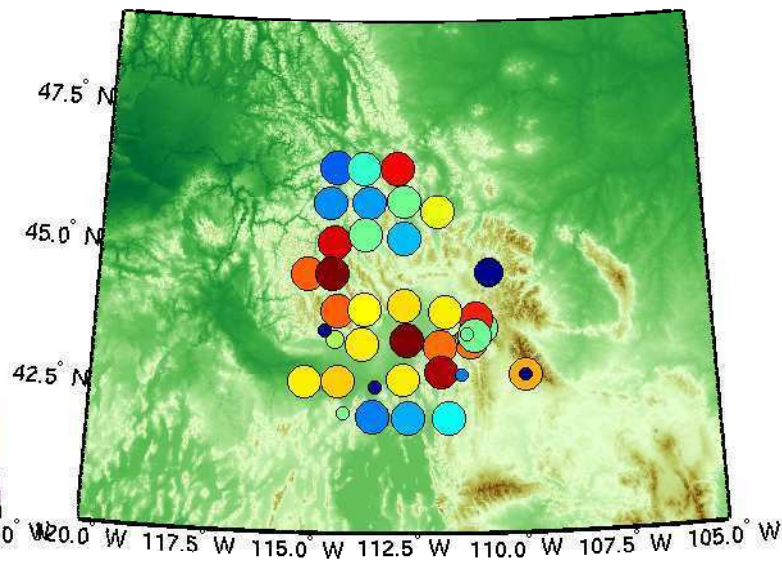
Baz = 261.5356  
Mean xcor value = 0.84925  
Range of  $t^*$  values is 1.977  
Median  $t^*$  err is 0.17609



travel time residuals

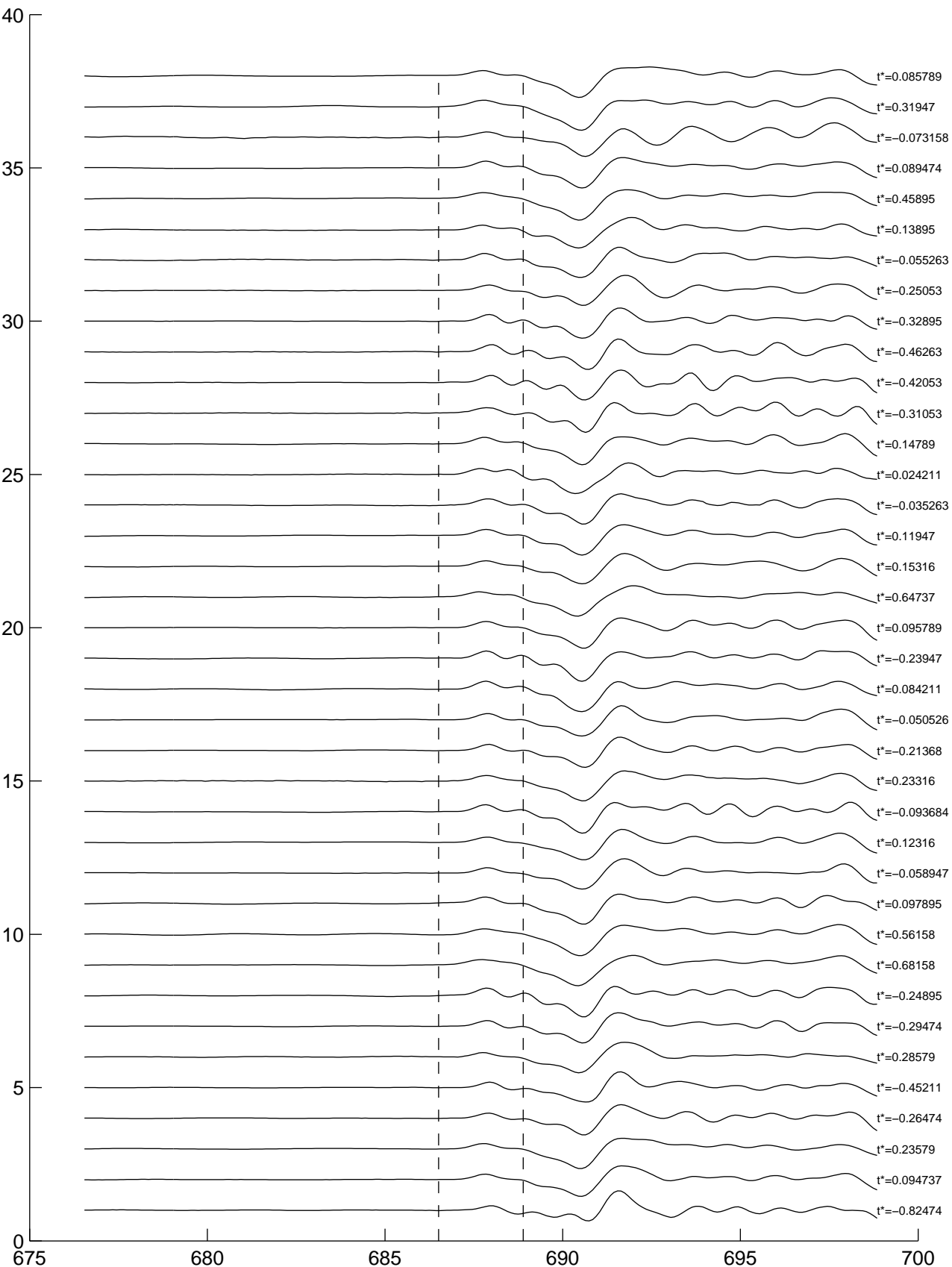


$t^*$  values



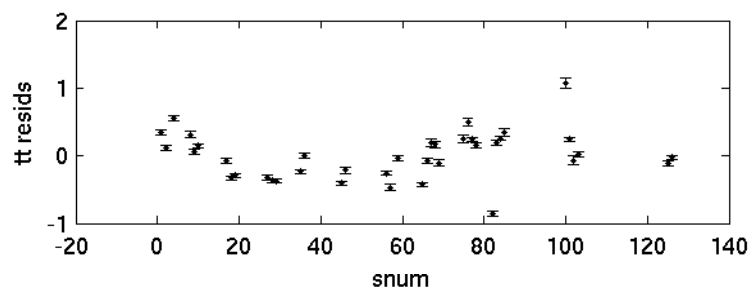
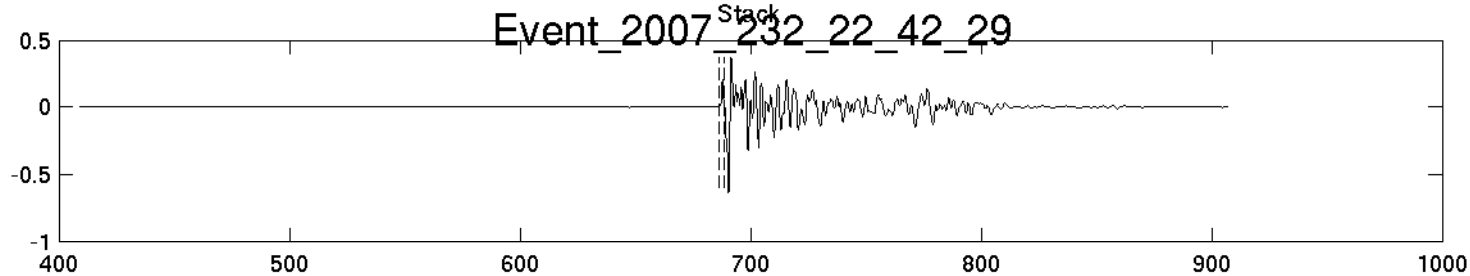


# Event\_2007\_232\_22\_42\_29

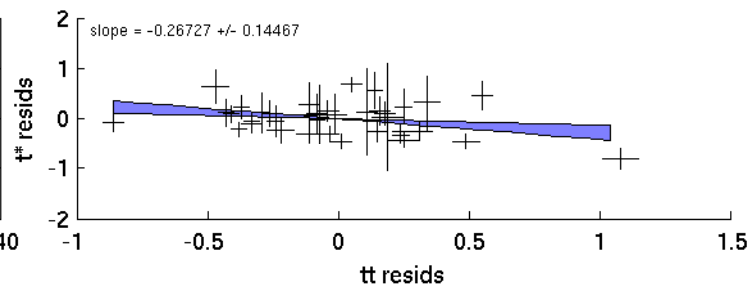
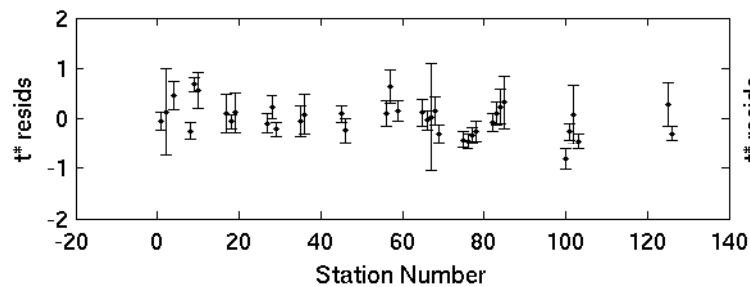




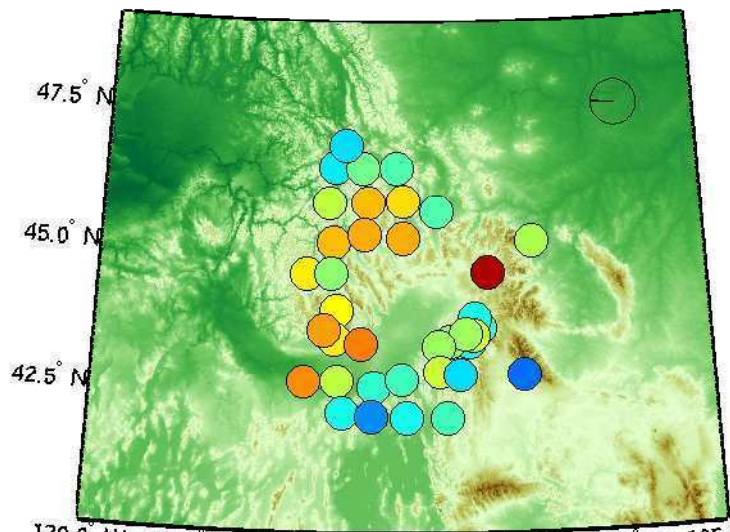
# Event\_2007\_232\_22\_42\_29



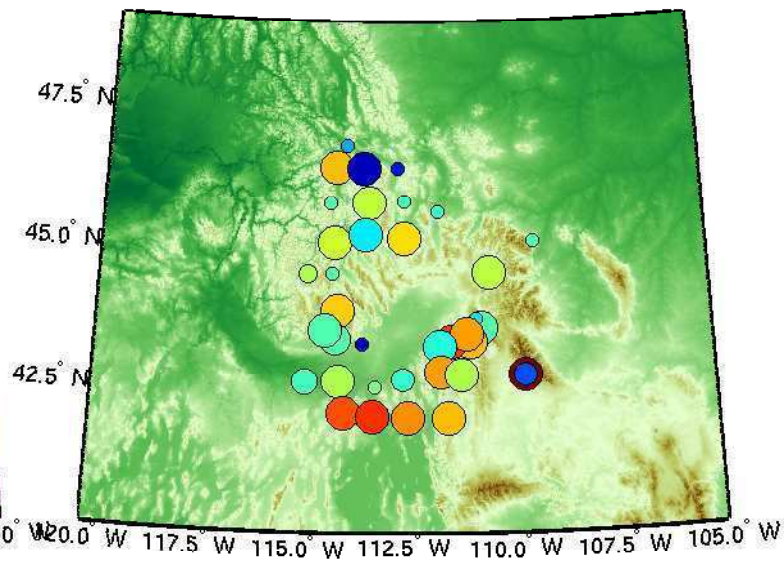
Baz = 95.8614  
 Mean xcor value = 0.85632  
 Range of  $t^*$  values is 1.5063  
 Median  $t^*$  err is 0.21785



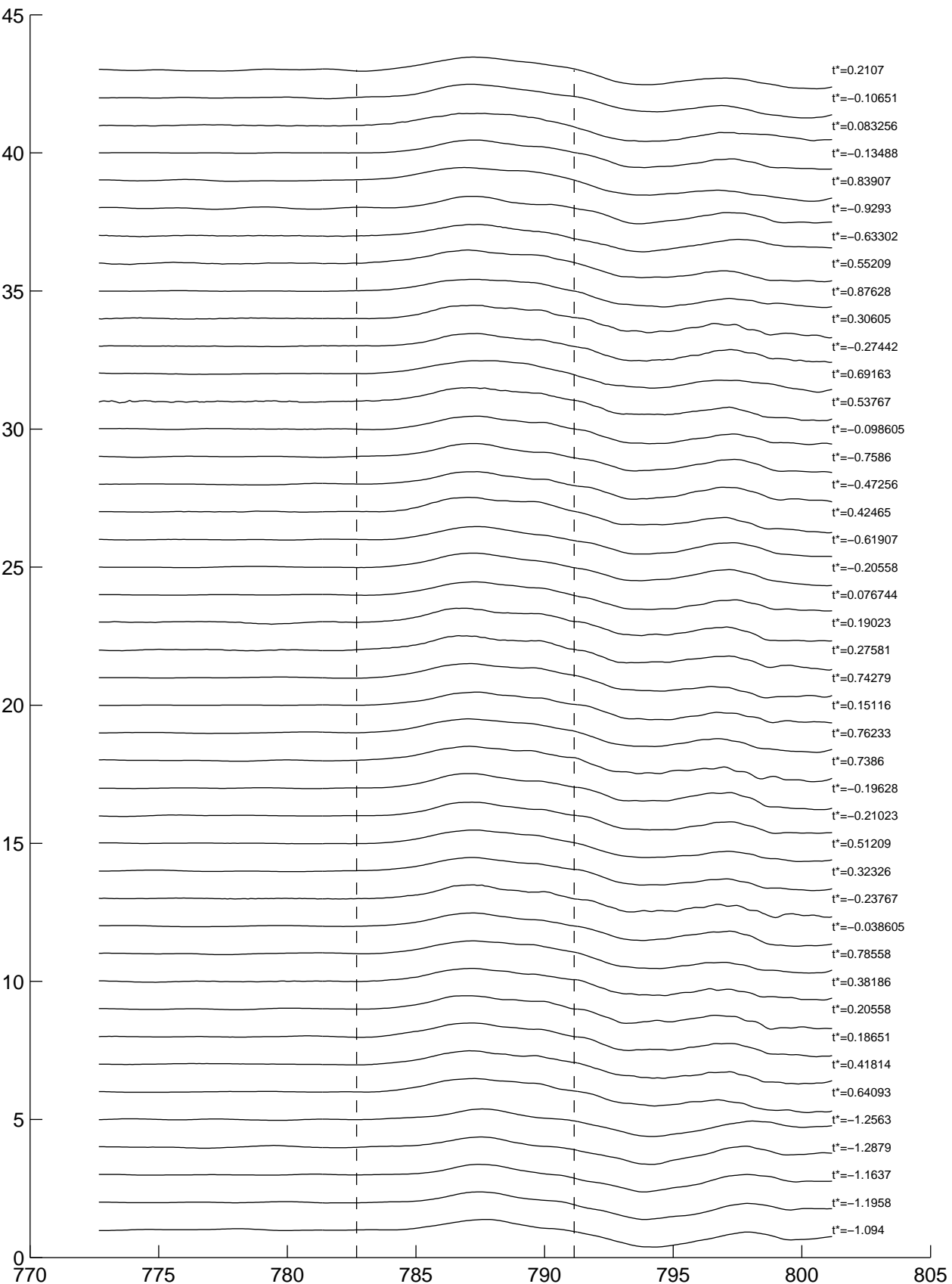
travel time residuals



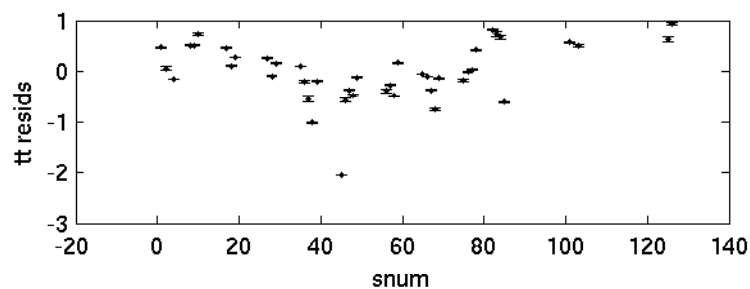
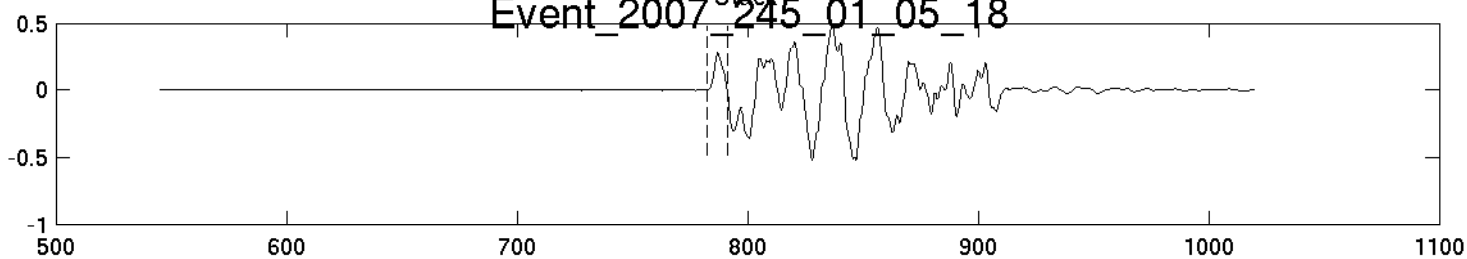
$t^*$  values



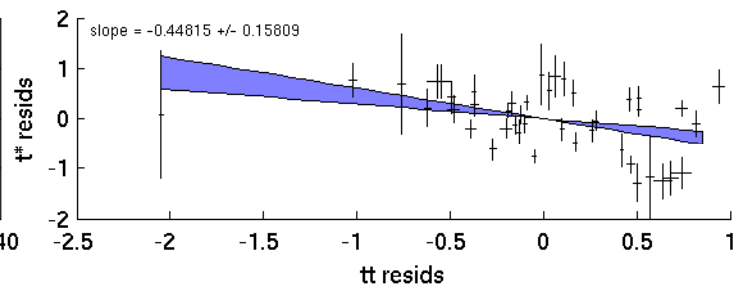
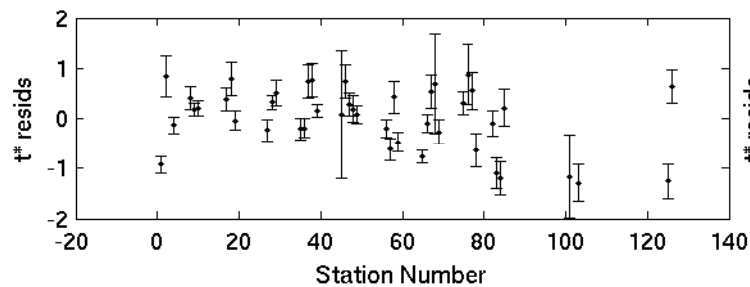
# Event\_2007\_245\_01\_05\_18



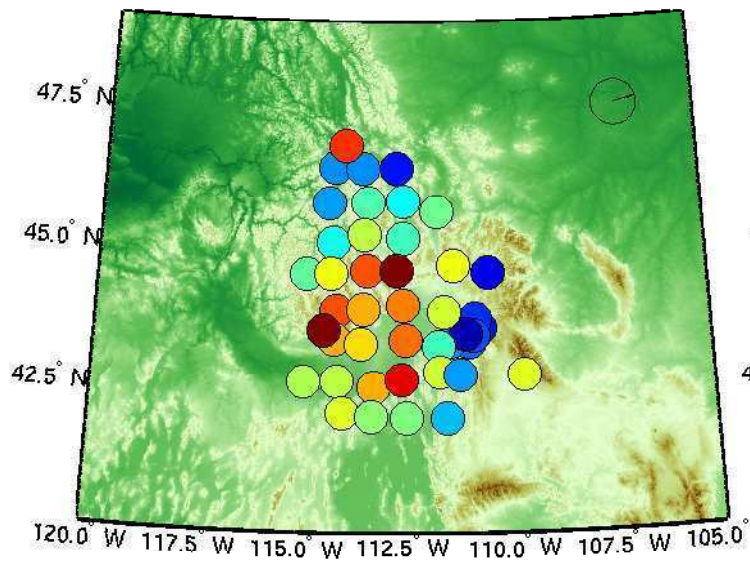
Event\_2007\_245\_01\_05\_18



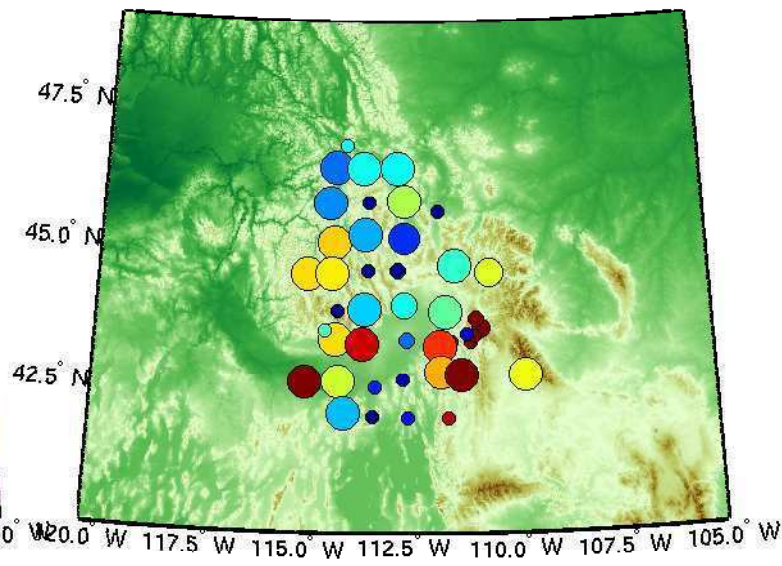
Baz = 255.9024  
Mean xcor value = 0.91767  
Range of  $t^*$  values is 2.1642  
Median  $t^*$  err is 0.25377



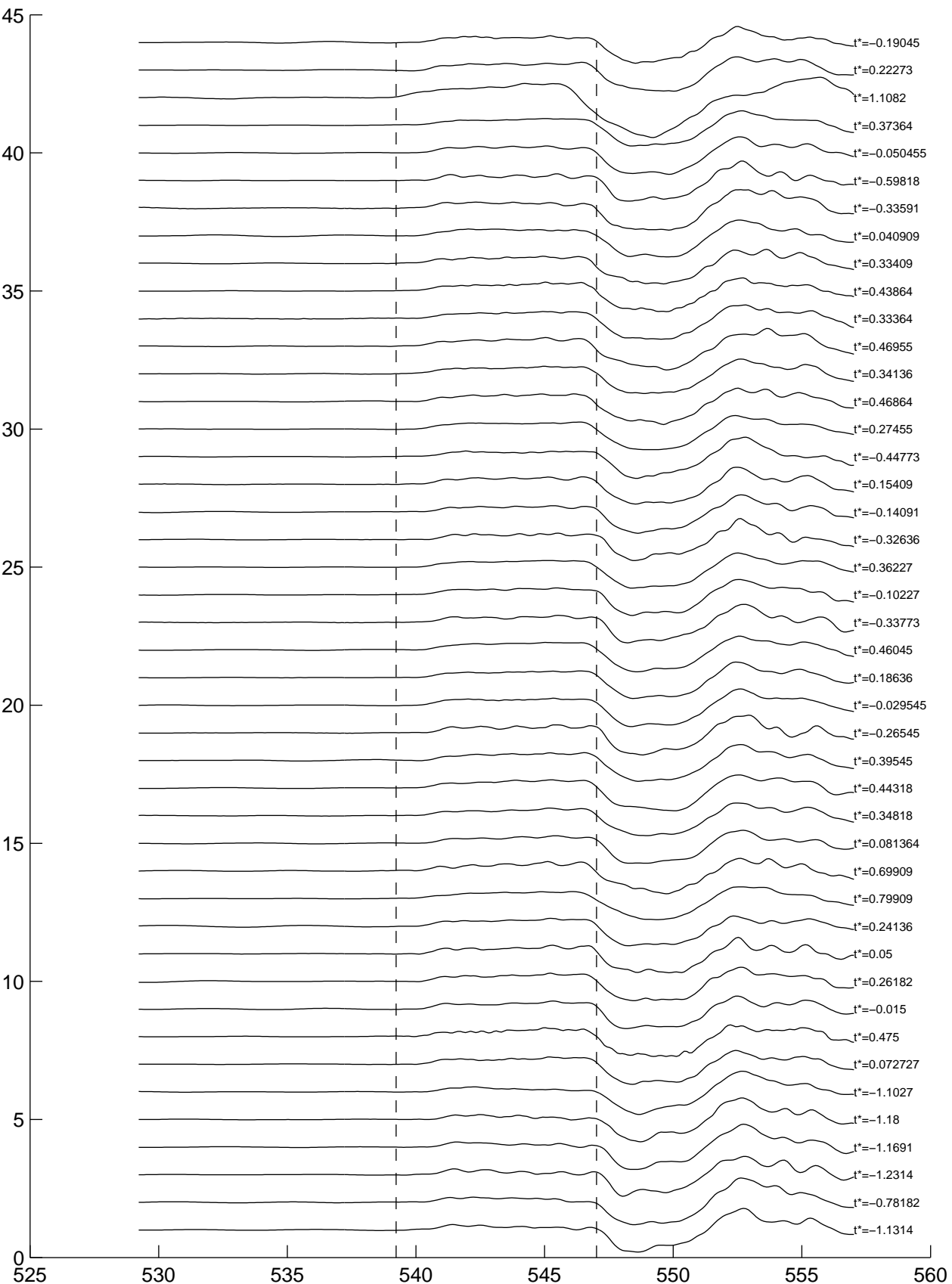
travel time residuals



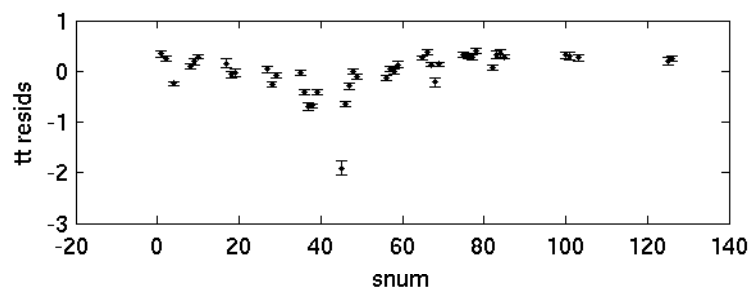
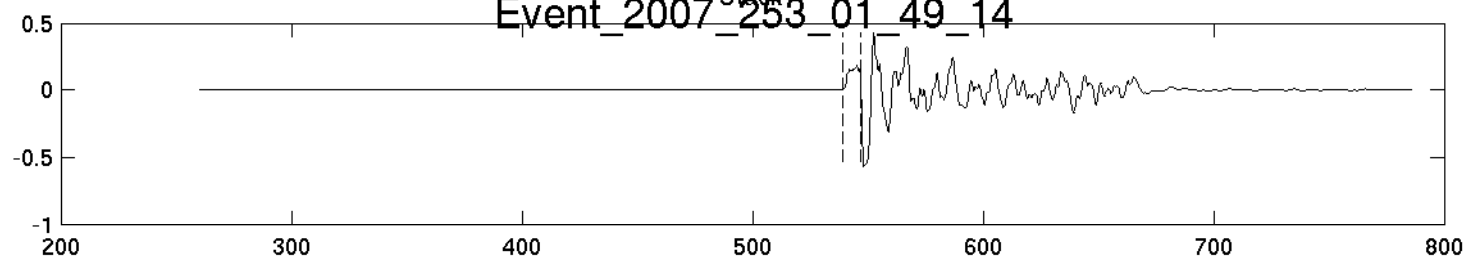
$t^*$  values



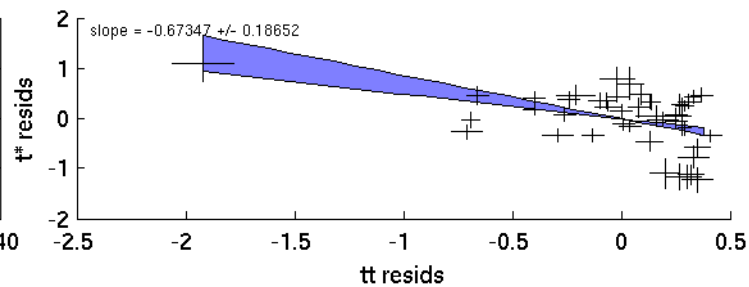
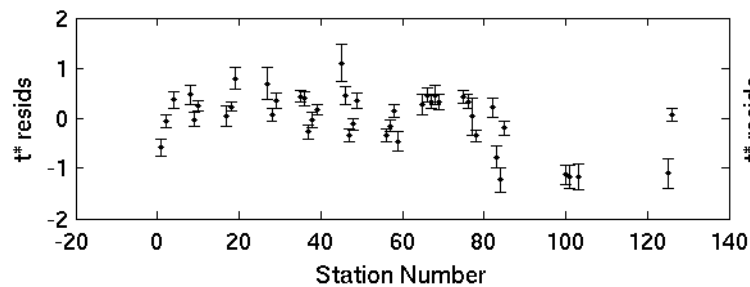
# Event\_2007\_253\_01\_49\_14



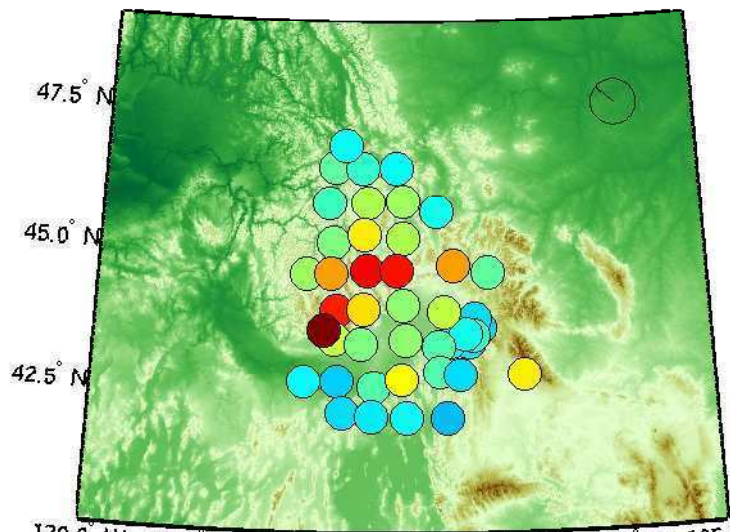
Event\_2007\_253\_01\_49\_14



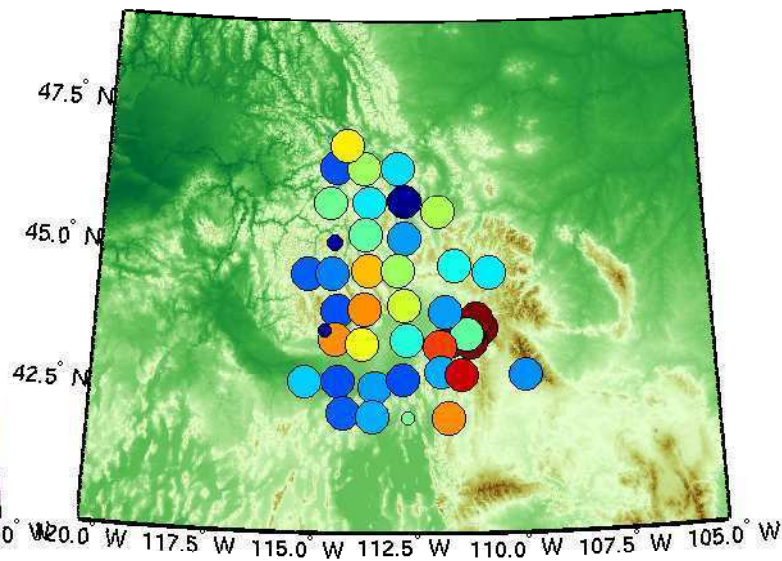
Baz = 133.3384  
Mean xcor value = 0.93523  
Range of  $t^*$  values is 2.3395  
Median  $t^*$  err is 0.1498



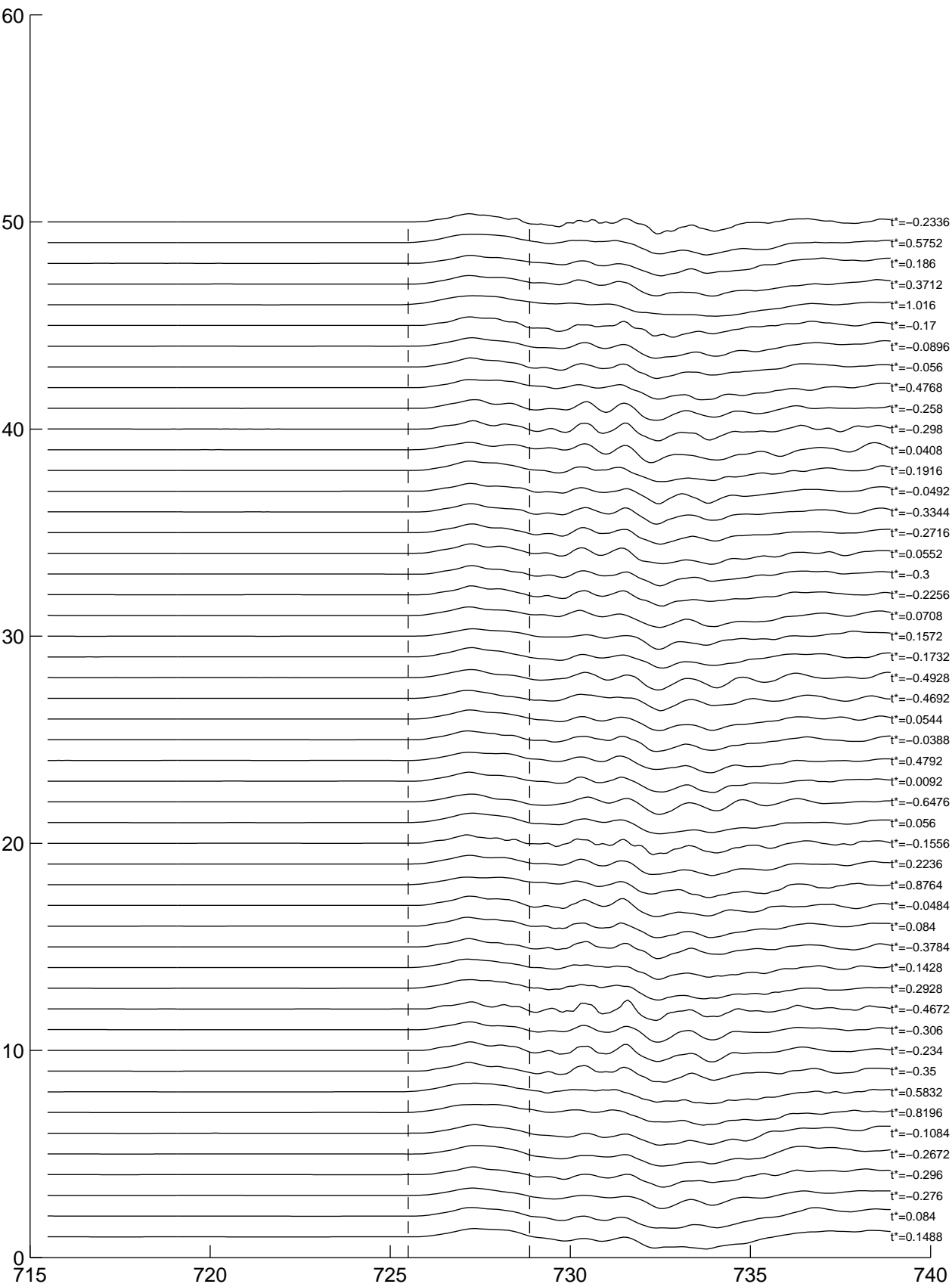
travel time residuals



$t^*$  values

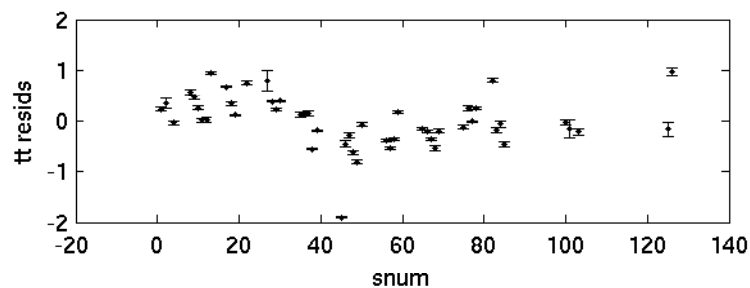
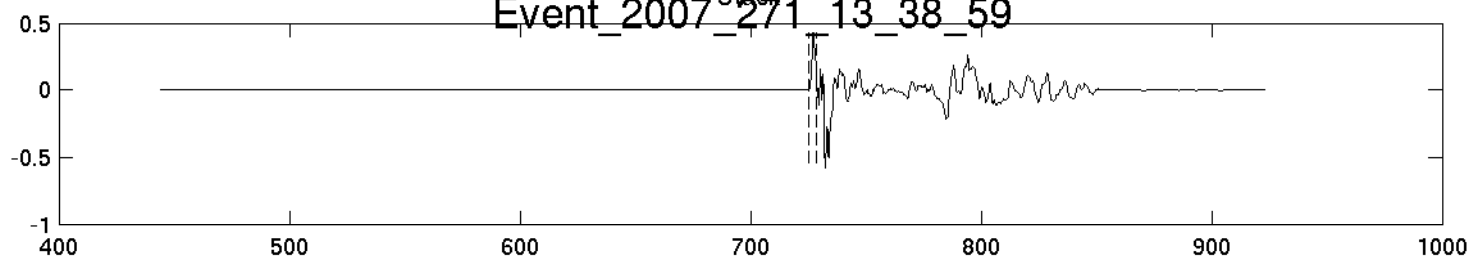


# Event\_2007\_271\_13\_38\_59

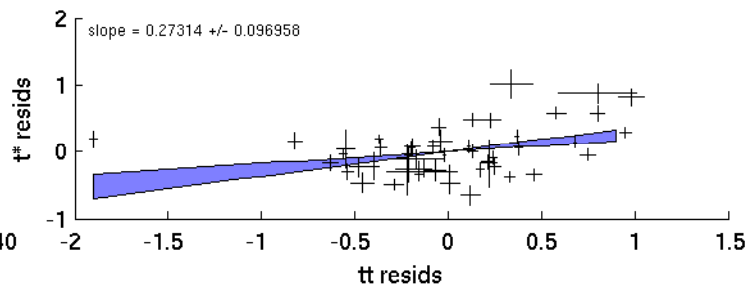
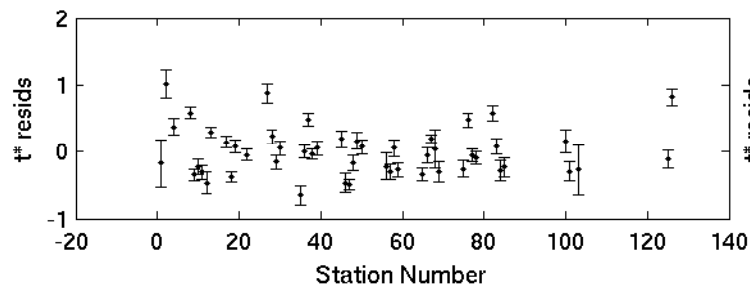




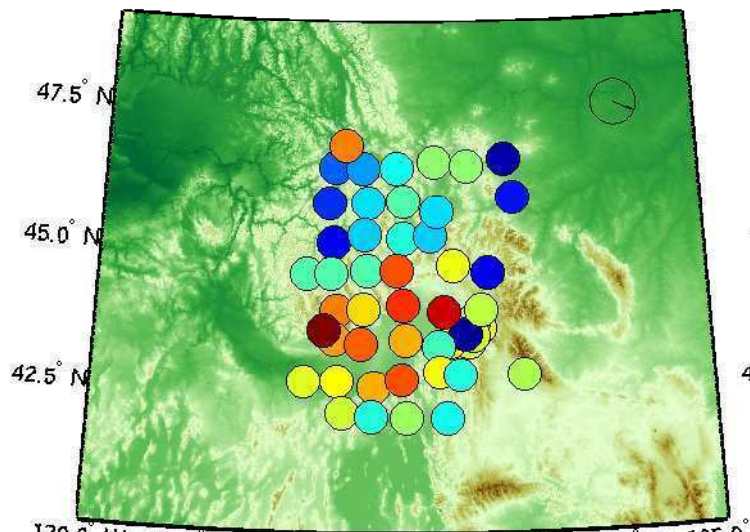
# Event\_2007\_271\_13\_38\_59



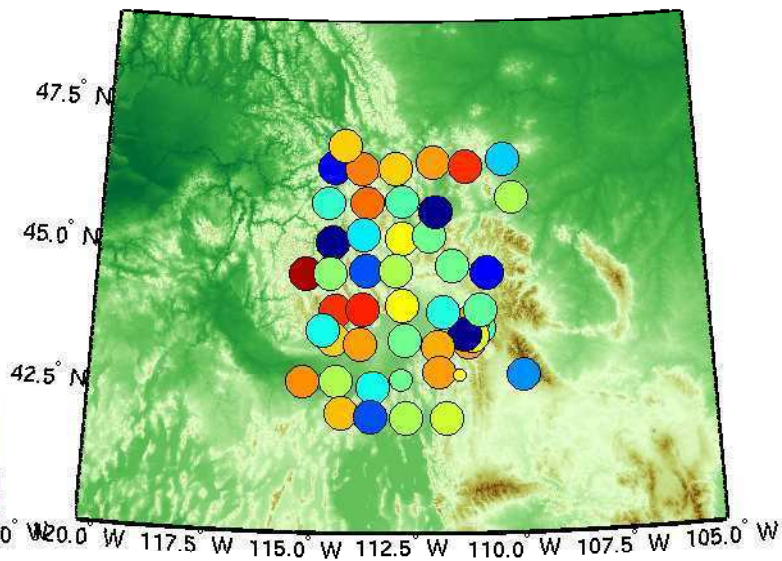
Baz = 295.9809  
Mean xcor value = 0.8786  
Range of  $t^*$  values is 1.6636  
Median  $t^*$  err is 0.1133



travel time residuals

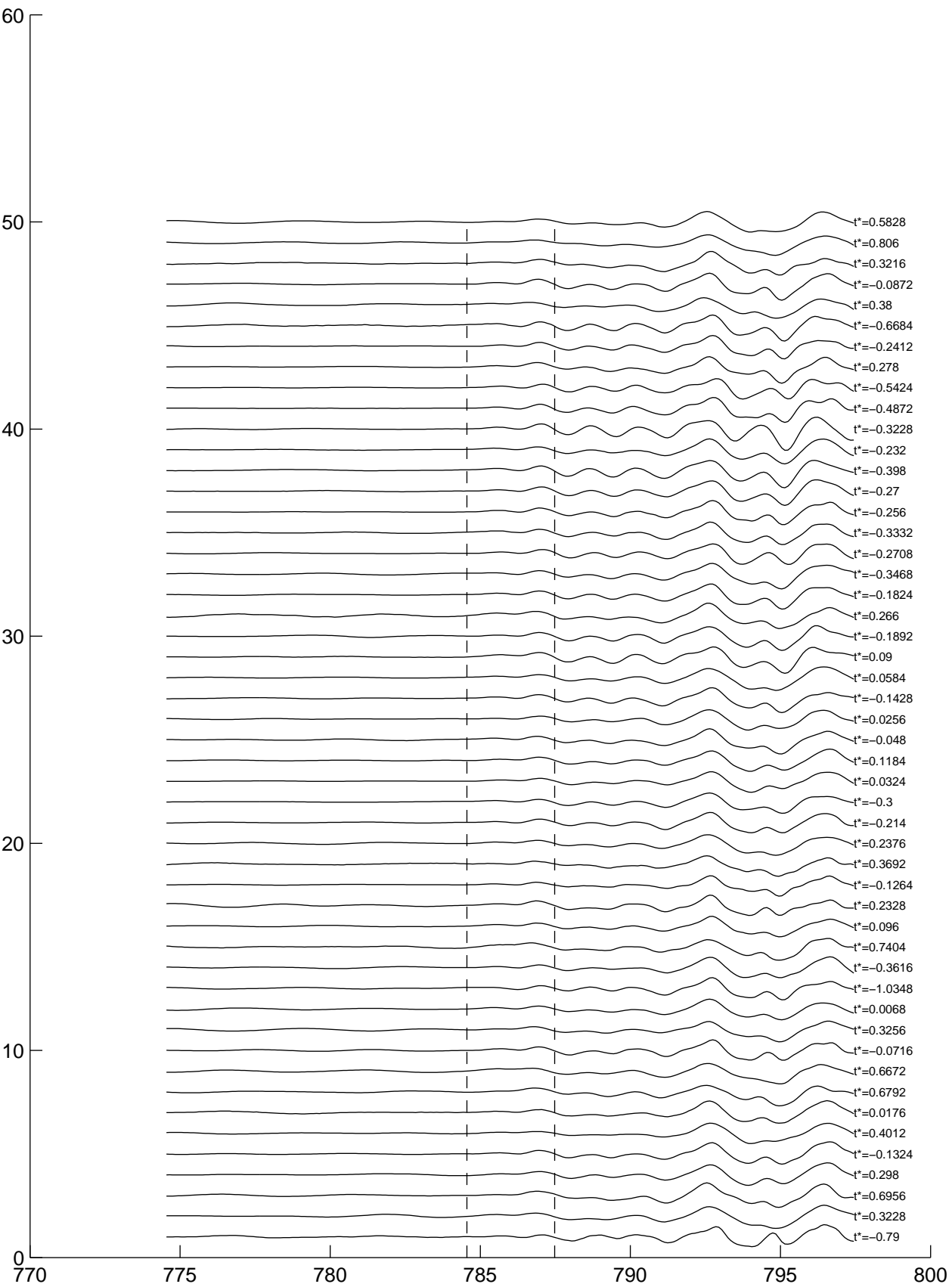


$t^*$  values

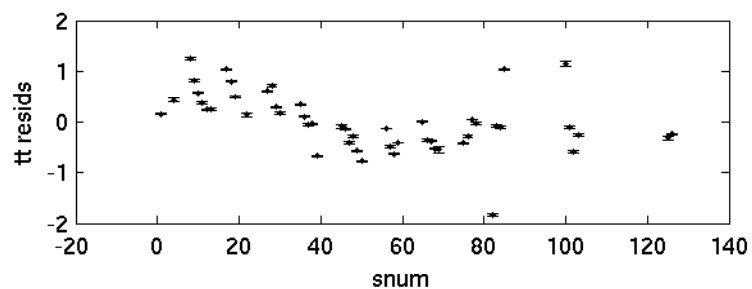
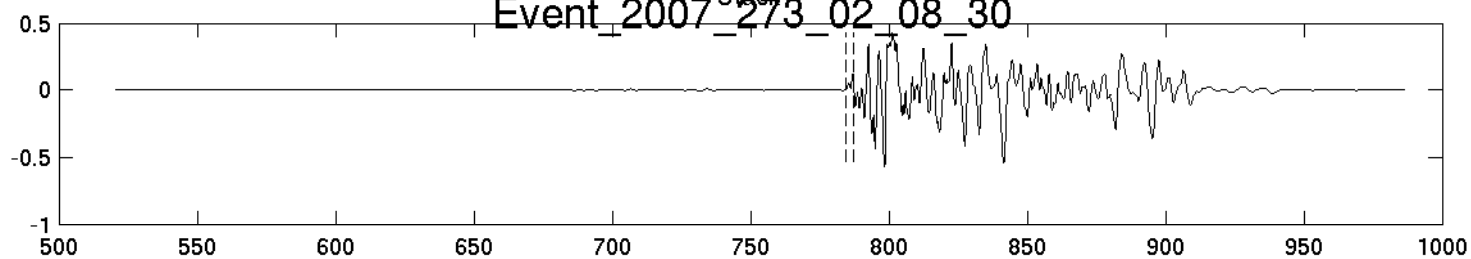




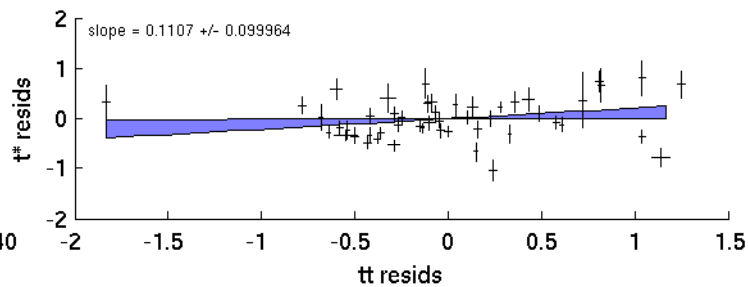
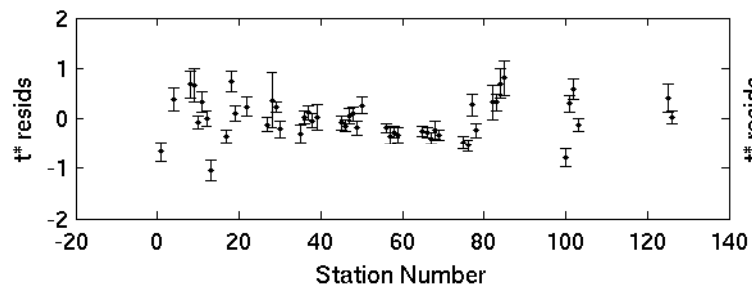
# Event\_2007\_273\_02\_08\_30



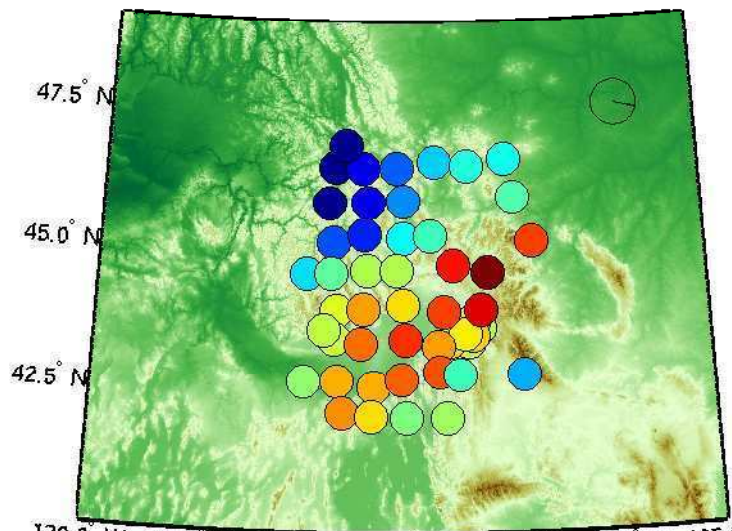
Event\_2007\_273\_02\_08\_30



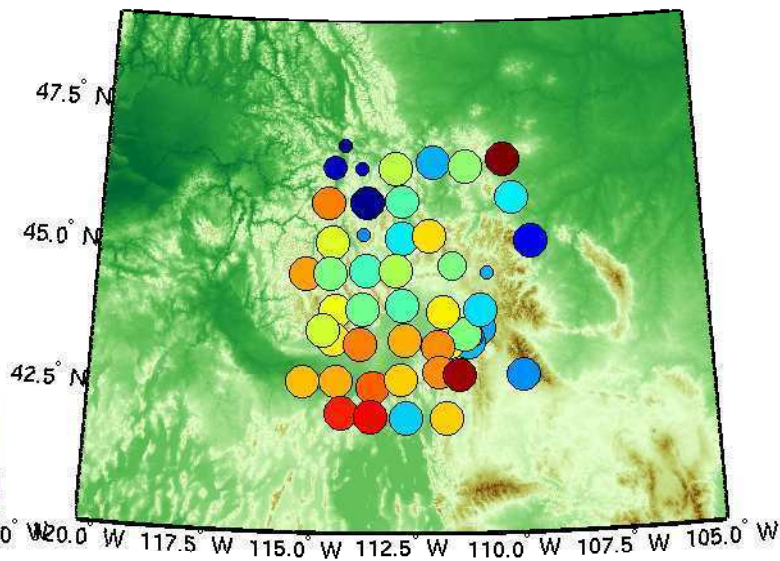
Baz = 285.7999  
 Mean xcor value = 0.8966  
 Range of  $t^*$  values is 1.8408  
 Median  $t^*$  err is 0.15383



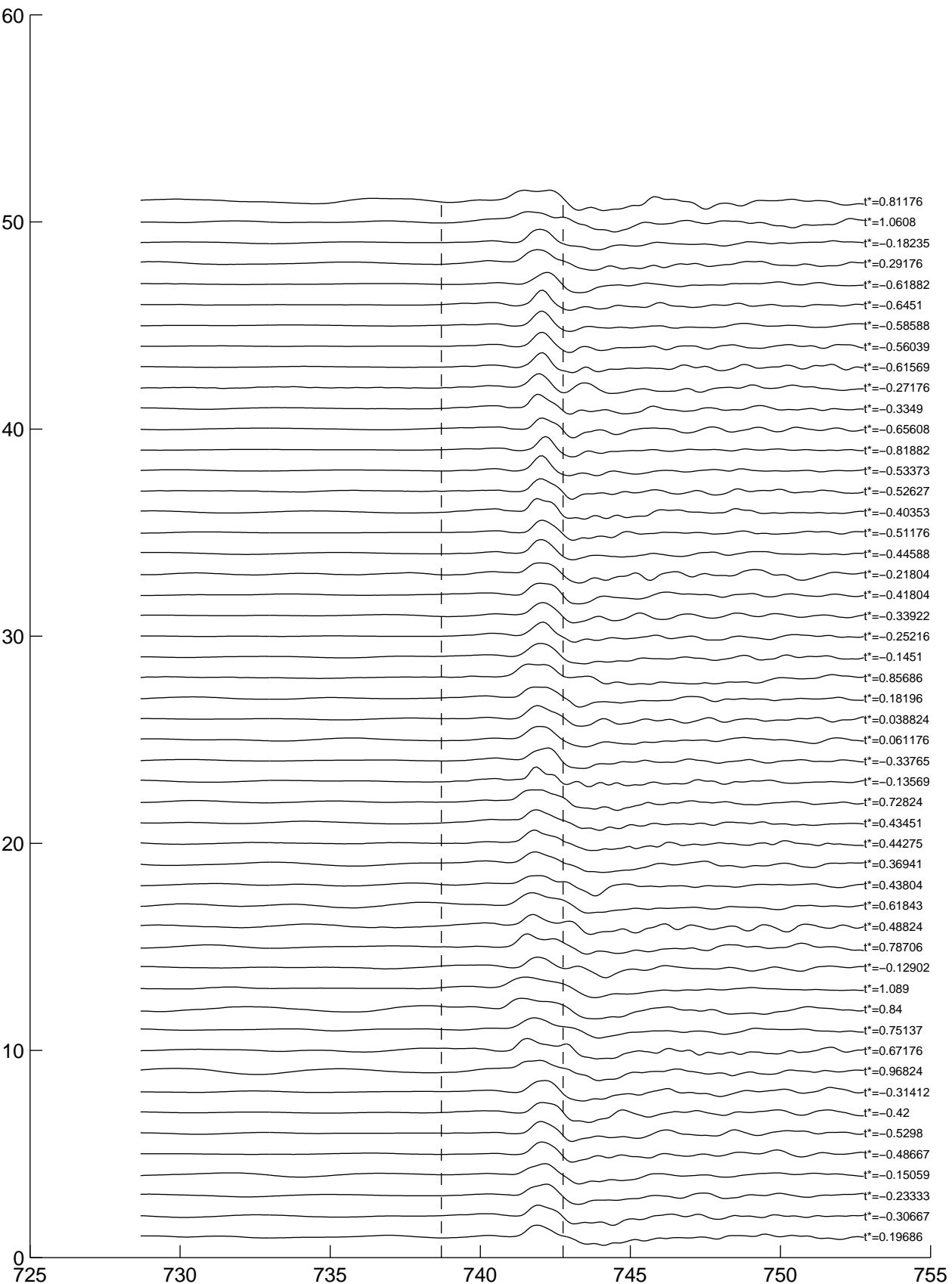
travel time residuals



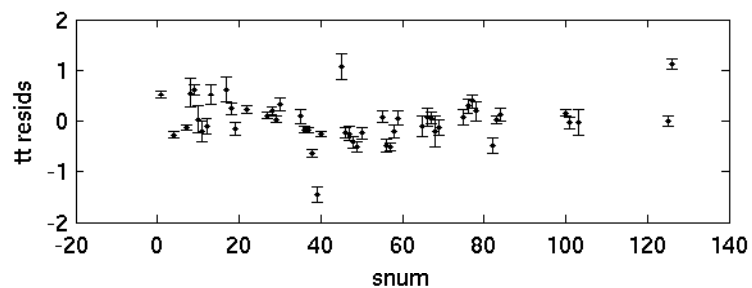
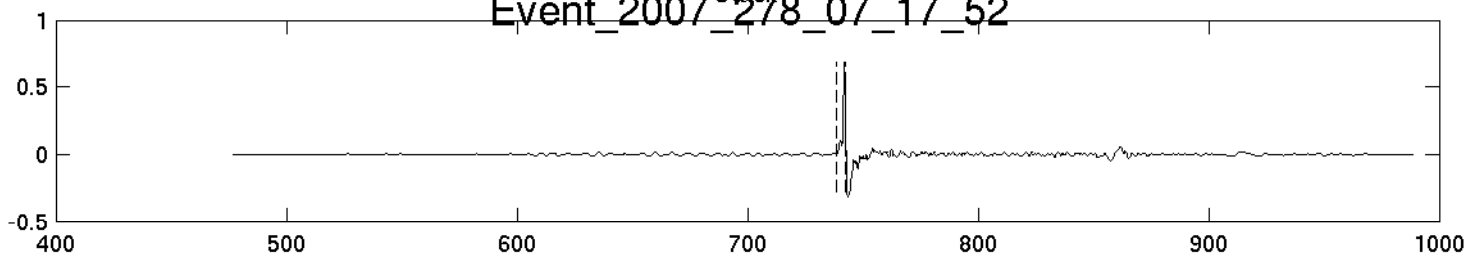
$t^*$  values



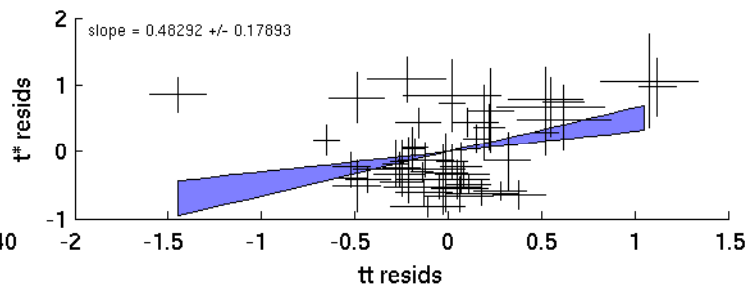
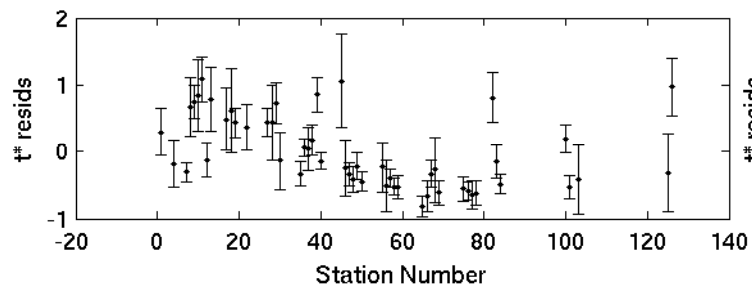
# Event\_2007\_278\_07\_17\_52



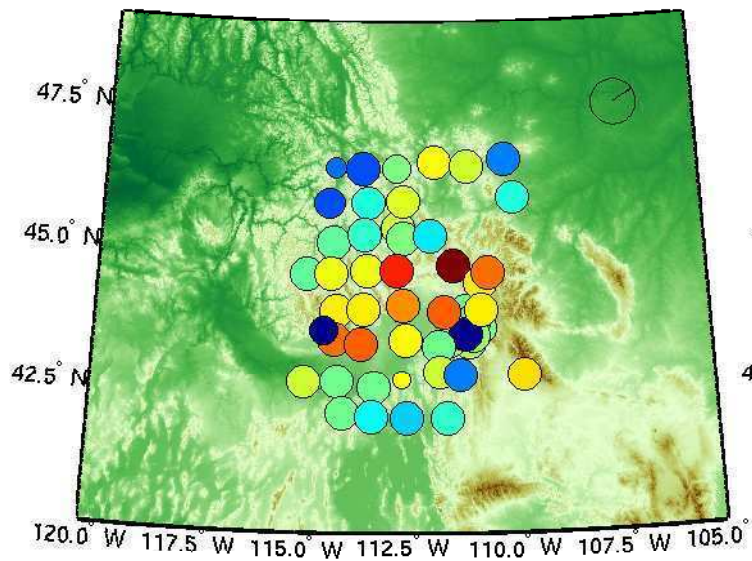
# Event\_2007\_278\_07\_17\_52



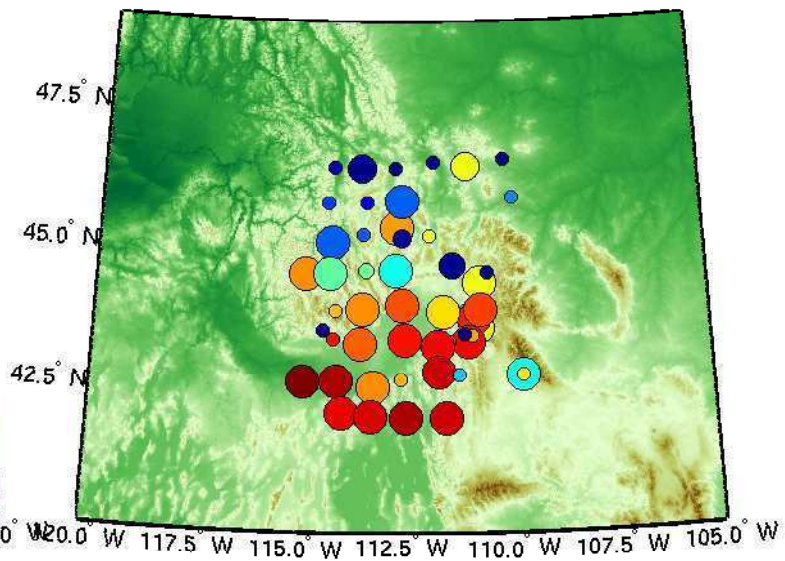
Baz = 237.3578  
 Mean xcor value = 0.71725  
 Range of  $t^*$  values is 1.9078  
 Median  $t^*$  err is 0.25093



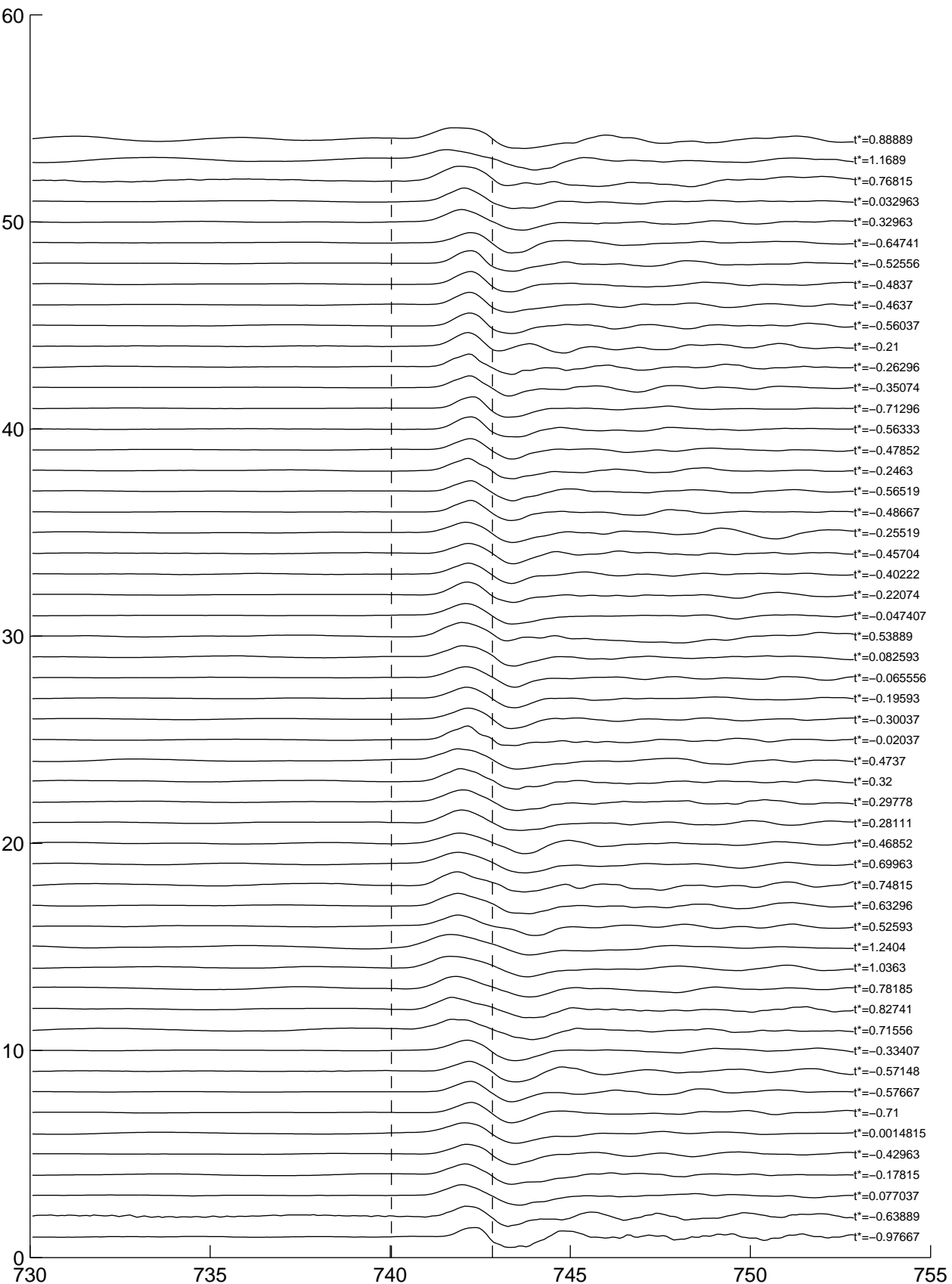
travel time residuals



$t^*$  values

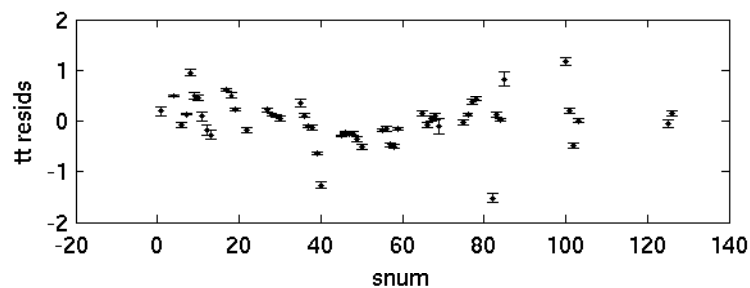
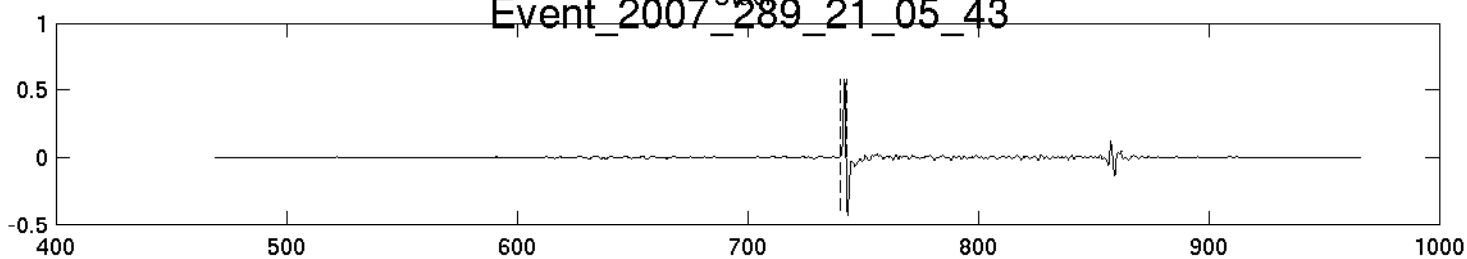


# Event\_2007\_289\_21\_05\_43

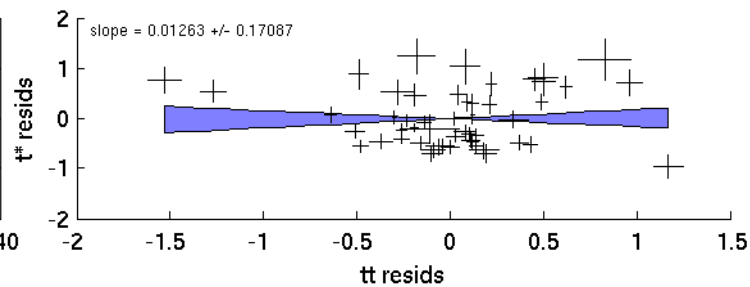
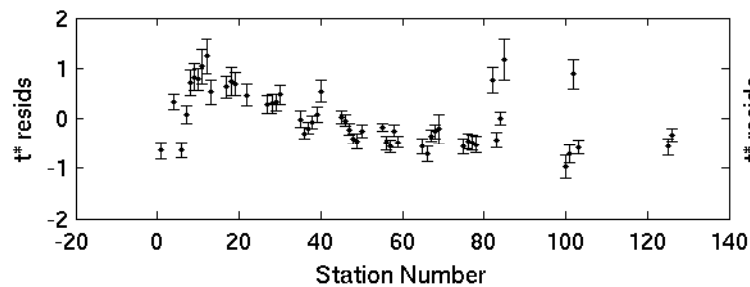




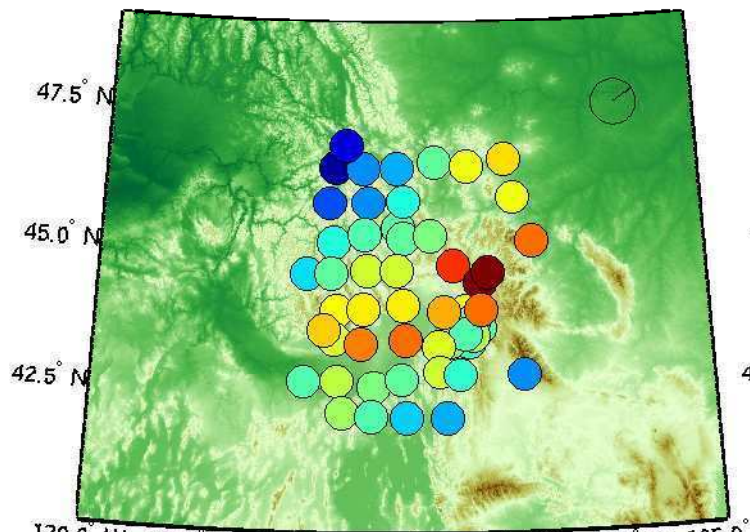
# Event\_2007\_289\_21\_05\_43



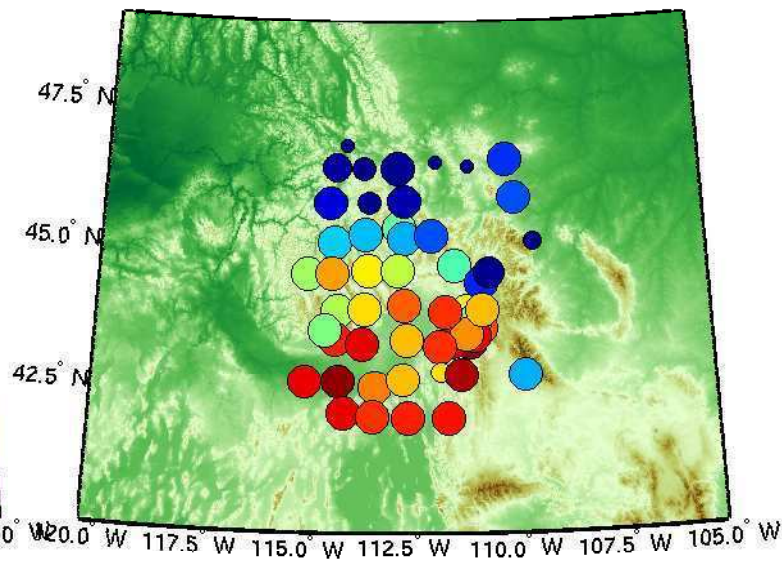
Baz = 236.9312  
 Mean xcor value = 0.78426  
 Range of  $t^*$  values is 2.217  
 Median  $t^*$  err is 0.15886



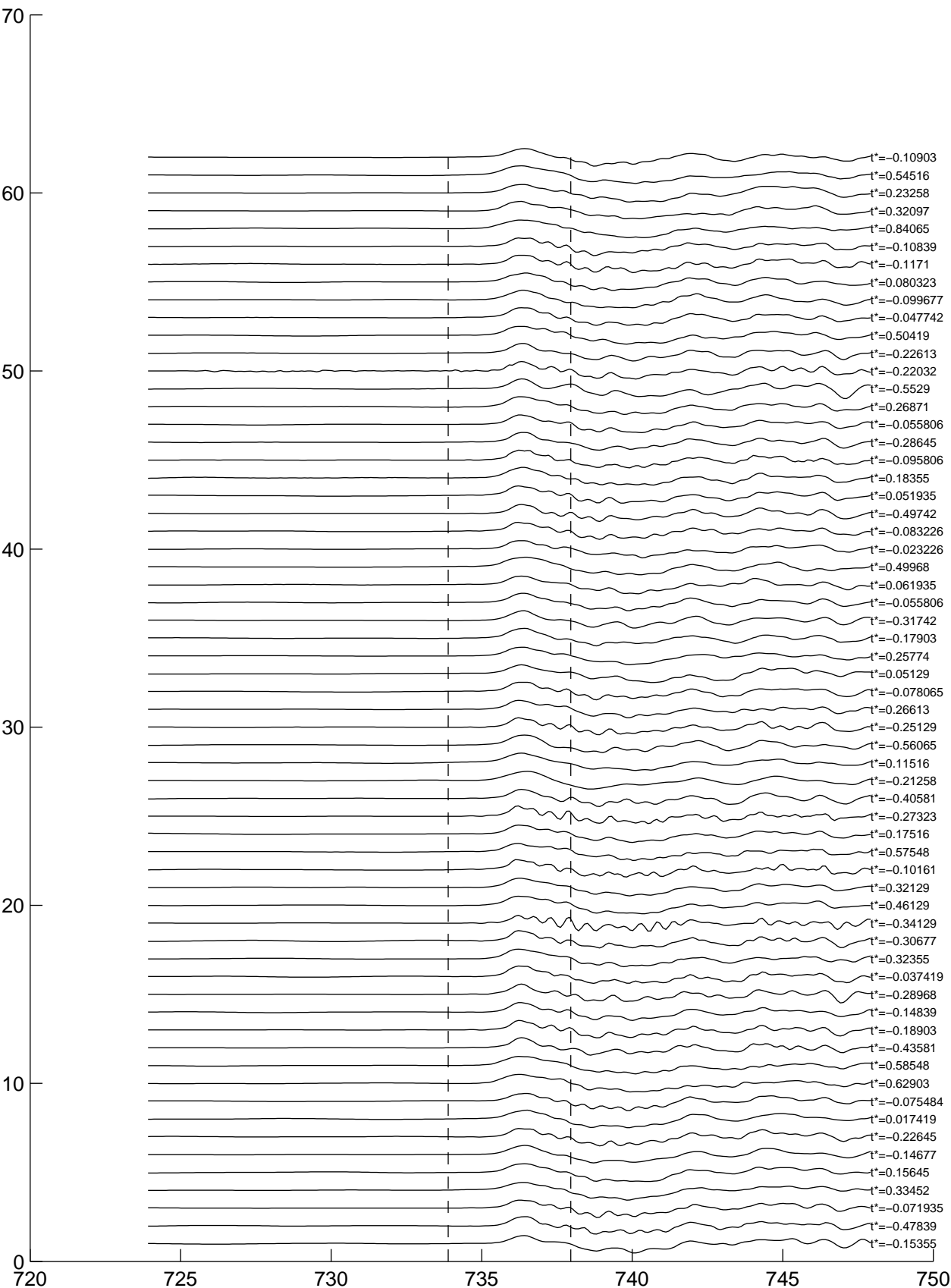
travel time residuals



$t^*$  values

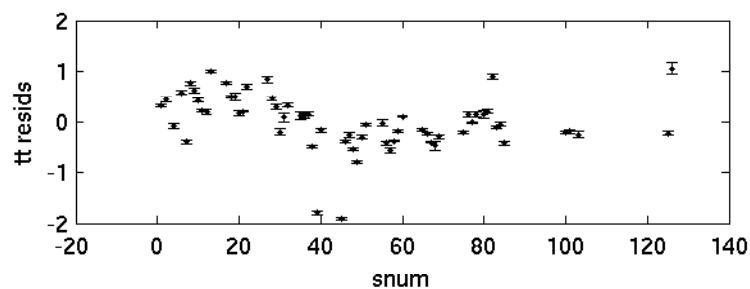
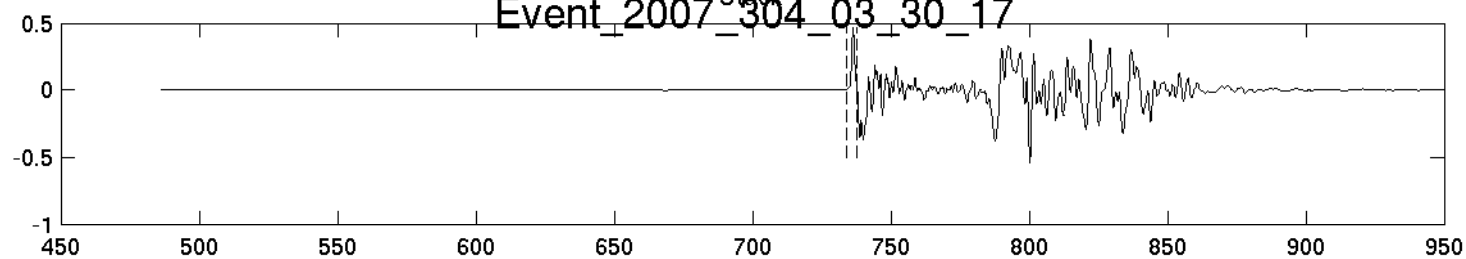


# Event\_2007\_304\_03\_30\_17

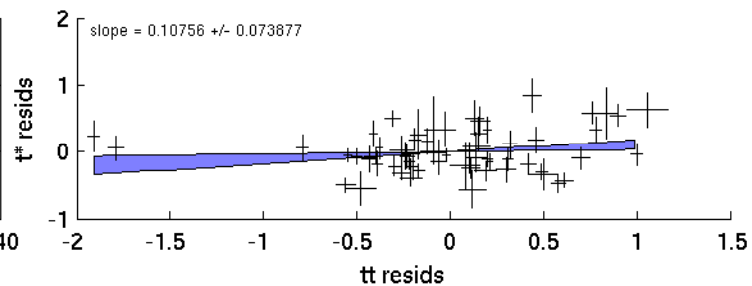
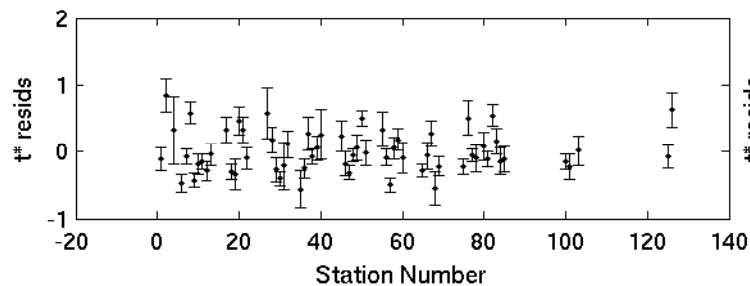




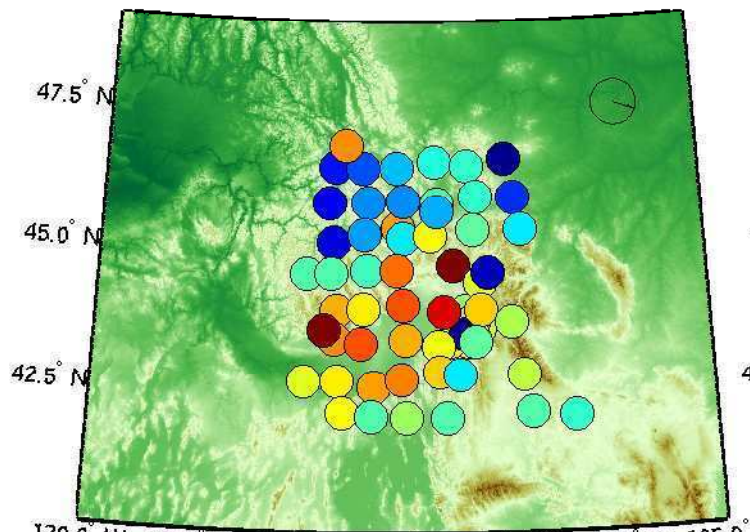
# Event\_2007\_304\_03\_30\_17



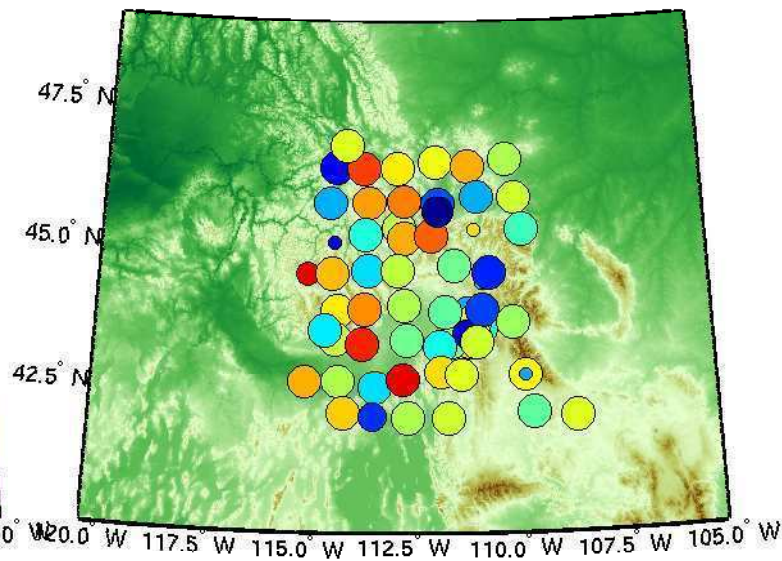
Baz = 292.2069  
 Mean xcor value = 0.84742  
 Range of  $t^*$  values is 1.4013  
 Median  $t^*$  err is 0.18603



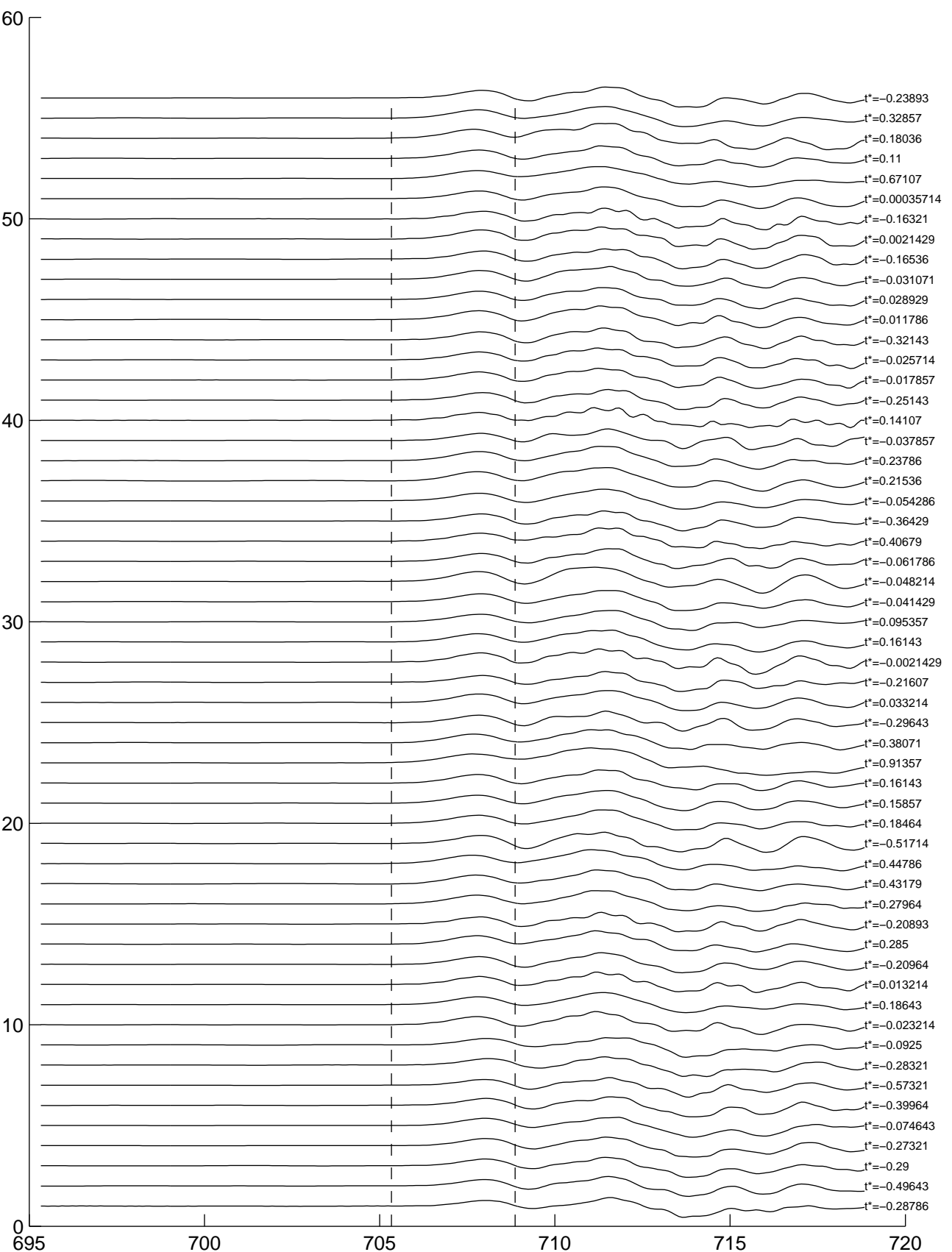
travel time residuals



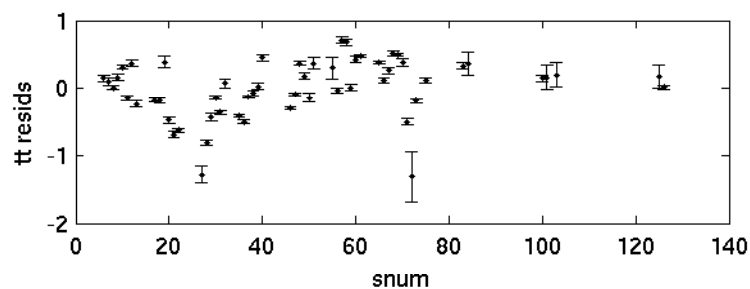
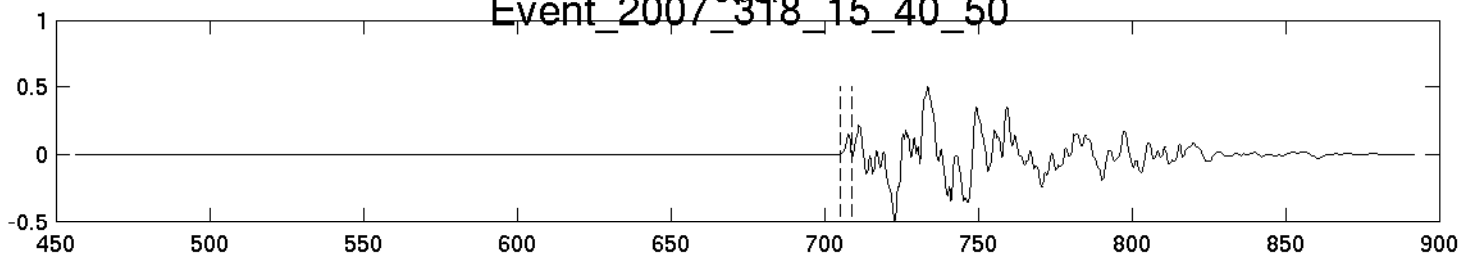
$t^*$  values



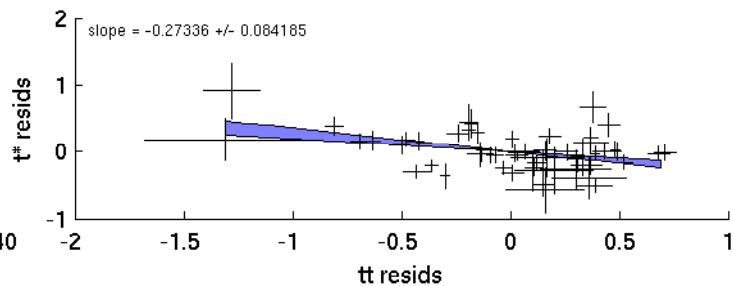
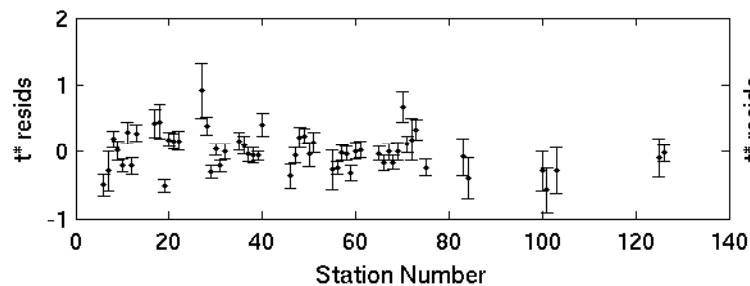
Event\_2007\_318\_15\_40\_50



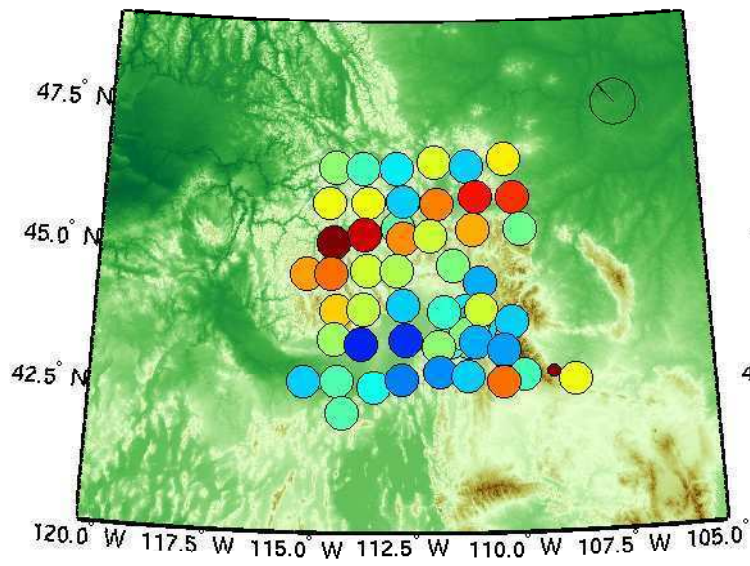
# Event\_2007\_318\_15\_40\_50<sup>Stack</sup>



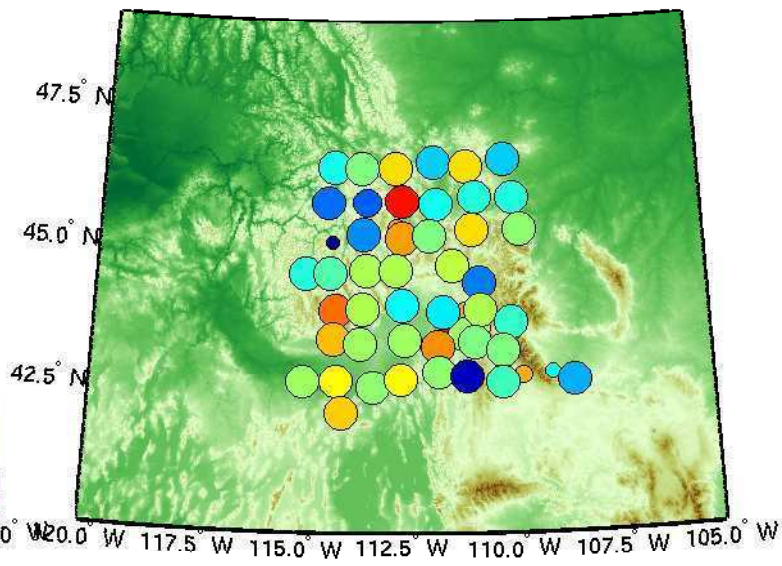
Baz = 140.5593  
 Mean xcor value = 0.77339  
 Range of  $t^*$  values is 1.4868  
 Median  $t^*$  err is 0.12945



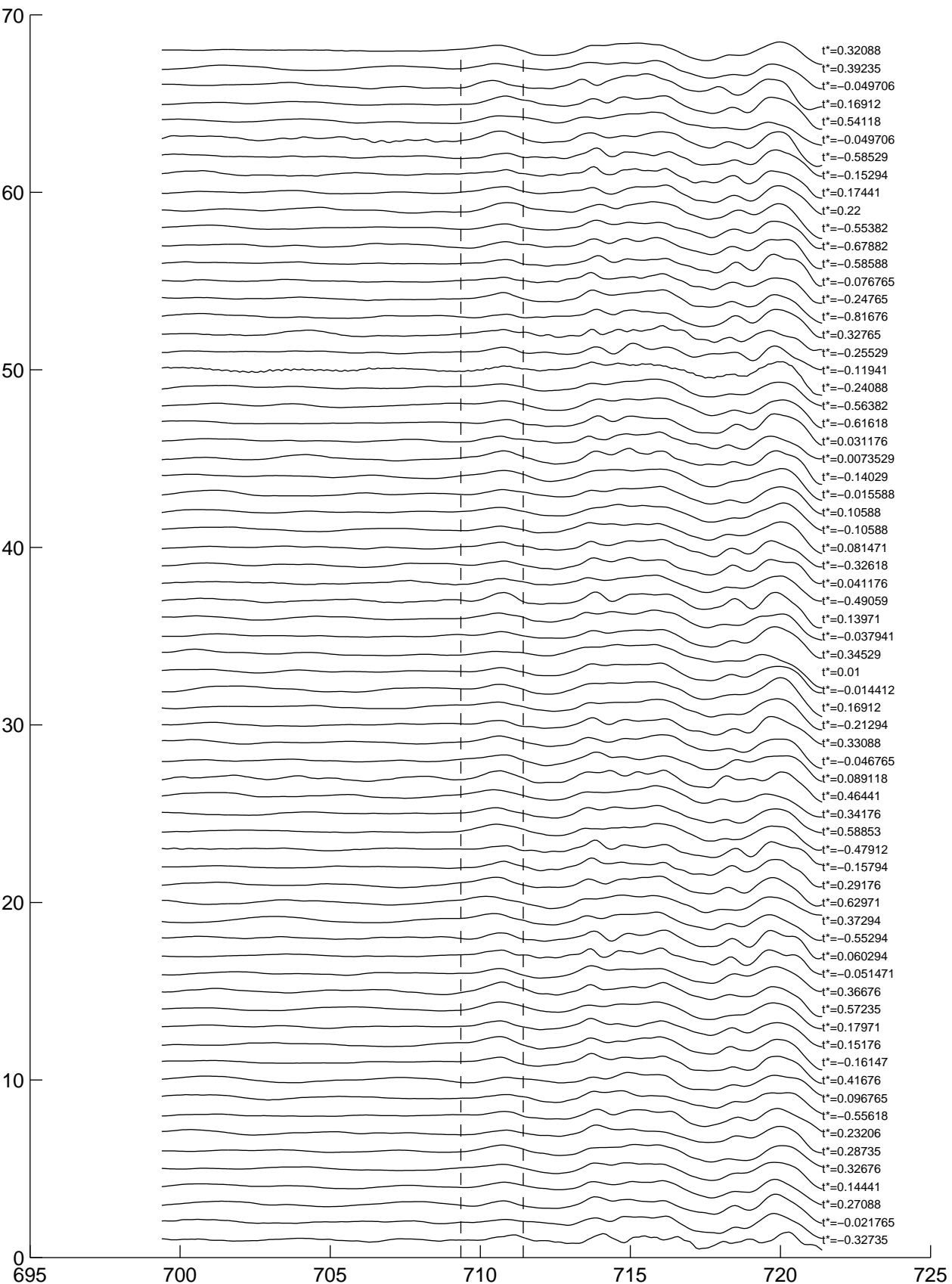
travel time residuals



$t^*$  values

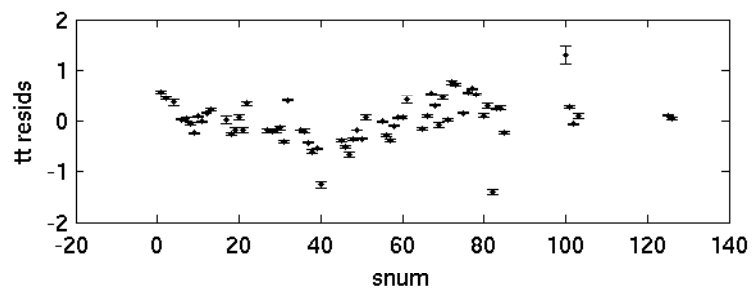
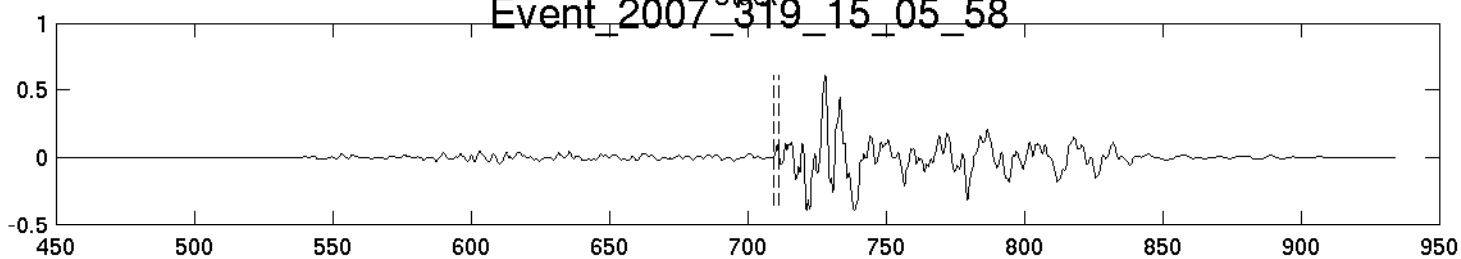


# Event\_2007\_319\_15\_05\_58

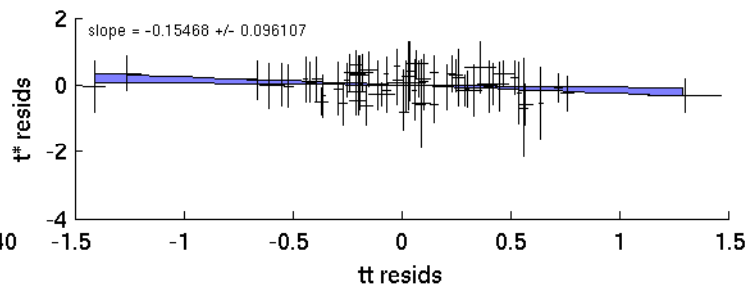
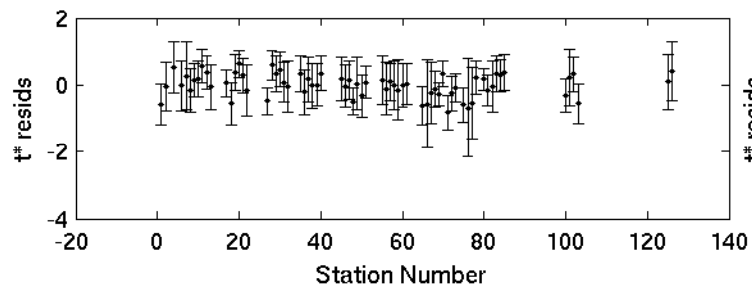




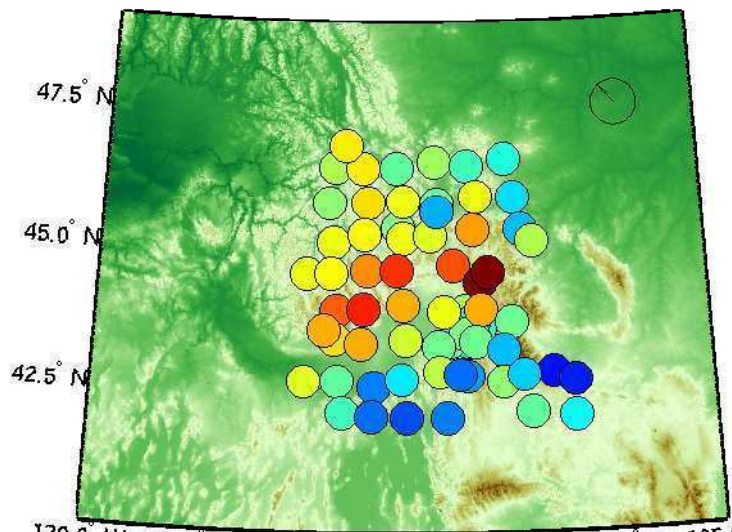
# Event\_2007\_319\_15\_05\_58



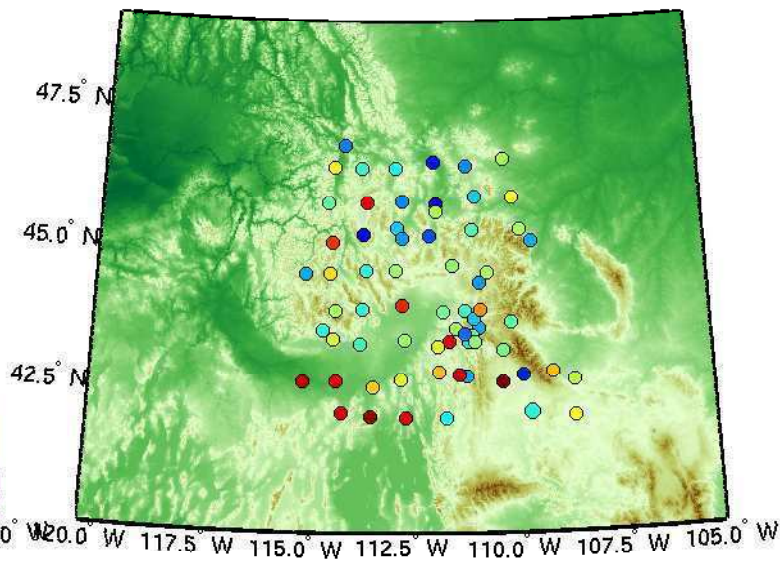
Baz = 141.1875  
Mean xcor value = 0.92809  
Range of  $t^*$  values is 1.4465  
Median  $t^*$  err is 0.58716



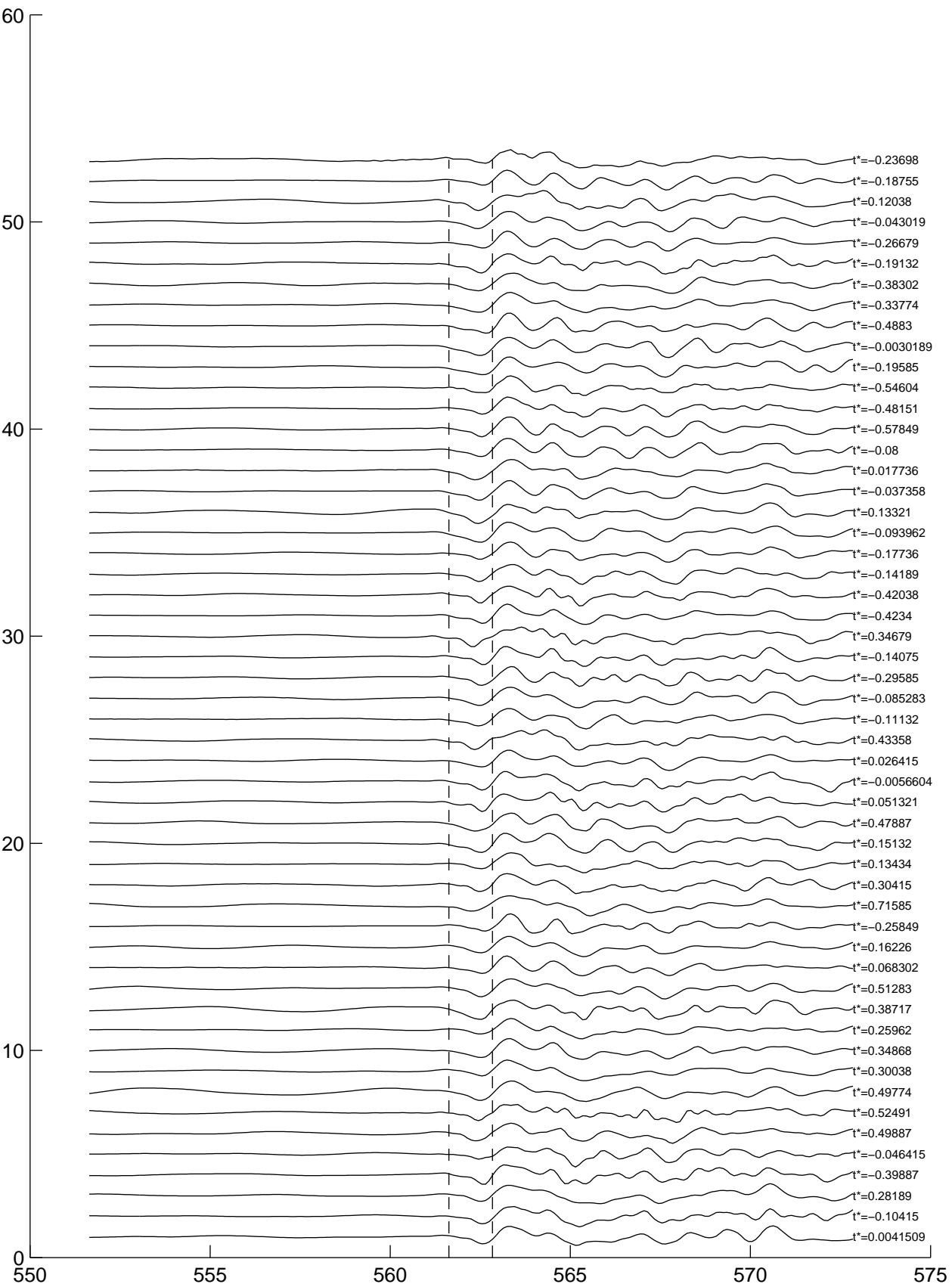
travel time residuals



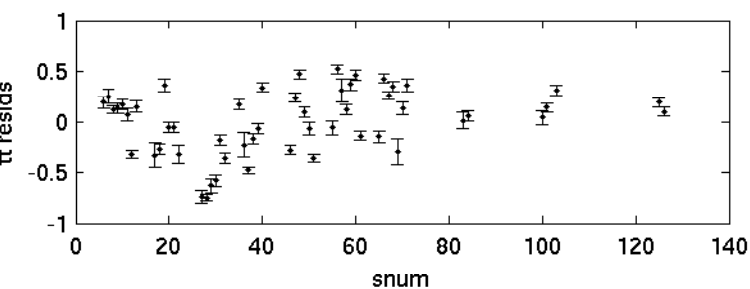
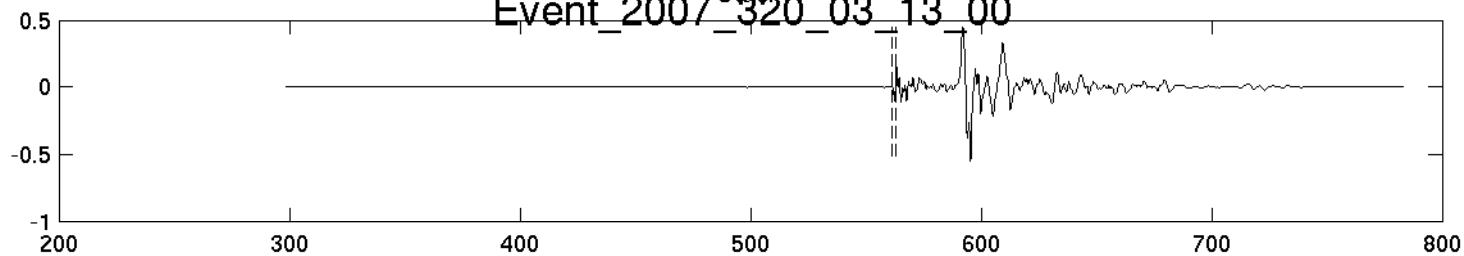
$t^*$  values



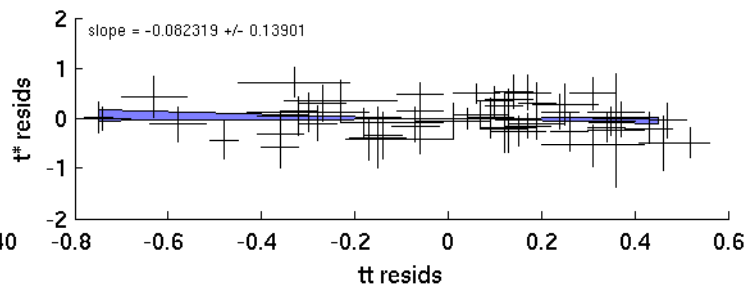
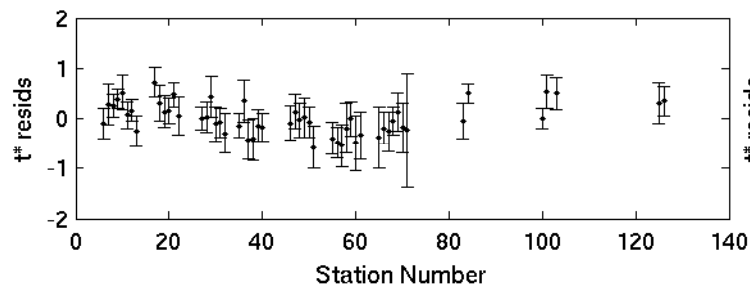
# Event\_2007\_320\_03\_13\_00



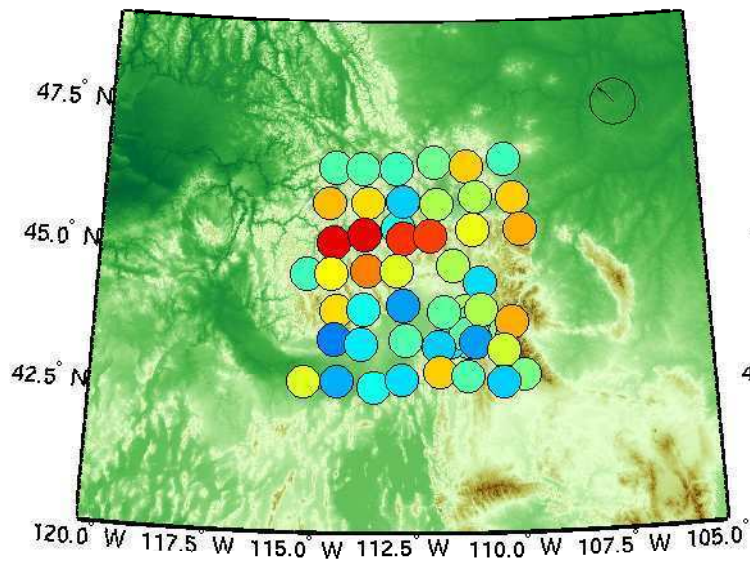
Event\_2007\_Stack 320\_03\_13\_00



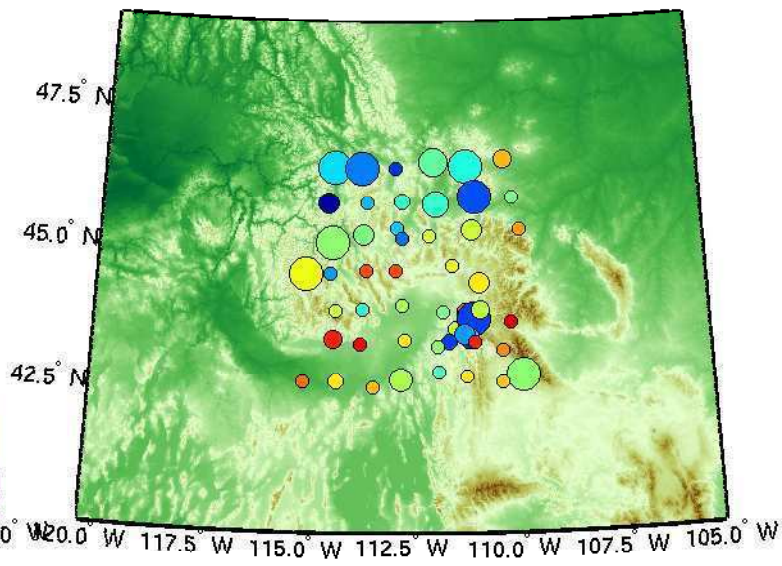
Baz = 137.3646  
Mean xcor value = 0.66245  
Range of  $t^*$  values is 1.2943  
Median  $t^*$  err is 0.34211



travel time residuals

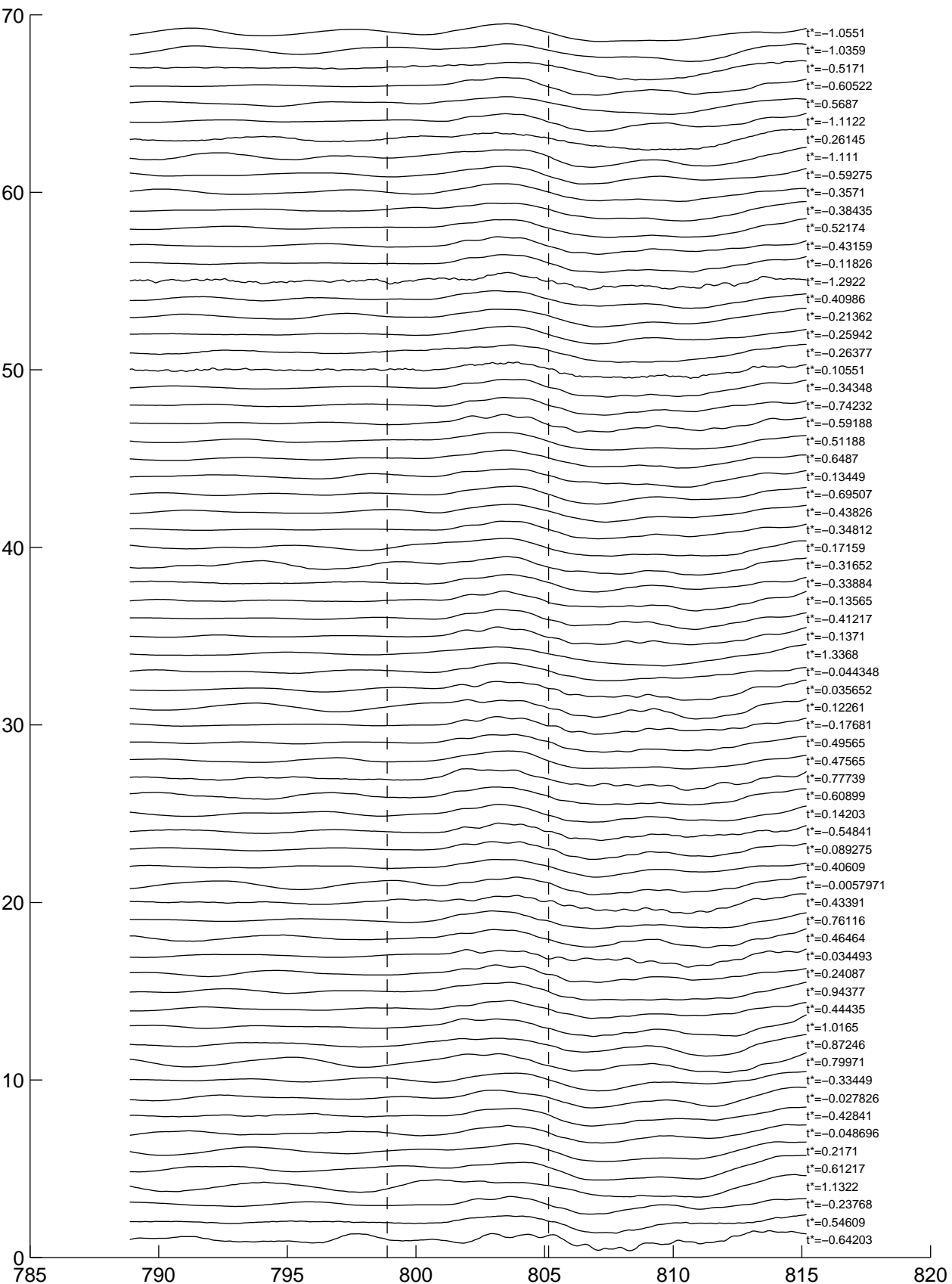


$t^*$  values

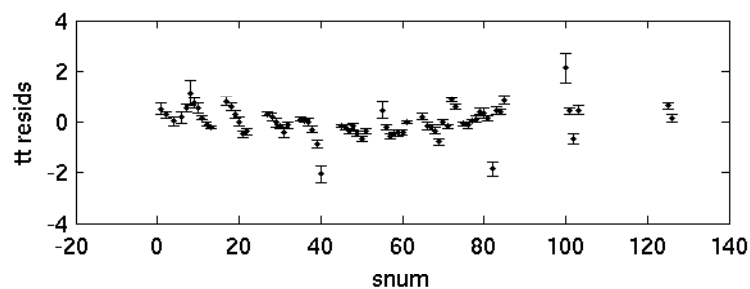
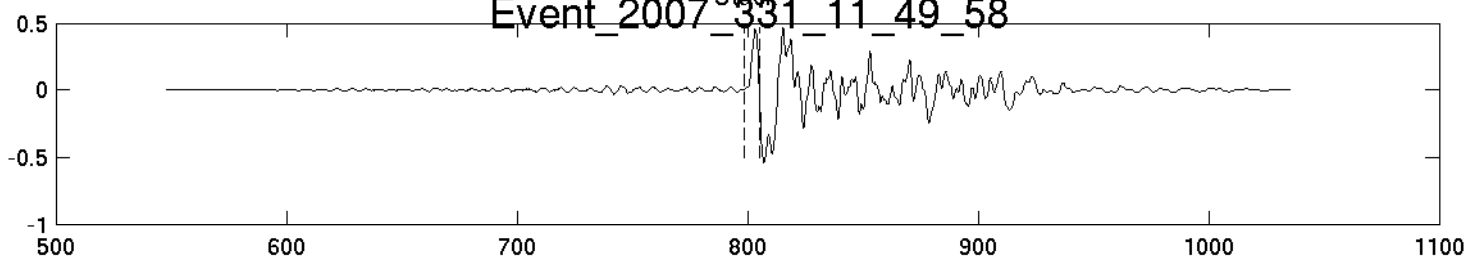




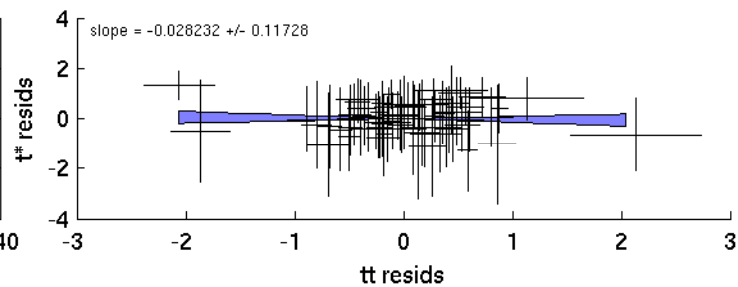
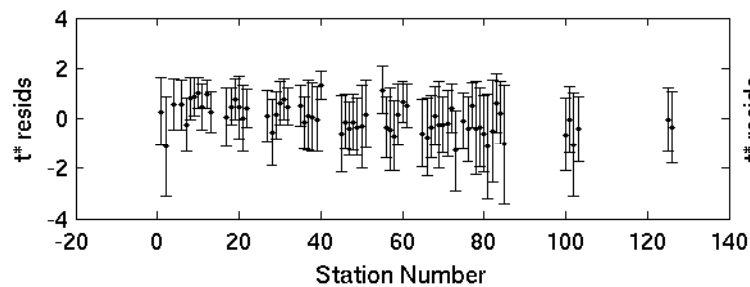
# Event\_2007\_331\_11\_49\_58



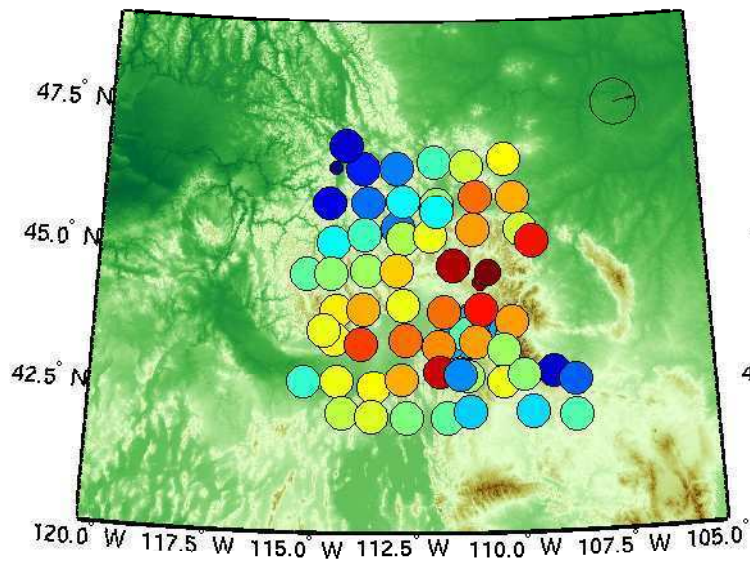
Event\_2007\_331\_11\_49\_58



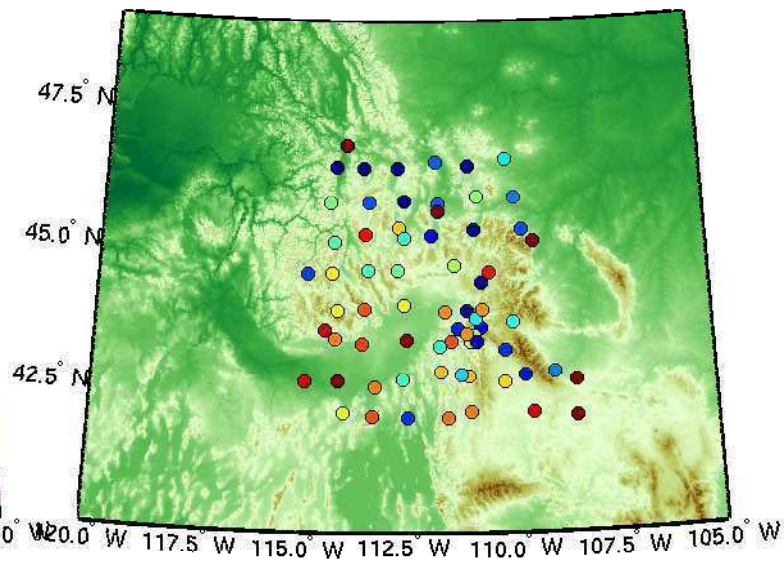
Baz = 259.4043  
Mean xcor value = 0.88348  
Range of  $t^*$  values is 2.629  
Median  $t^*$  err is 1.2164



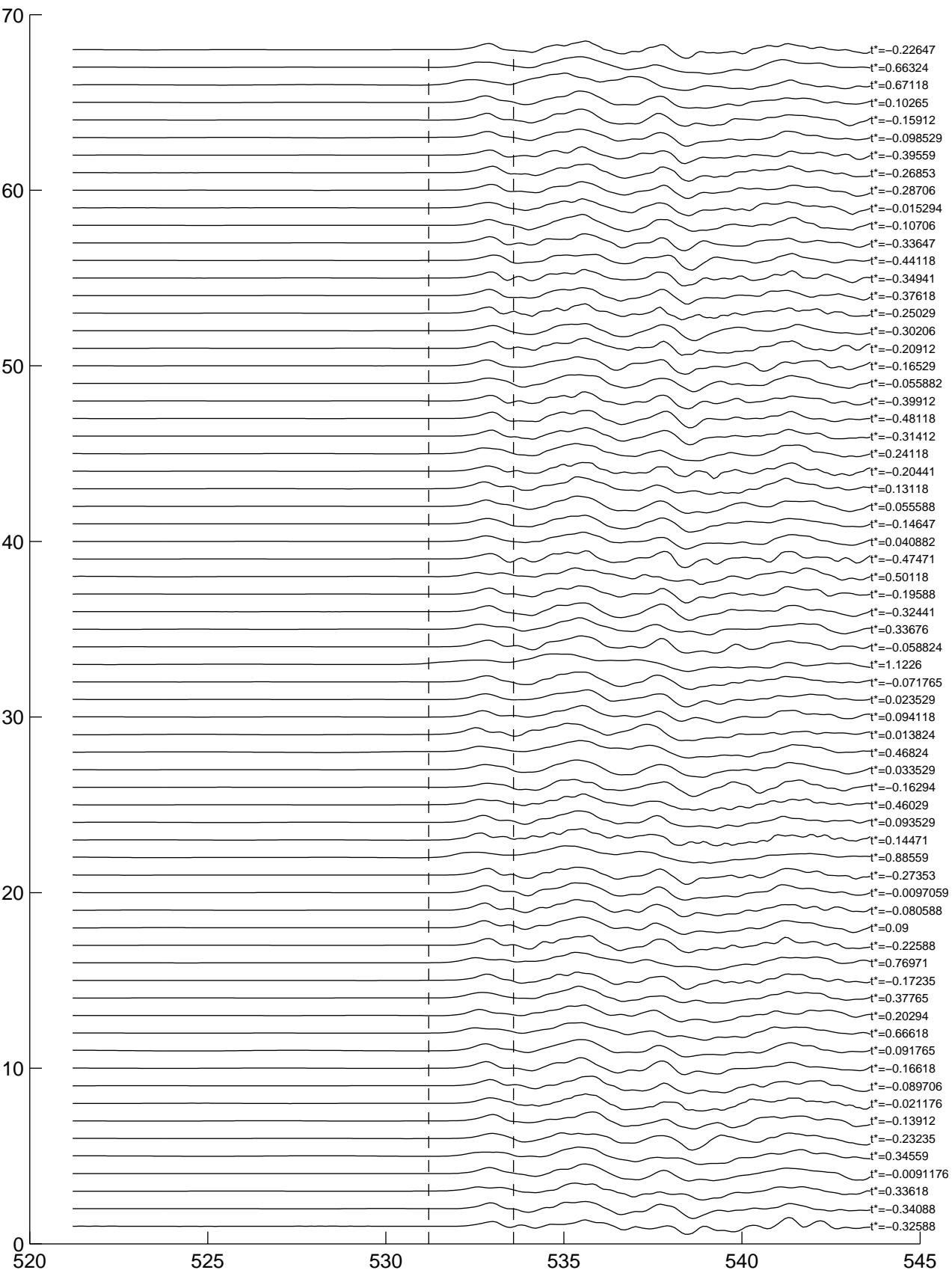
travel time residuals



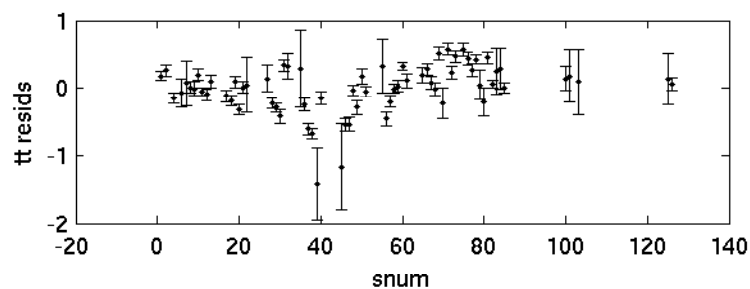
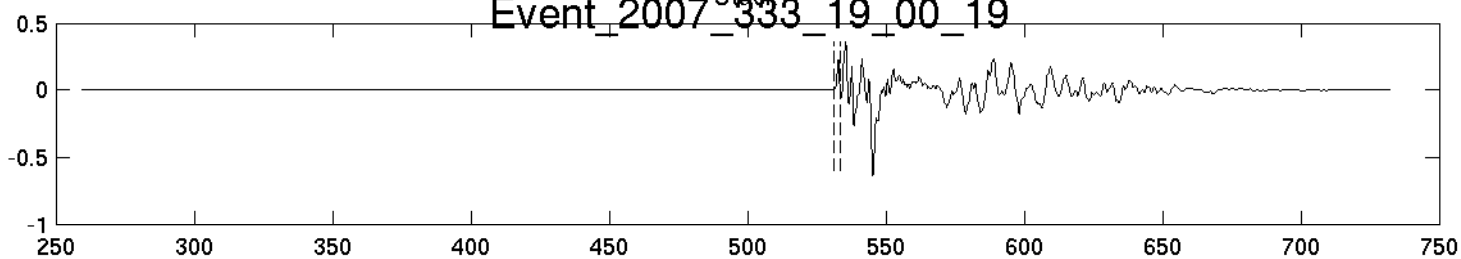
$t^*$  values



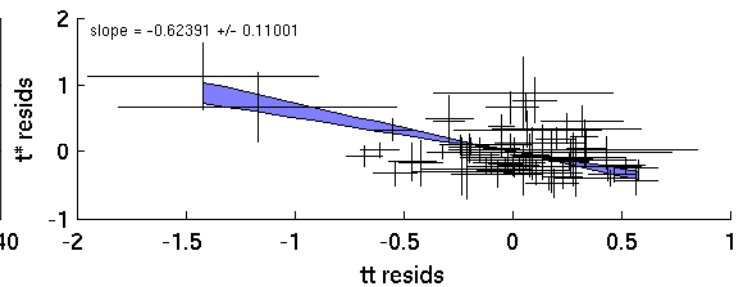
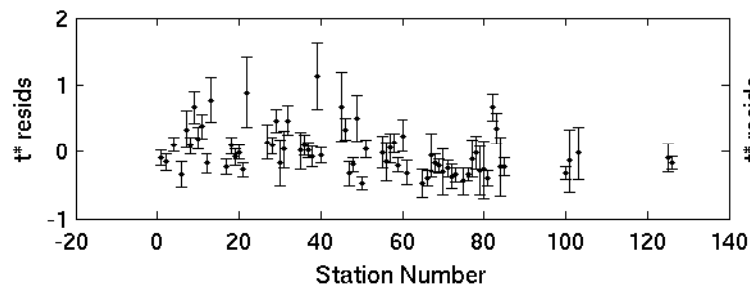
# Event\_2007\_333\_19\_00\_19



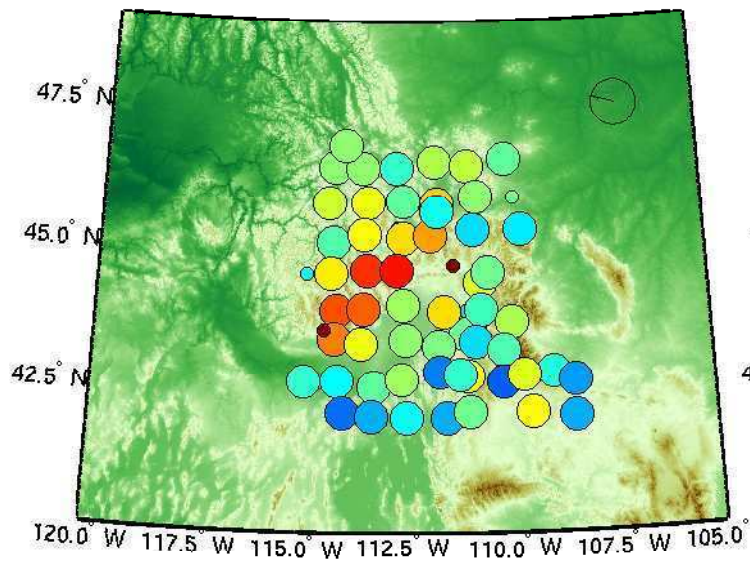
# Event\_2007\_333\_19\_00\_19



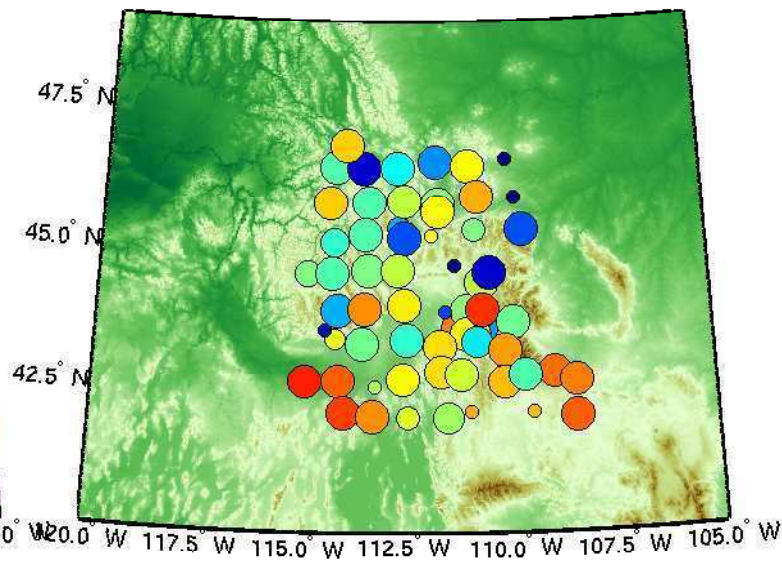
Baz = 107.9778  
Mean xcor value = 0.81441  
Range of  $t^*$  values is 1.6038  
Median  $t^*$  err is 0.17997



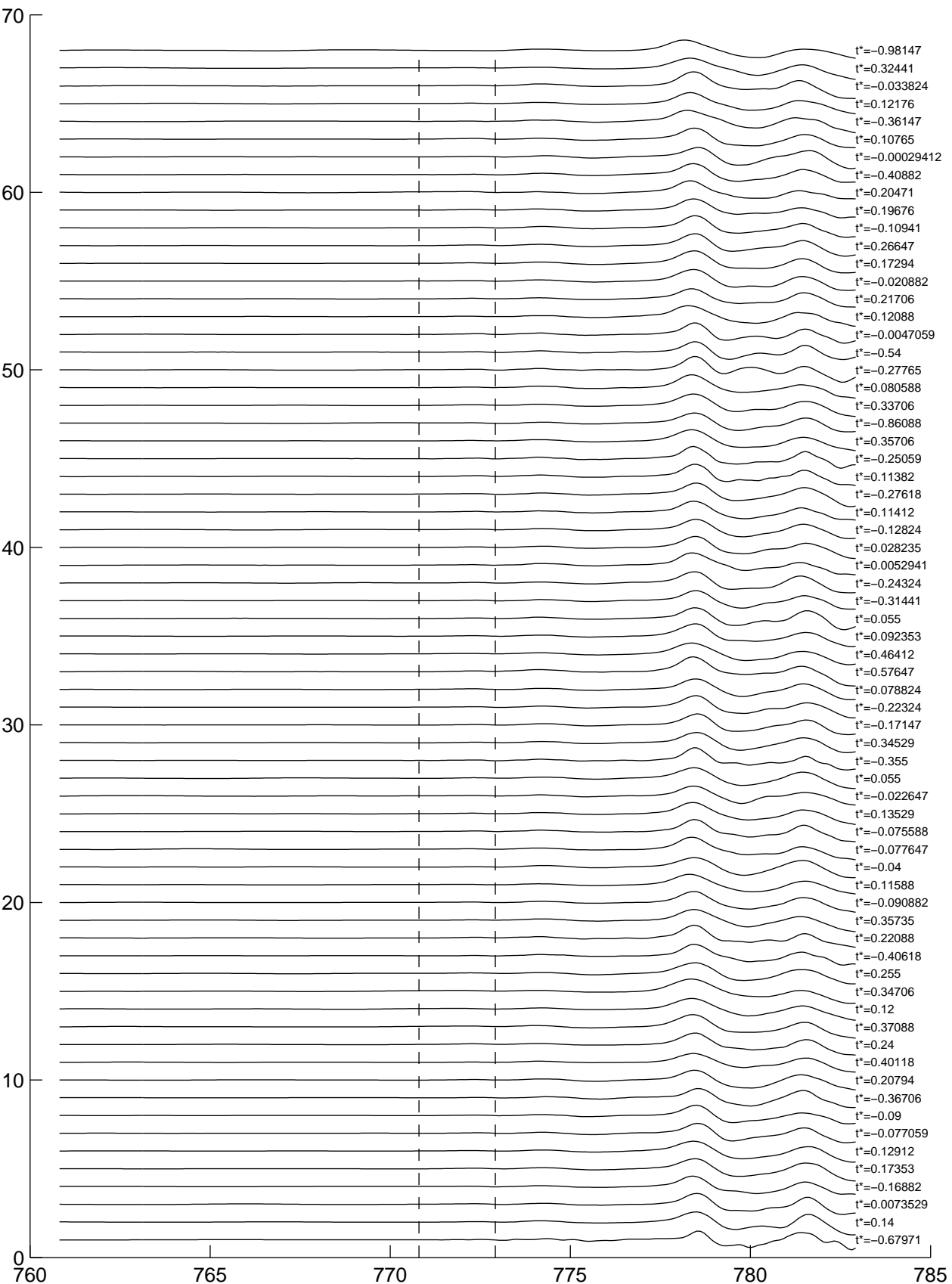
travel time residuals



$t^*$  values

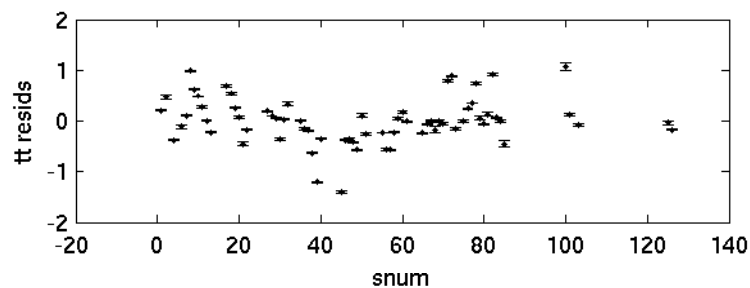
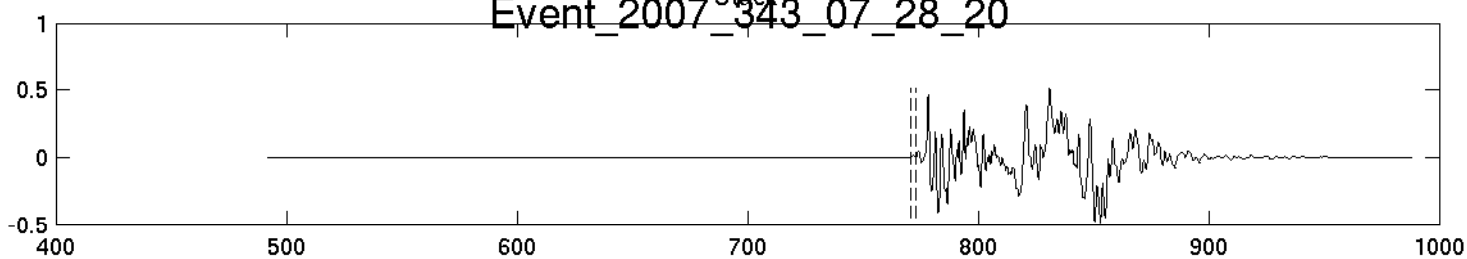


# Event\_2007\_343\_07\_28\_20

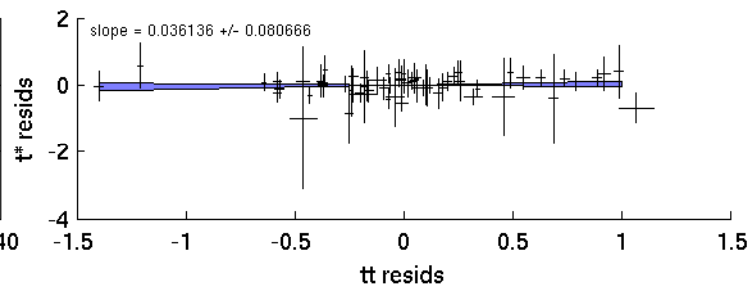
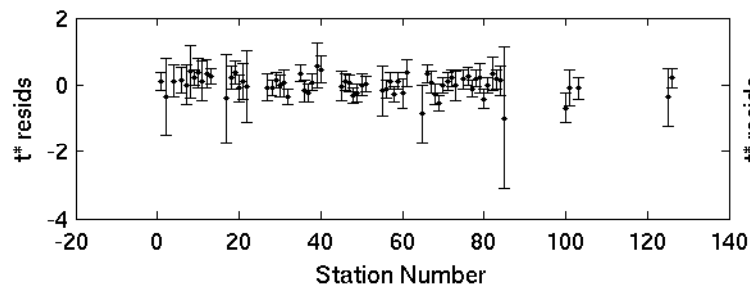




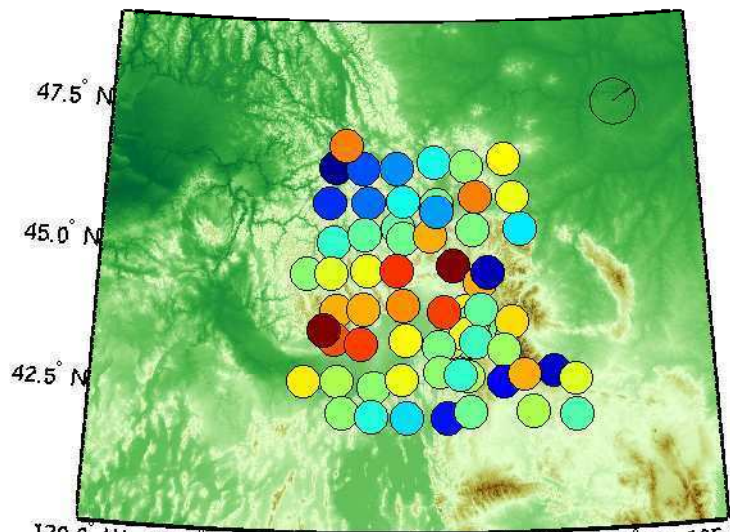
# Event\_2007\_343\_07\_28\_20



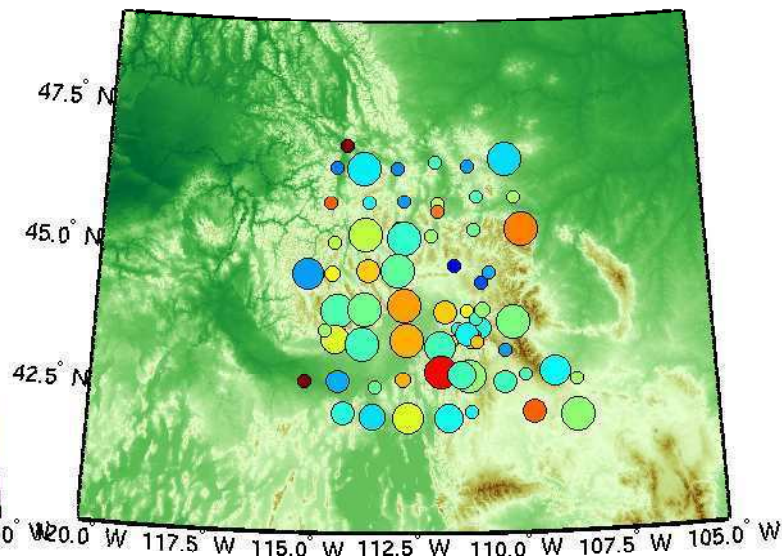
Baz = 235.0929  
Mean xcor value = 0.86382  
Range of  $t^*$  values is 1.5579  
Median  $t^*$  err is 0.32471



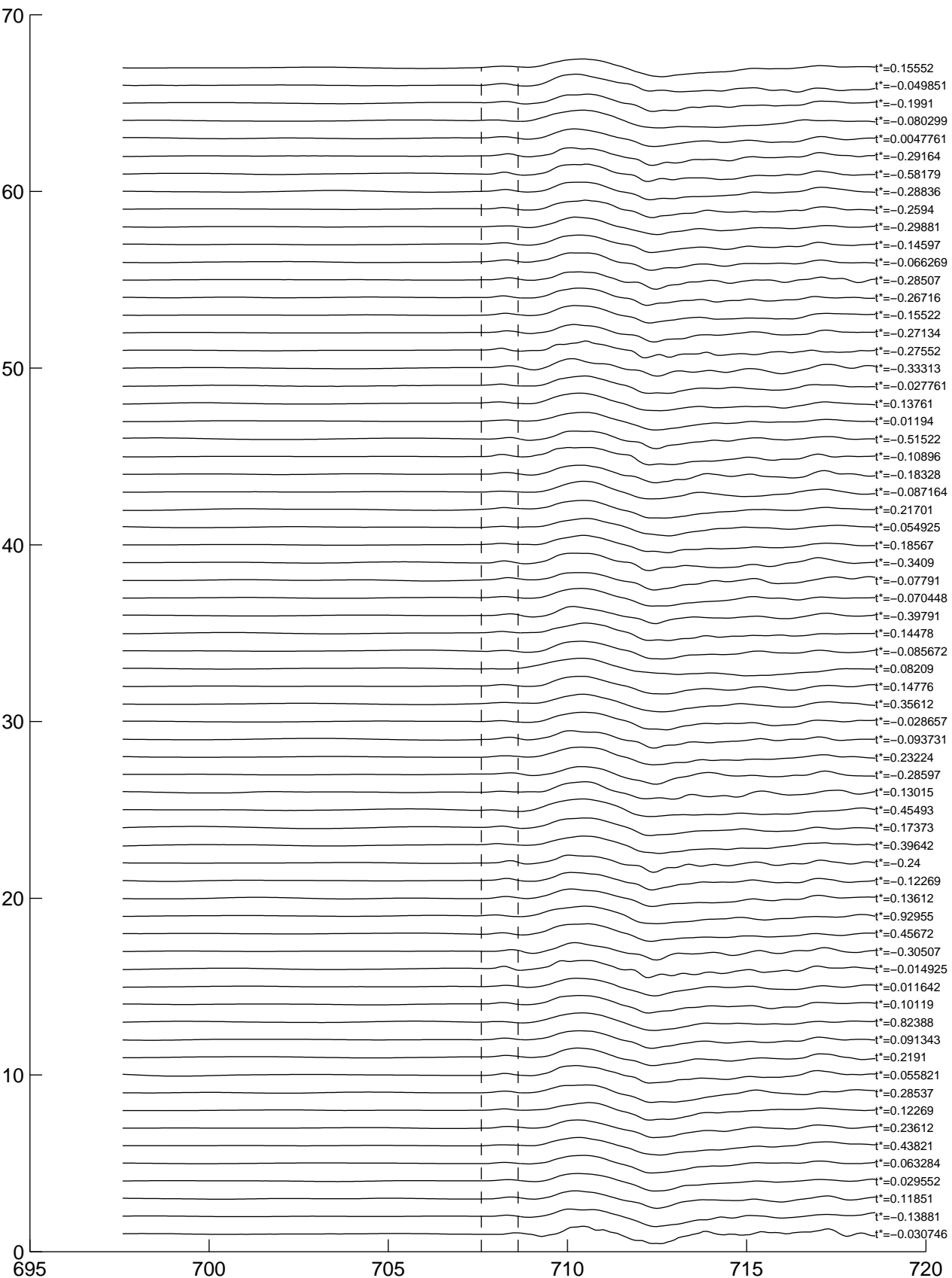
travel time residuals



$t^*$  values

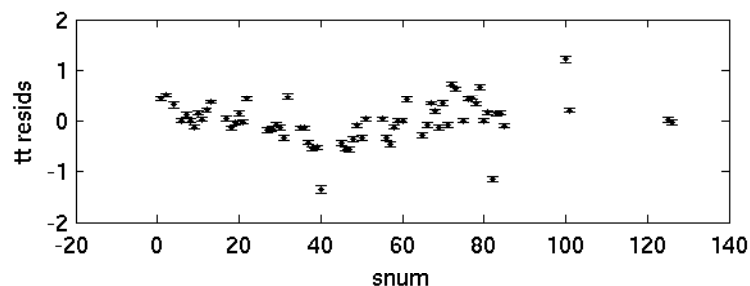
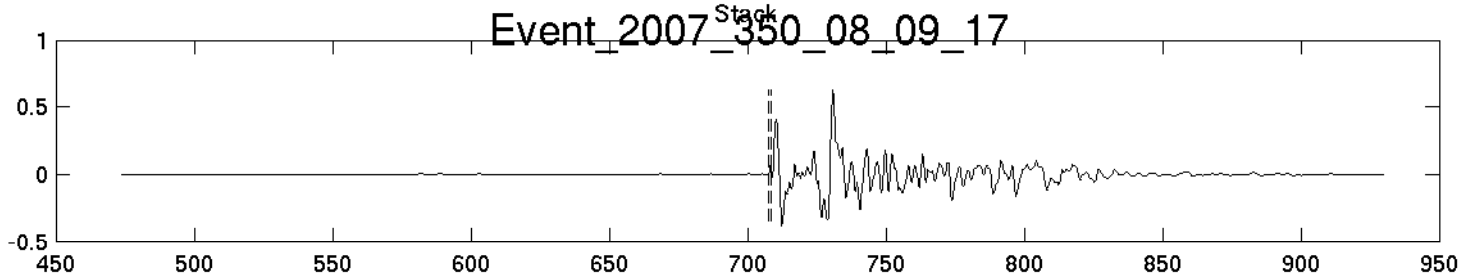


# Event\_2007\_350\_08\_09\_17

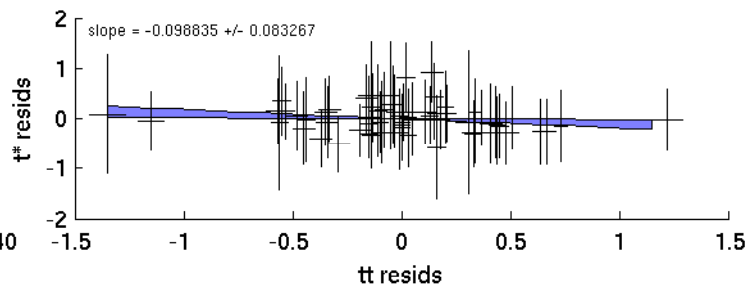
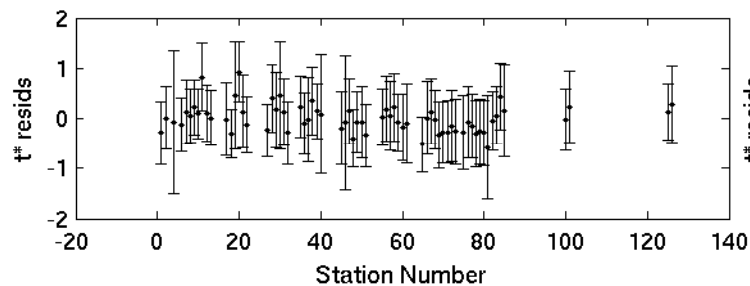




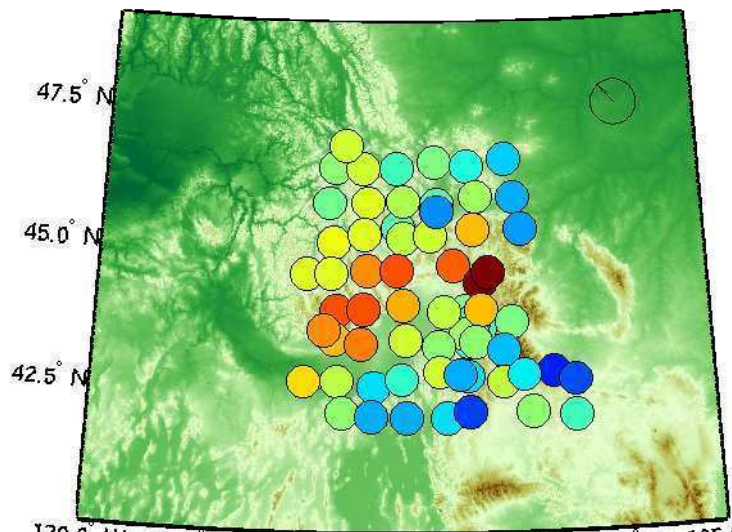
# Event\_2007\_350\_08\_09\_17



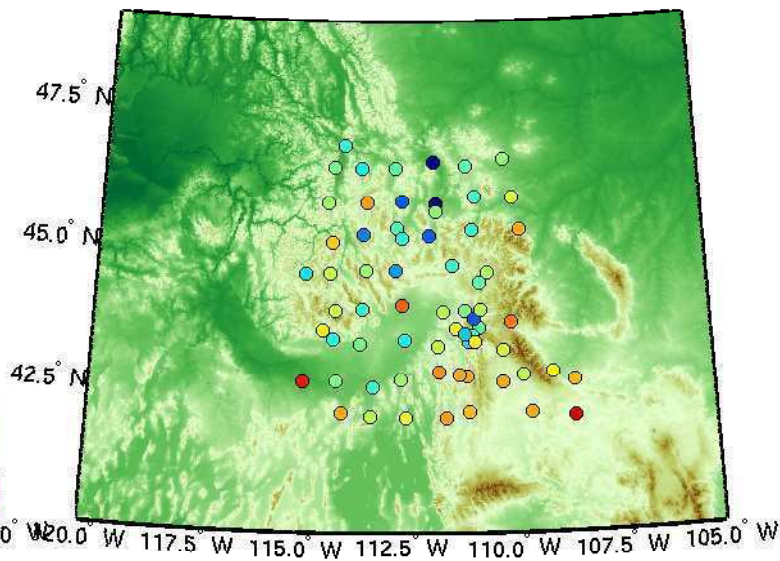
Baz = 141.1258  
 Mean xcor value = 0.87657  
 Range of  $t^*$  values is 1.5113  
 Median  $t^*$  err is 0.65221



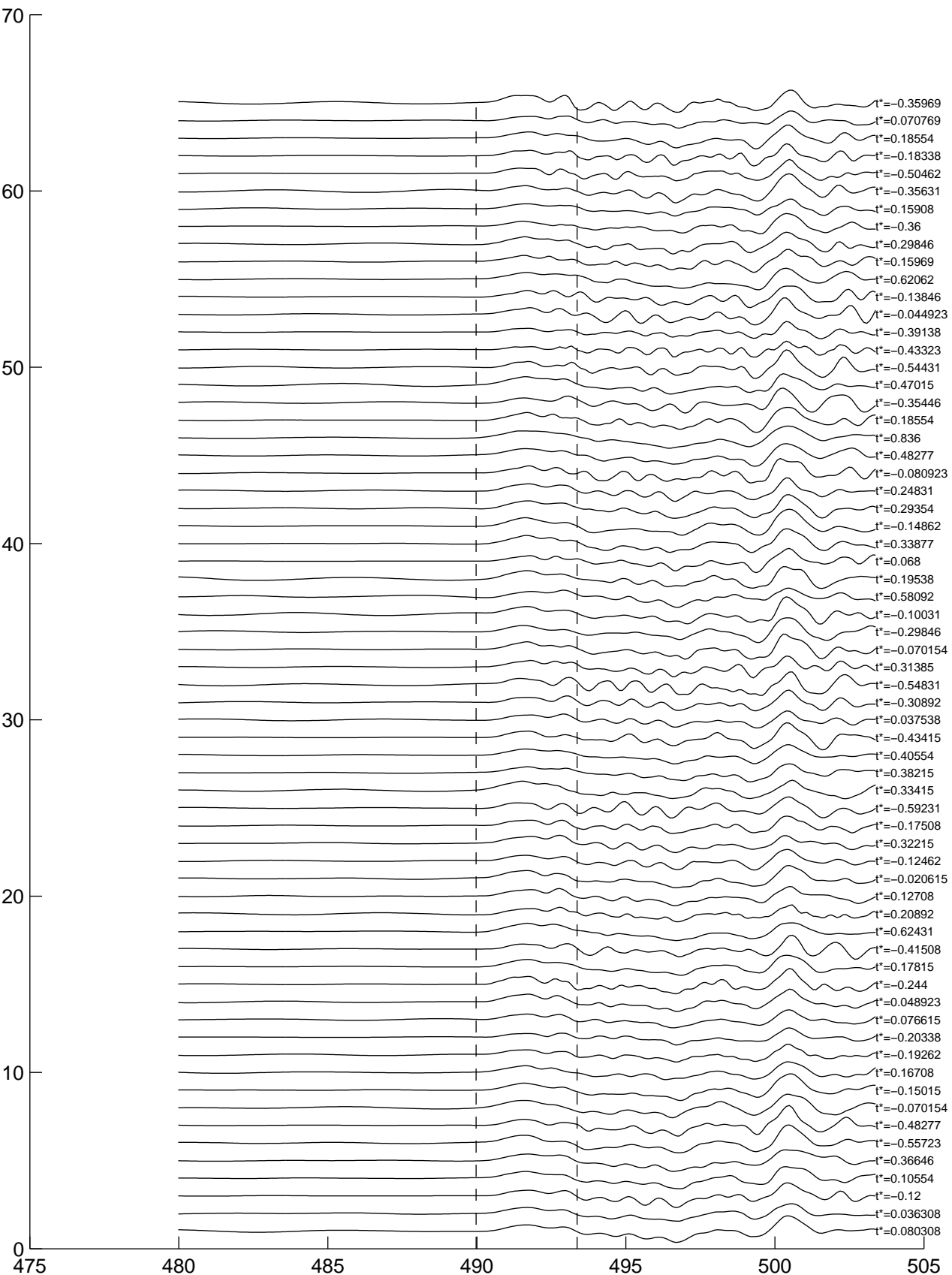
travel time residuals



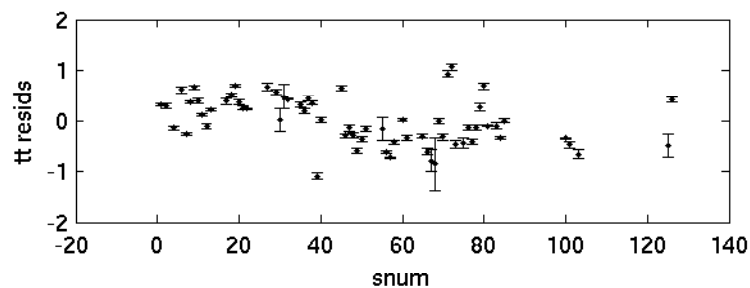
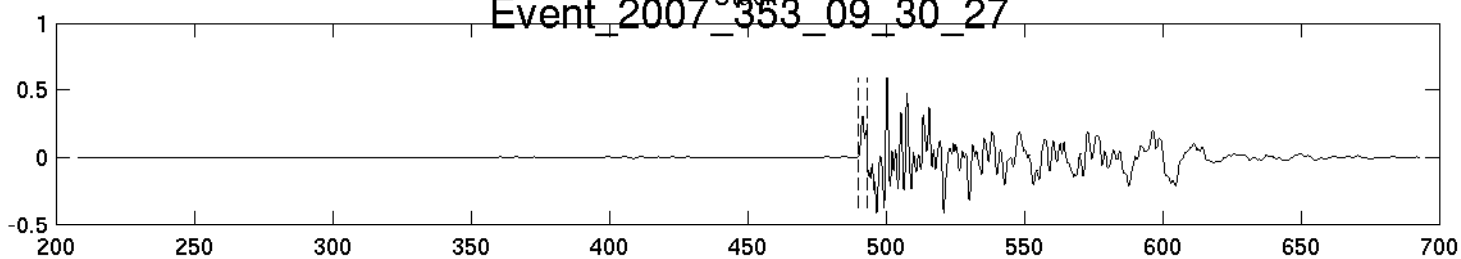
$t^*$  values



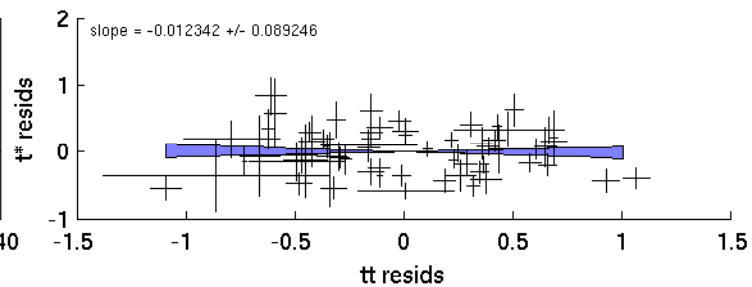
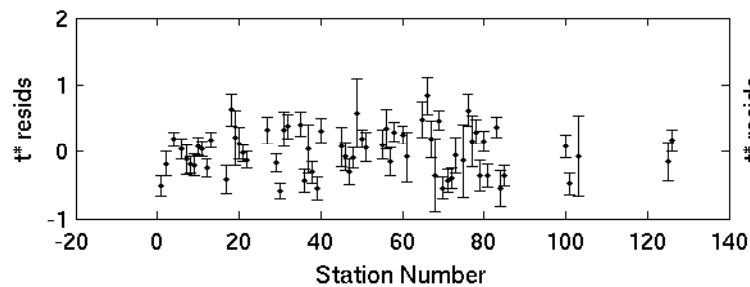
# Event\_2007\_353\_09\_30\_27



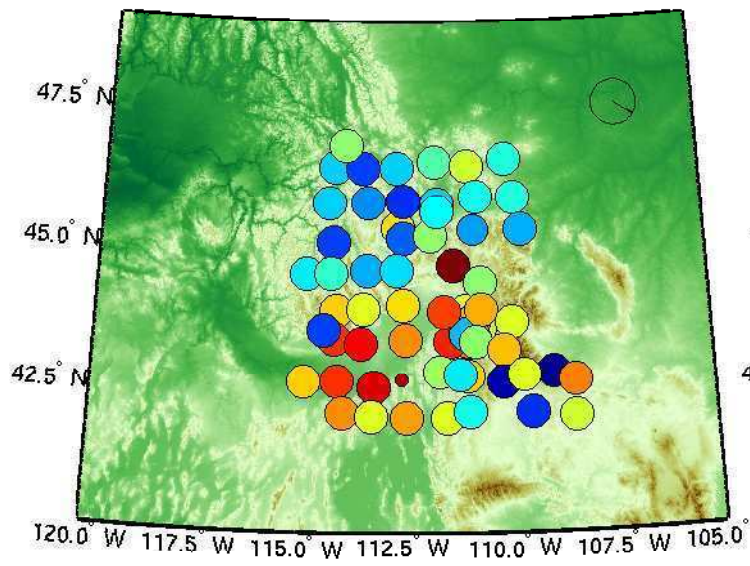
# Event\_2007\_353\_09\_30\_27



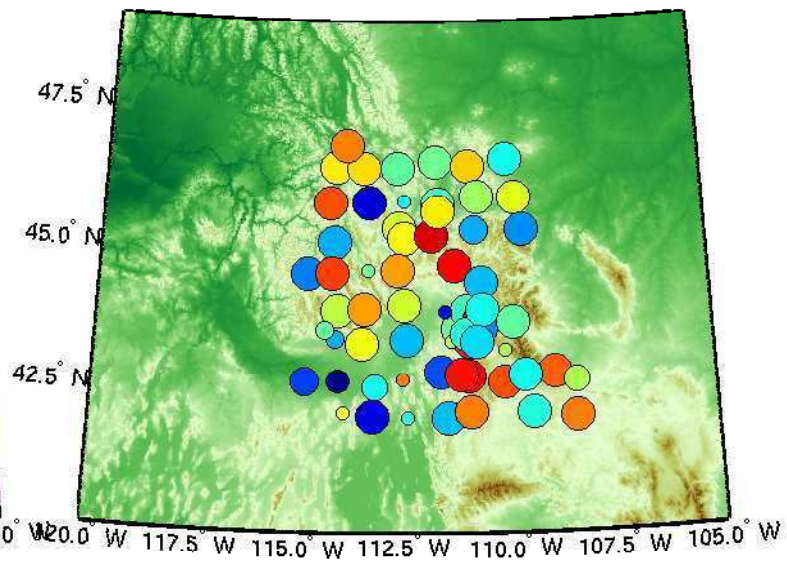
Baz = 304.4384  
 Mean xcor value = 0.77754  
 Range of  $t^*$  values is 1.4283  
 Median  $t^*$  err is 0.17827



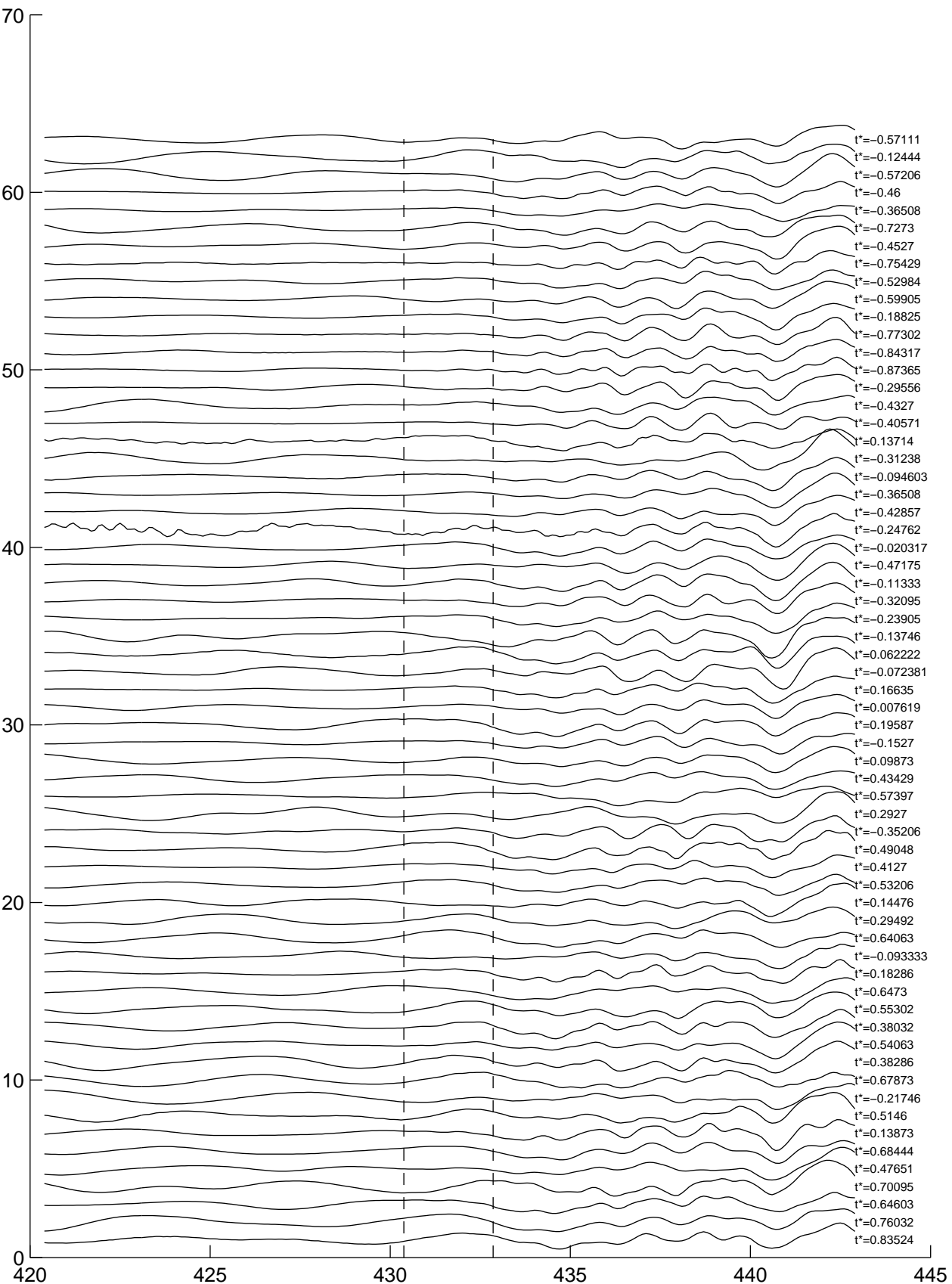
travel time residuals



$t^*$  values

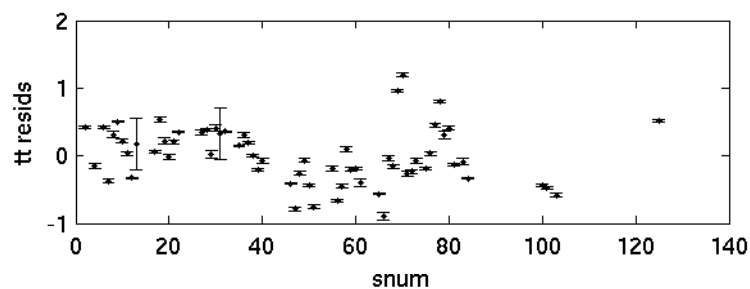
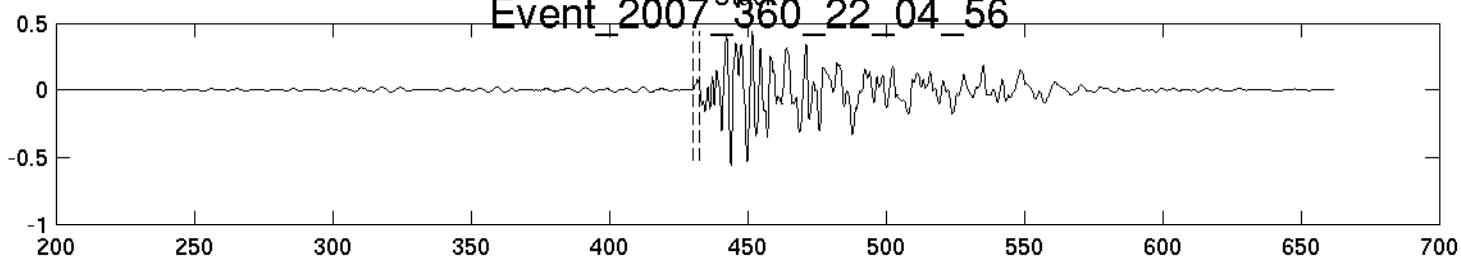


# Event\_2007\_360\_22\_04\_56

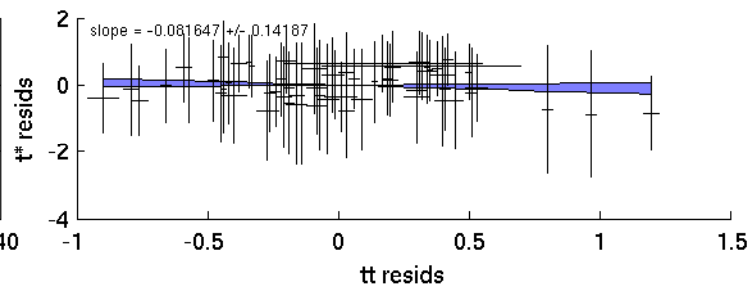
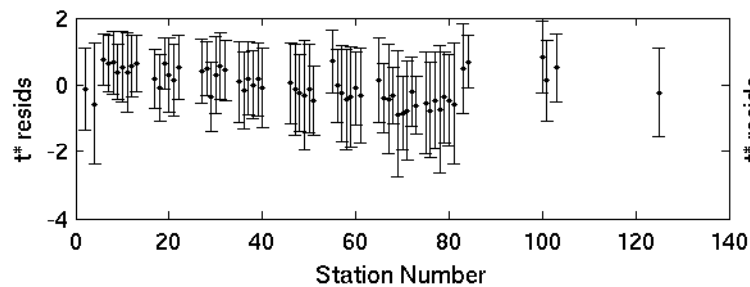




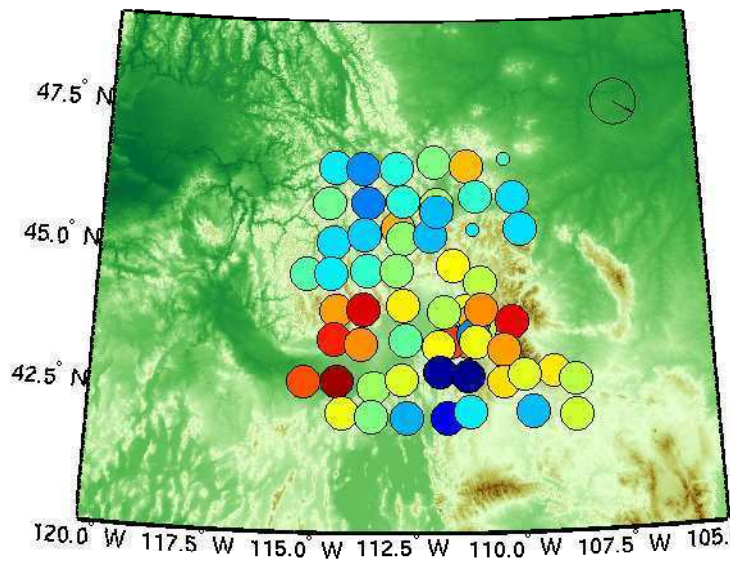
Event\_2007\_360\_22\_04\_56



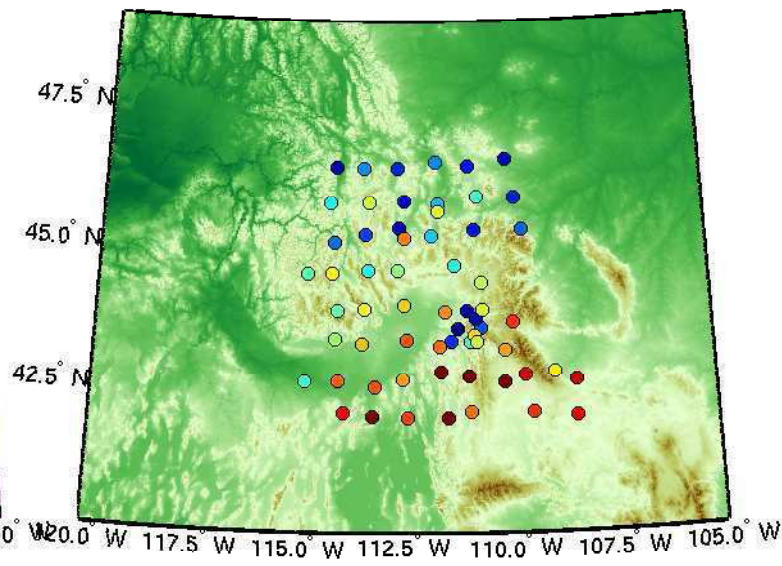
Baz = 303.5472  
Mean xcor value = 0.78397  
Range of  $t^*$  values is 1.7089  
Median  $t^*$  err is 1.0946



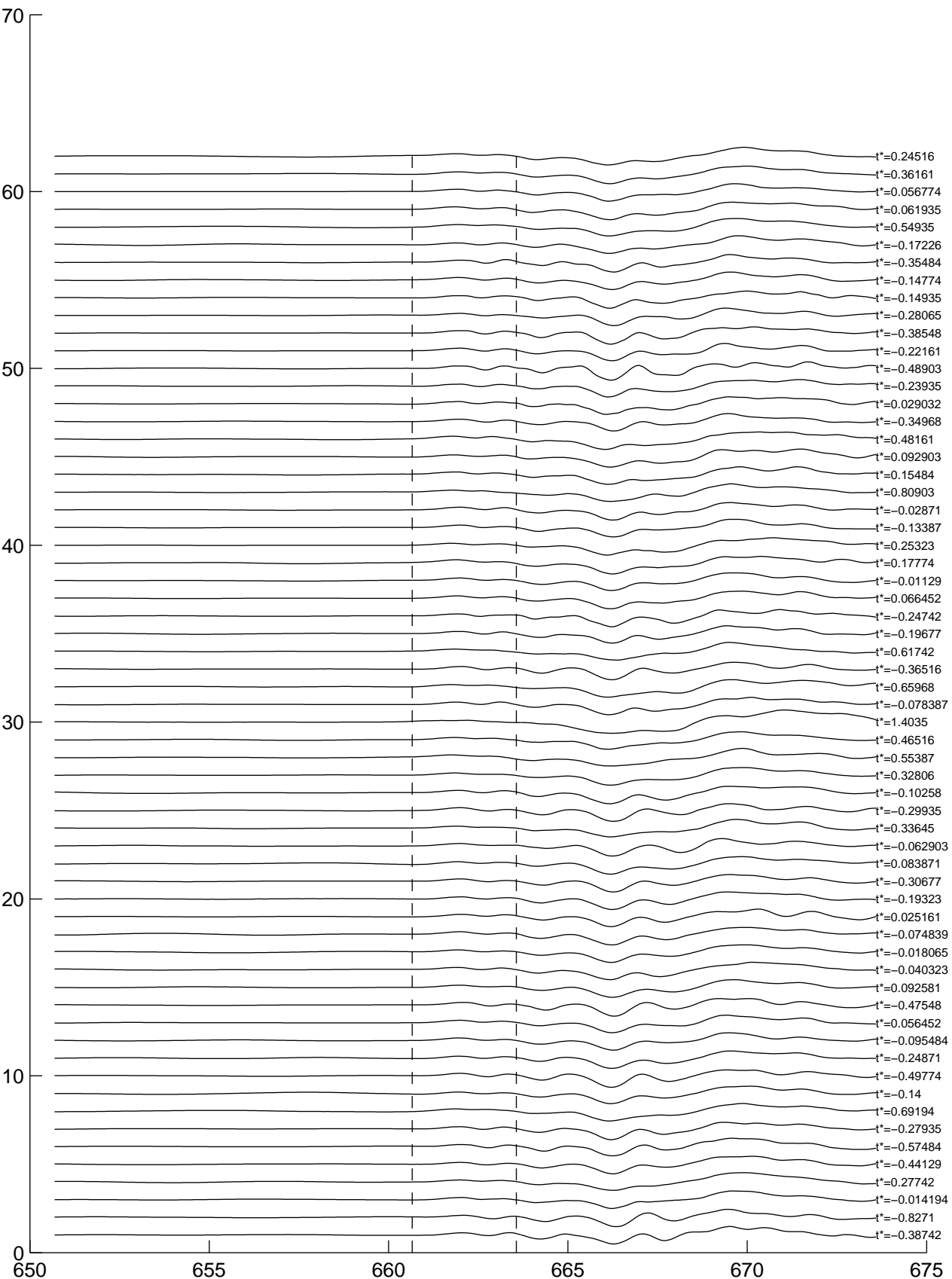
travel time residuals



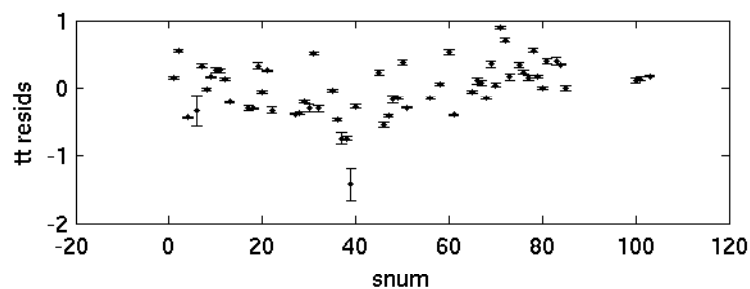
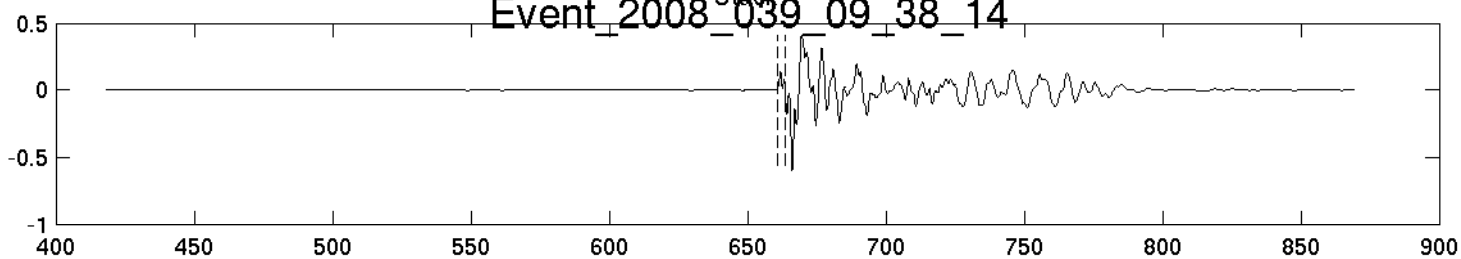
$t^*$  values



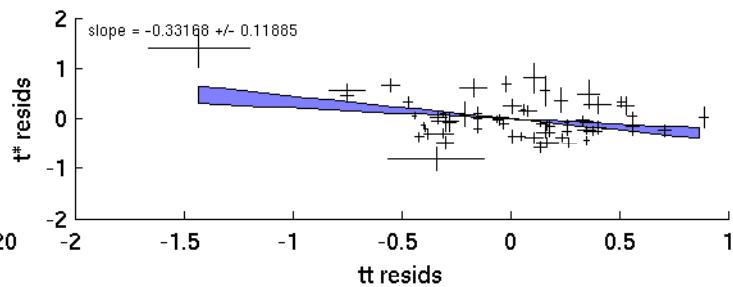
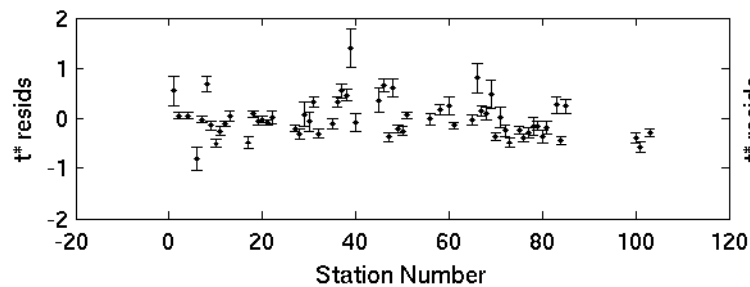
# Event\_2008\_039\_09\_38\_14



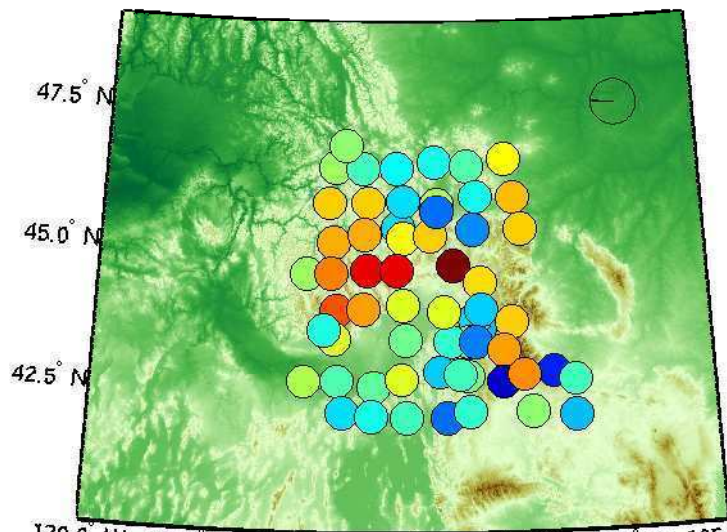
Event\_2008\_039\_09\_38\_14



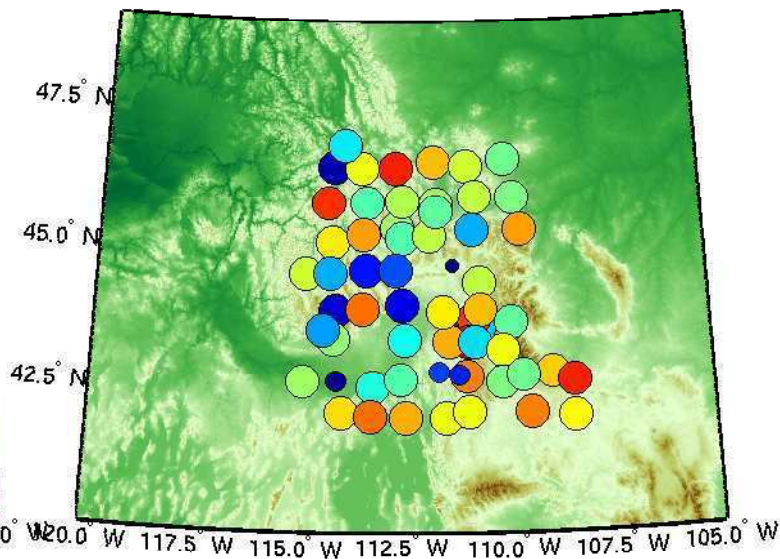
Baz = 96.3109  
Mean xcor value = 0.89048  
Range of  $t^*$  values is 2.2306  
Median  $t^*$  err is 0.10477



travel time residuals

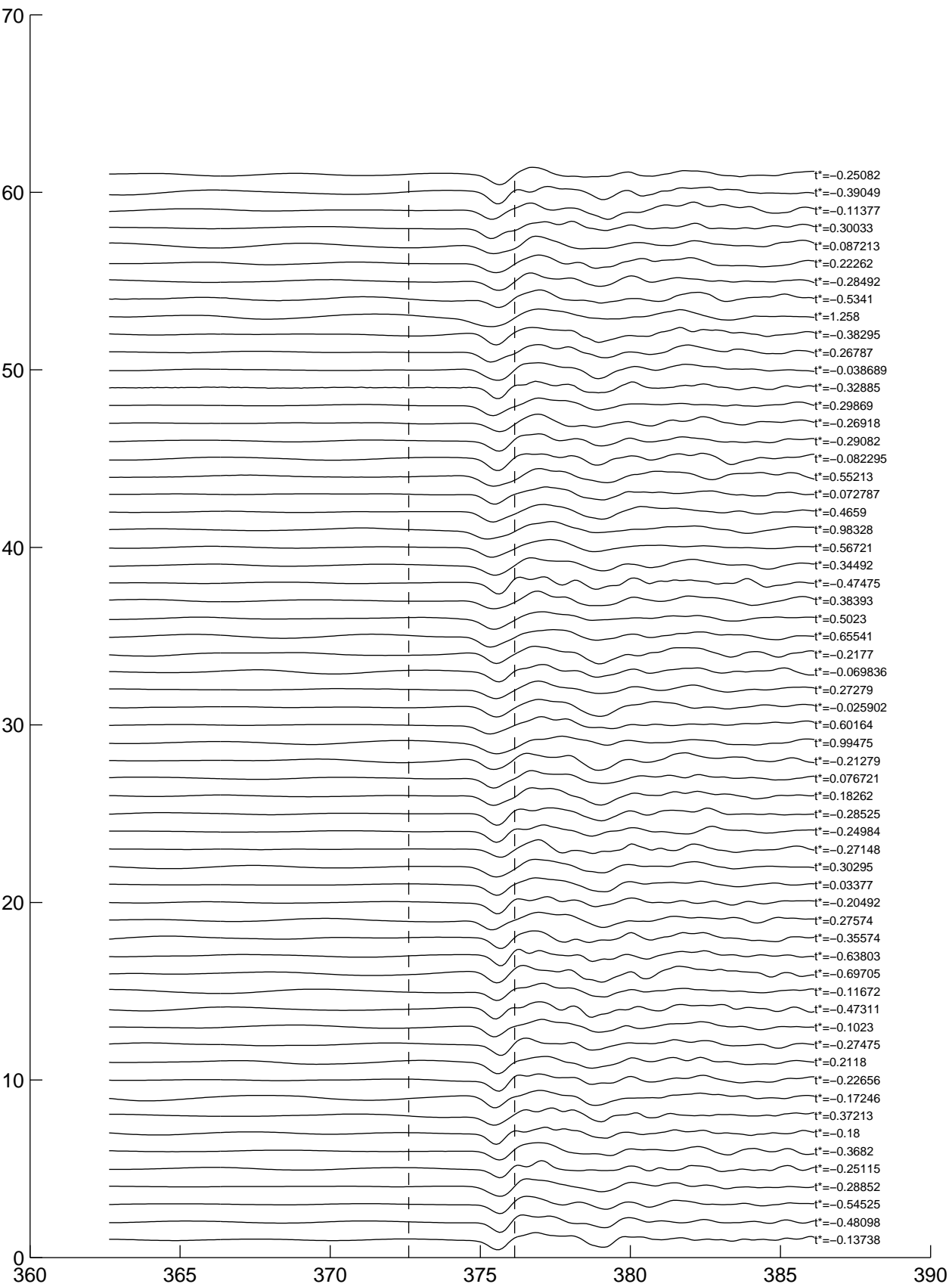


$t^*$  values

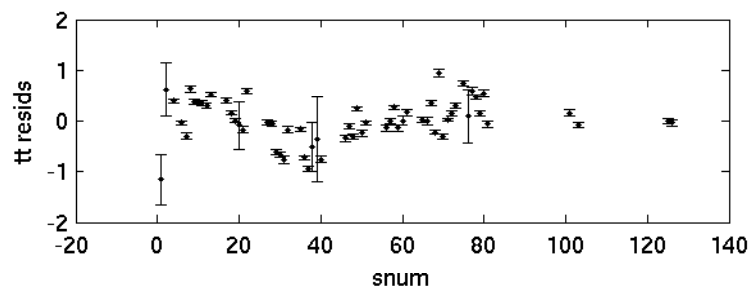
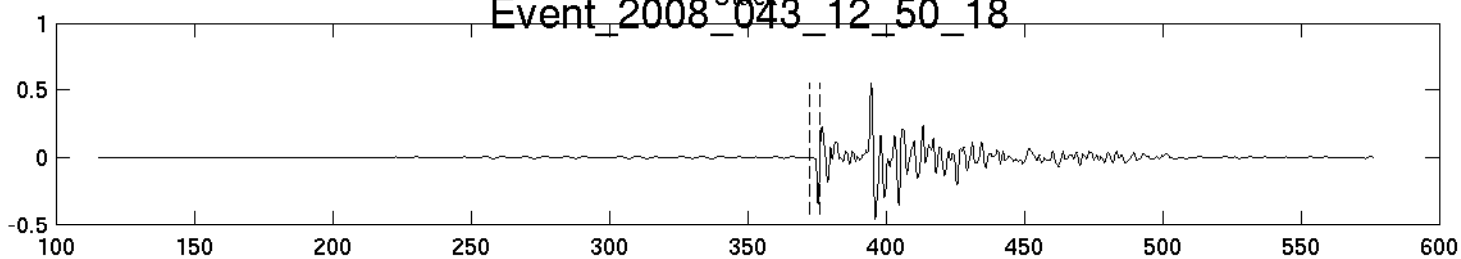




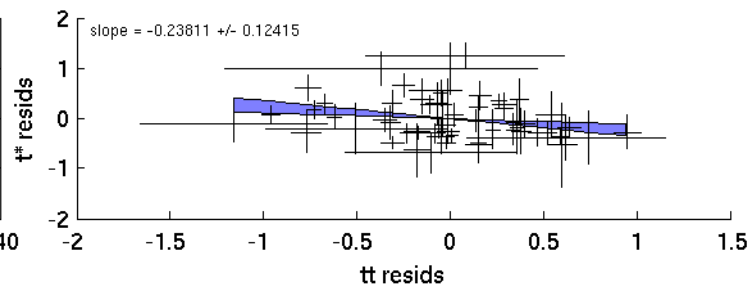
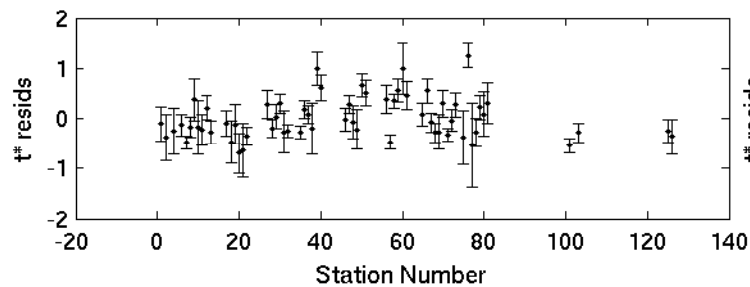
# Event\_2008\_043\_12\_50\_18



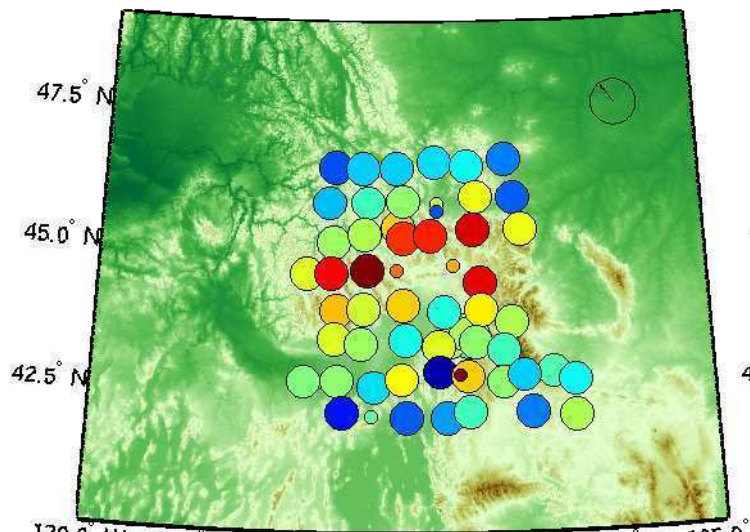
# Event\_2008\_043\_12\_50\_18



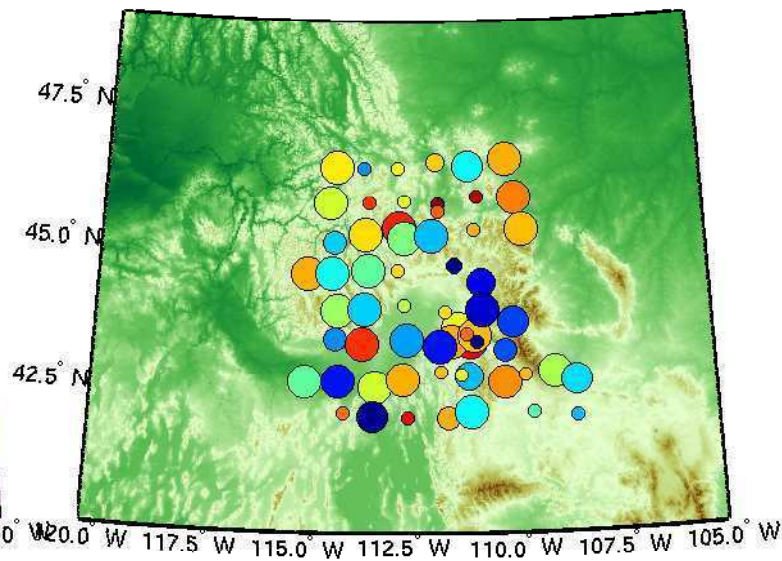
Baz = 146.3715  
 Mean xcor value = 0.69967  
 Range of  $t^*$  values is 1.9551  
 Median  $t^*$  err is 0.24808



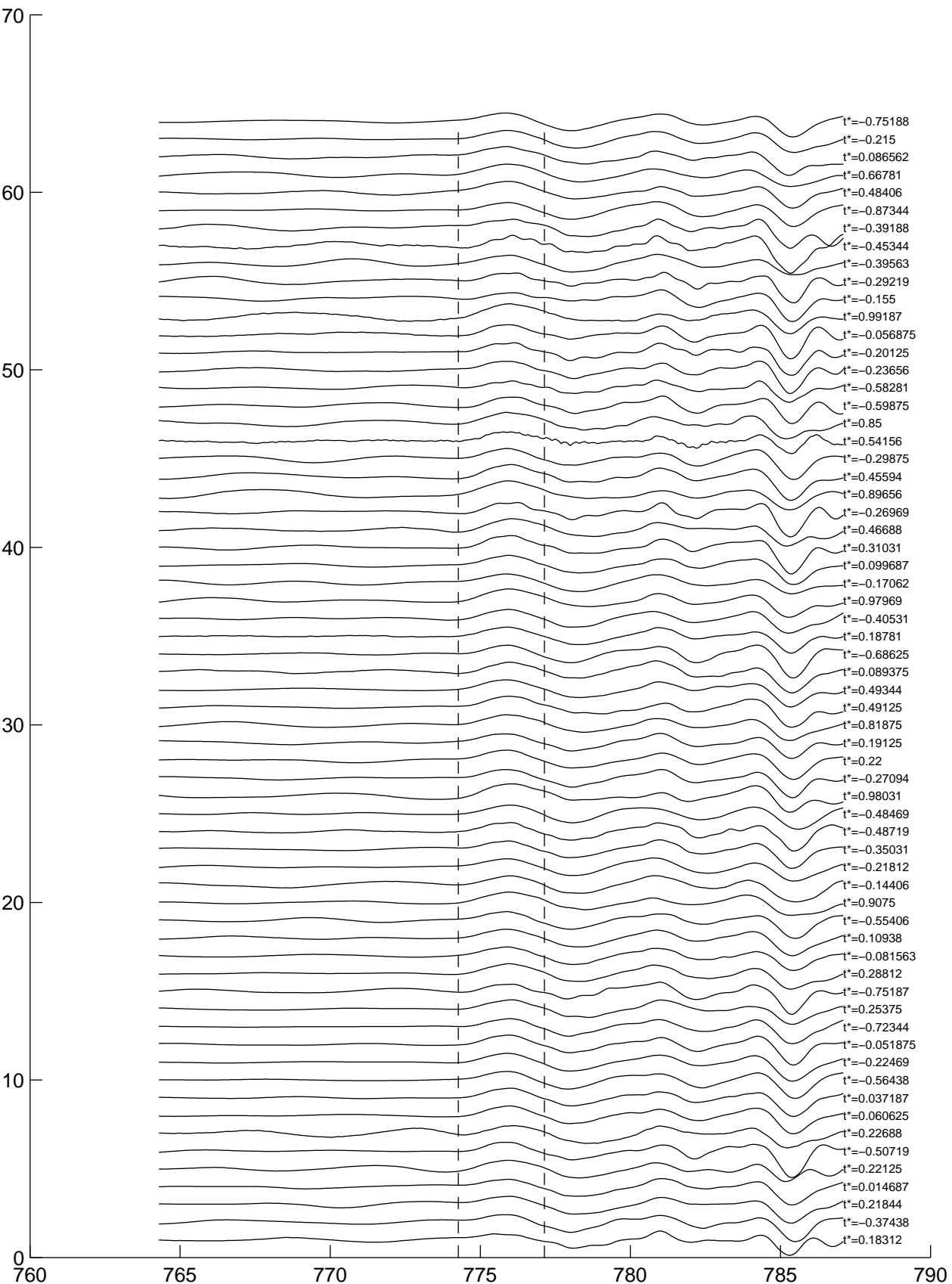
travel time residuals



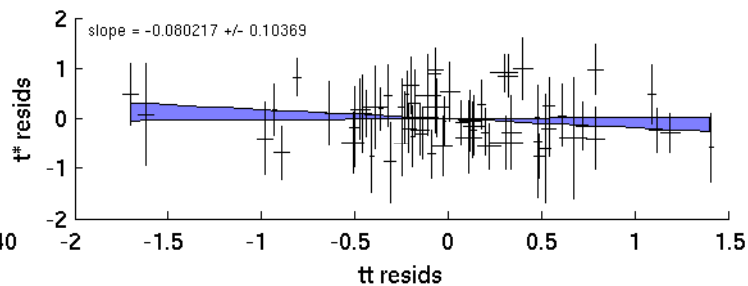
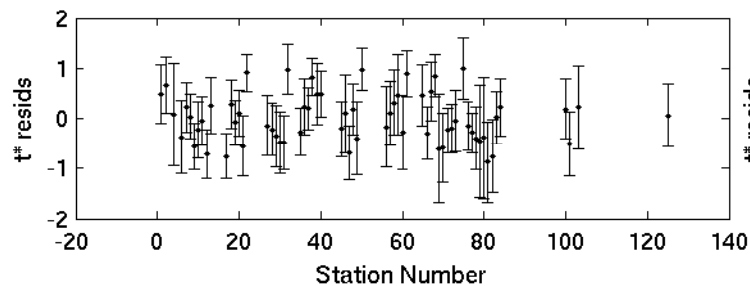
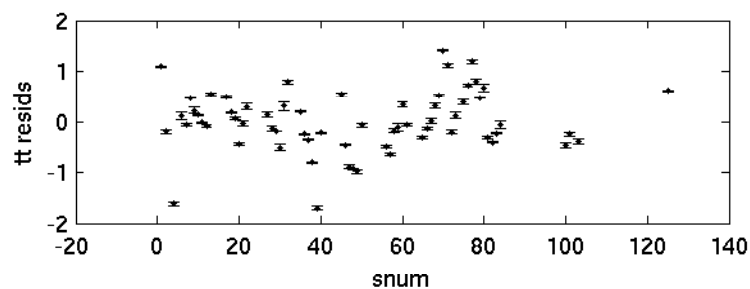
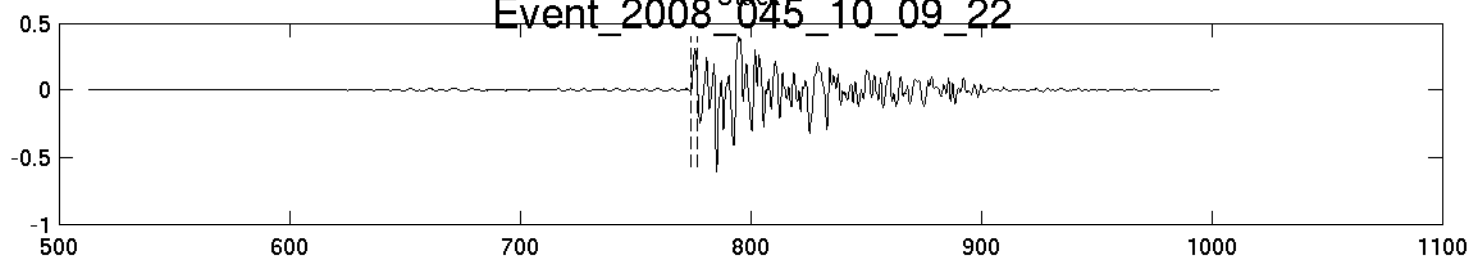
$t^*$  values



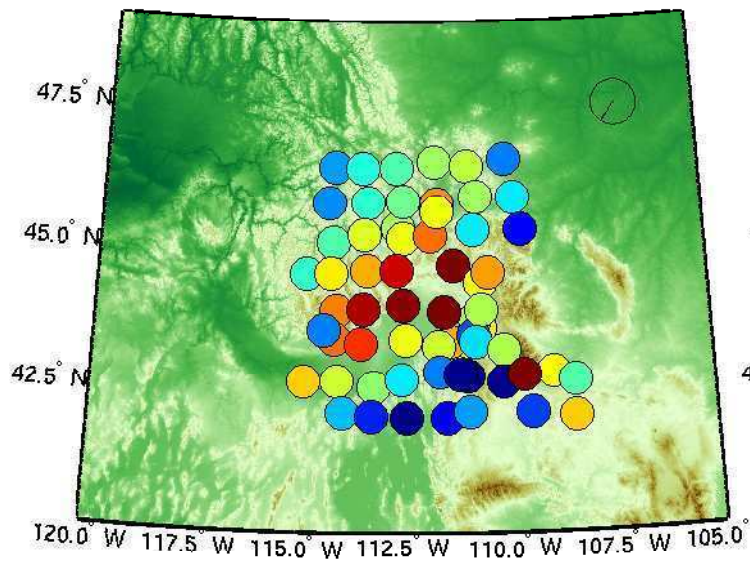
# Event\_2008\_045\_10\_09\_22



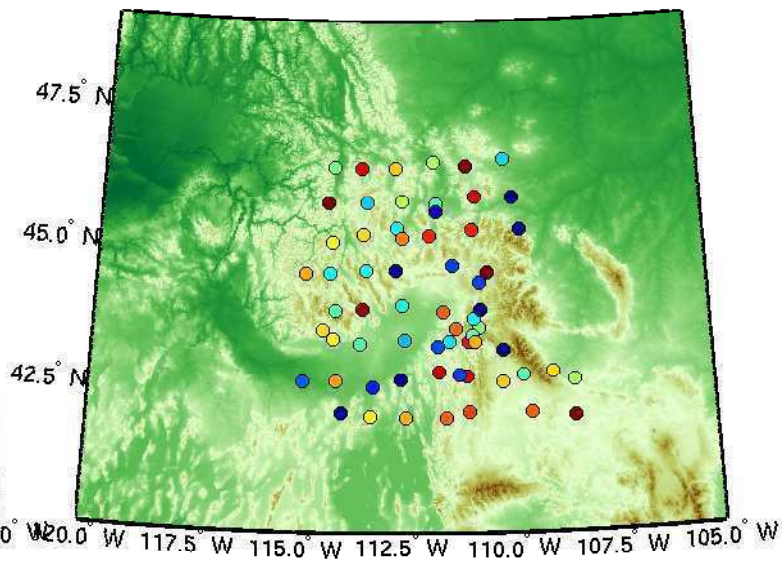
# Event\_2008\_045\_10\_09\_22



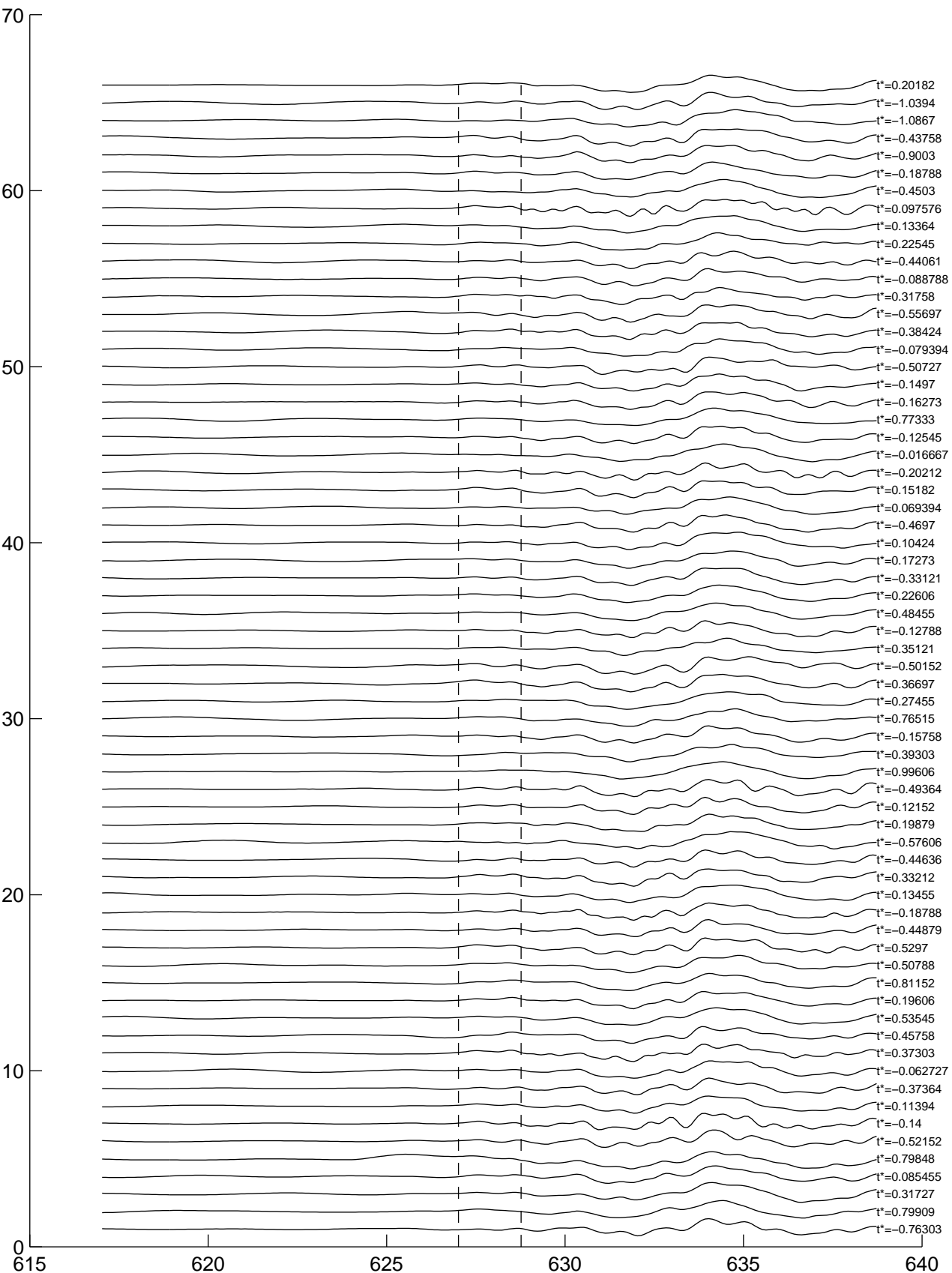
travel time residuals



$t^*$  values



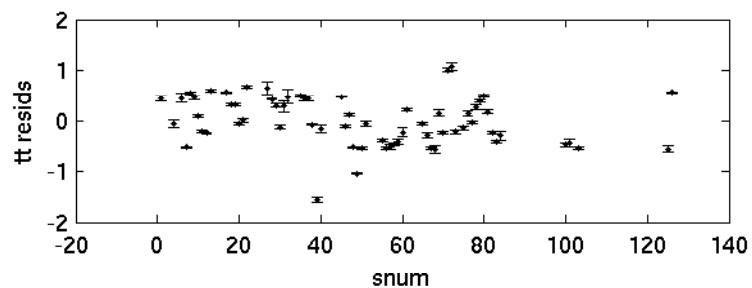
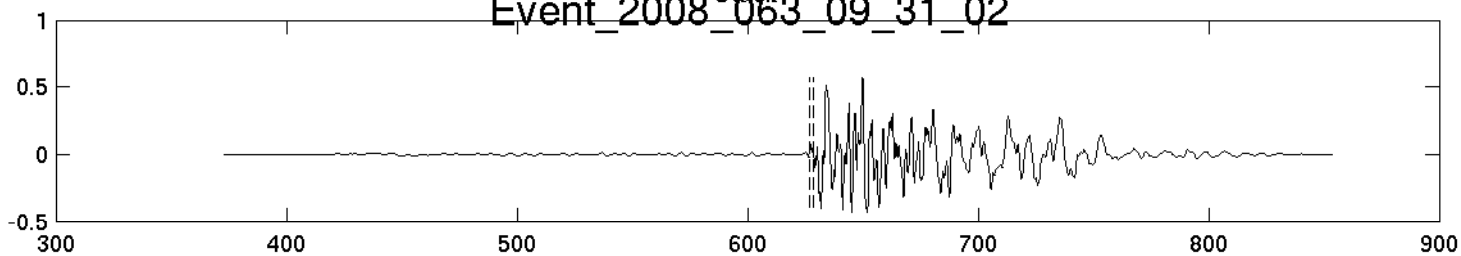
# Event\_2008\_063\_09\_31\_02



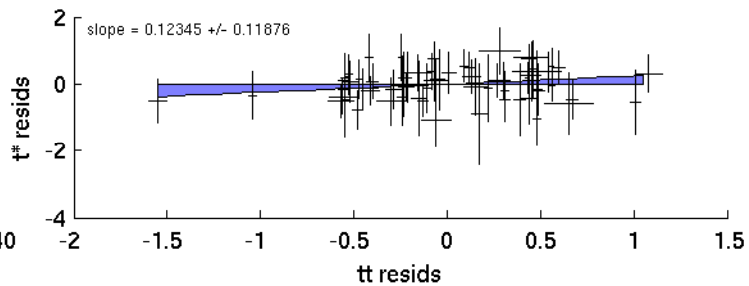
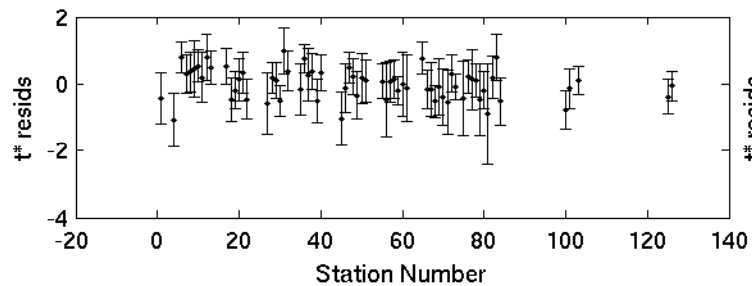


# Event\_2008\_063\_09\_31\_02

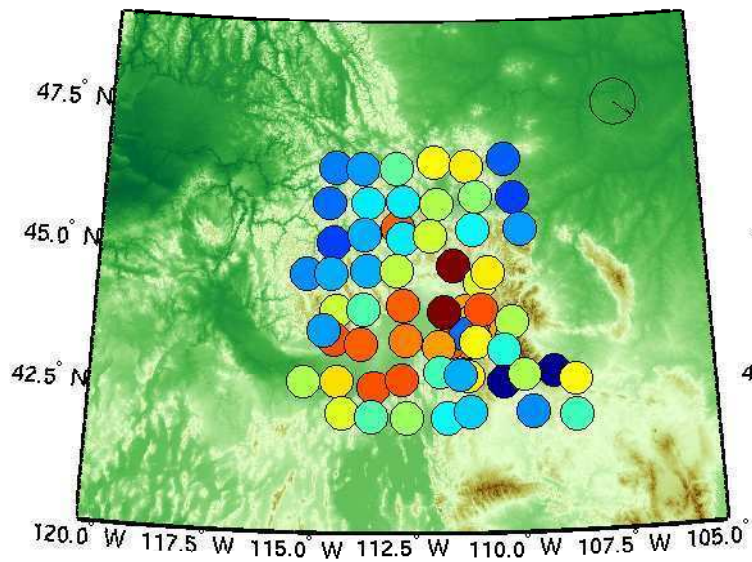
Stack



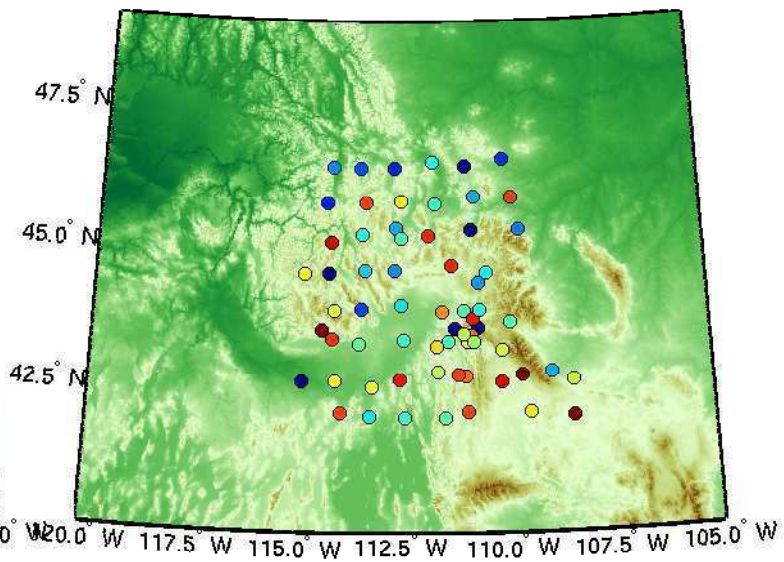
Baz = 309.3049  
Mean xcor value = 0.81773  
Range of  $t^*$  values is 2.0827  
Median  $t^*$  err is 0.60338



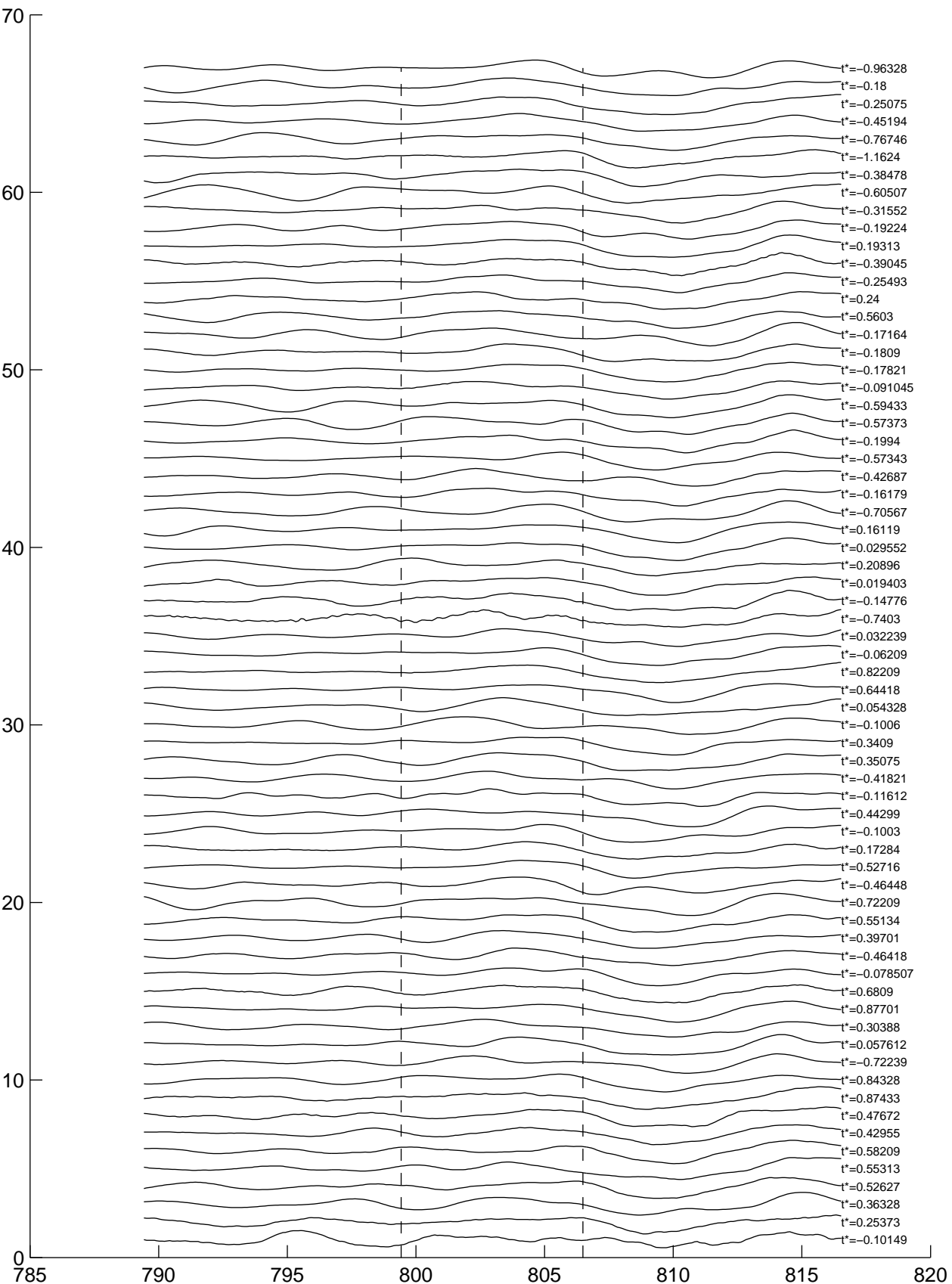
travel time residuals



$t^*$  values

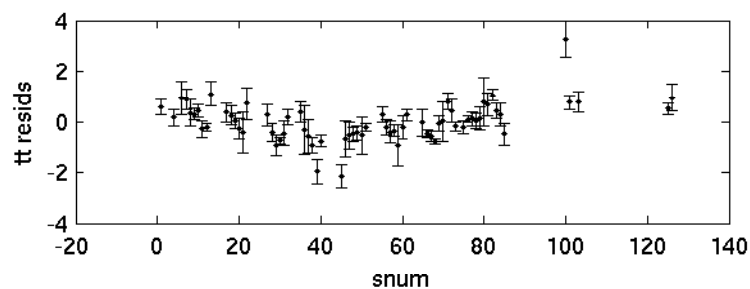
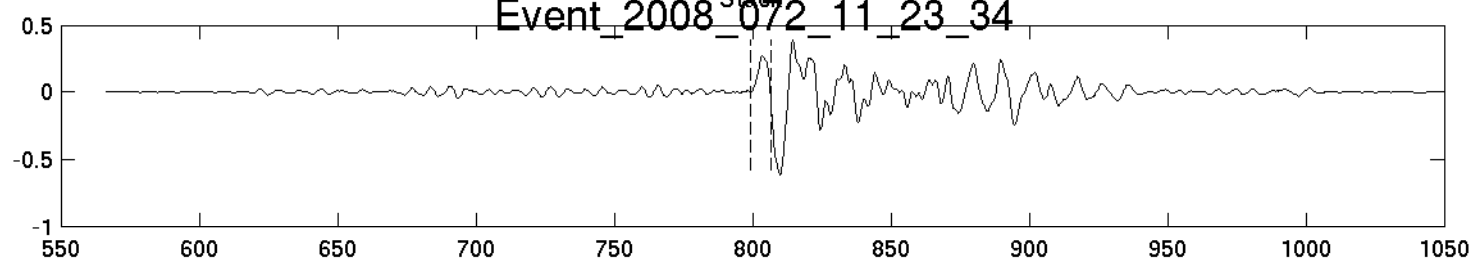


# Event\_2008\_072\_11\_23\_34

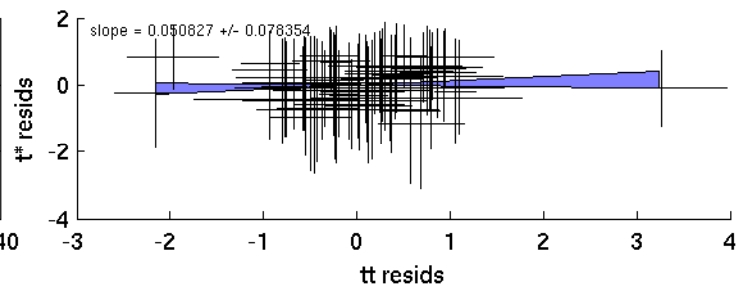
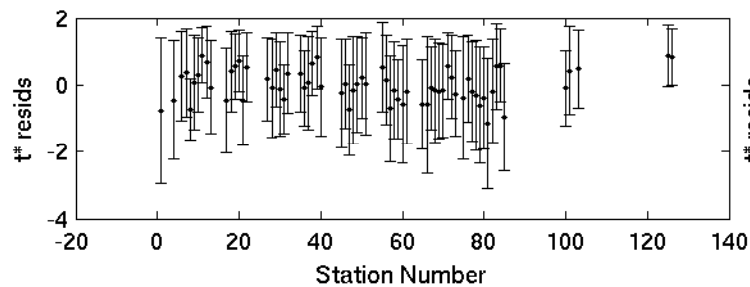




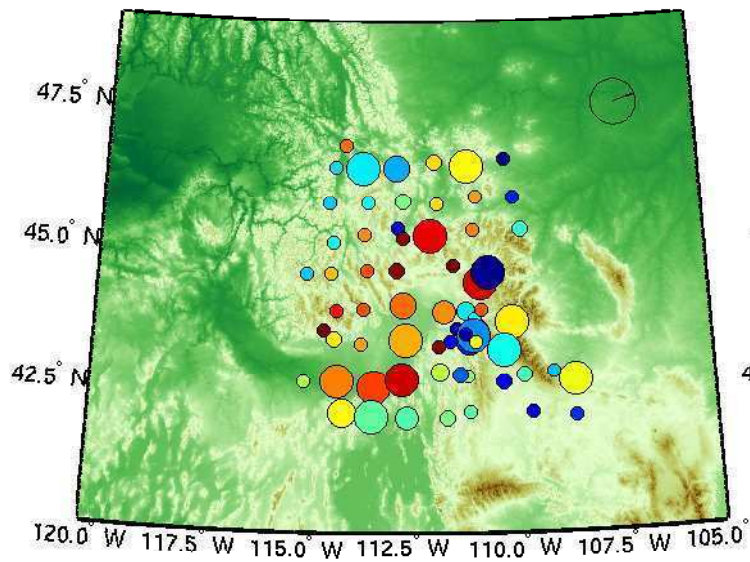
# Event\_2008\_072\_11\_23\_34



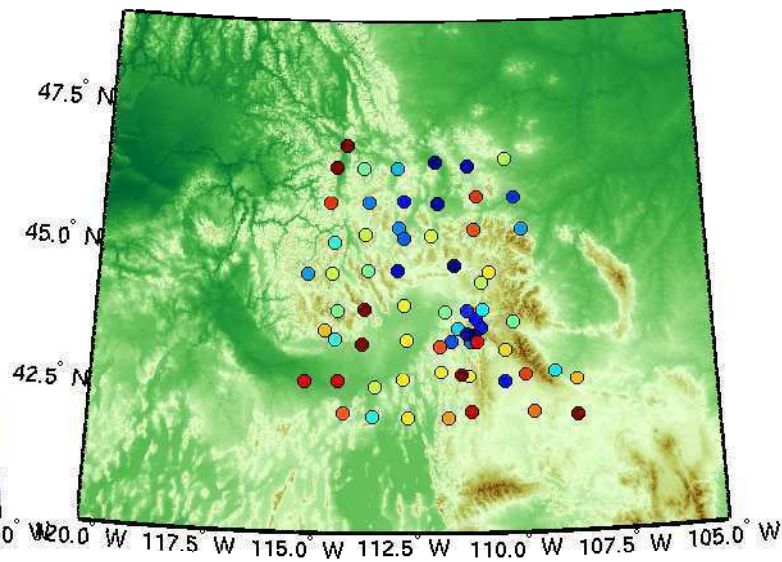
Baz = 251.8364  
 Mean xcor value = 0.77239  
 Range of  $t^*$  values is 2.0394  
 Median  $t^*$  err is 1.3316



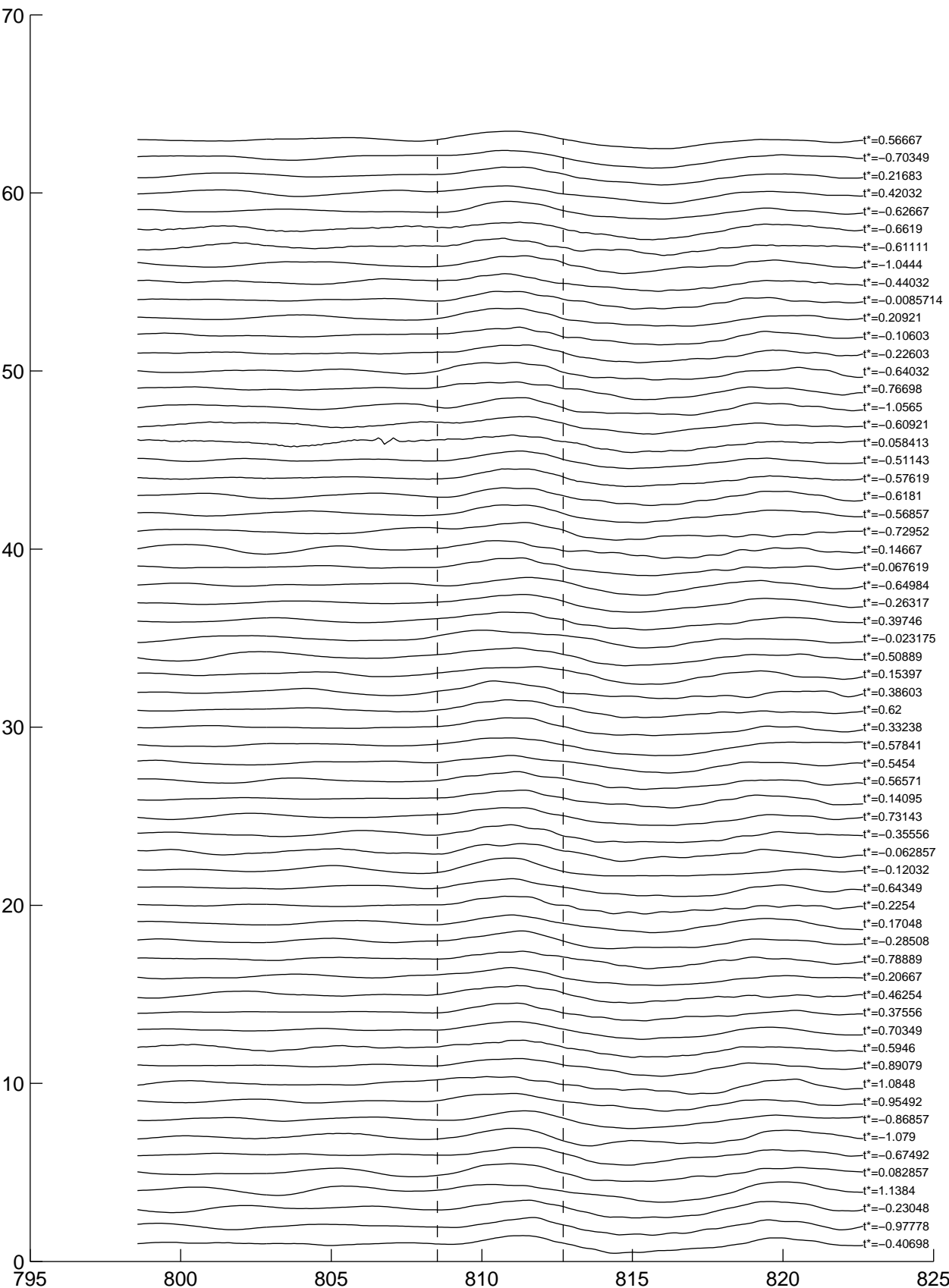
travel time residuals



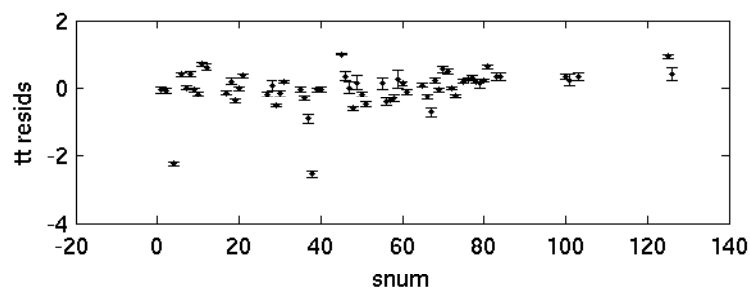
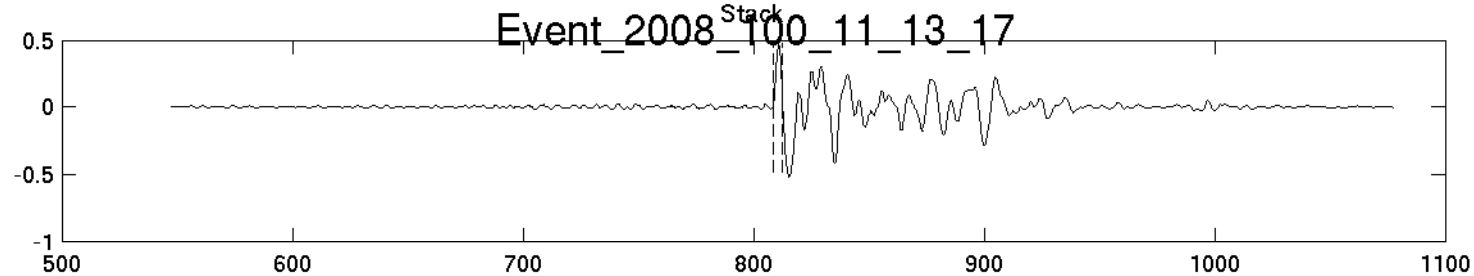
$t^*$  values



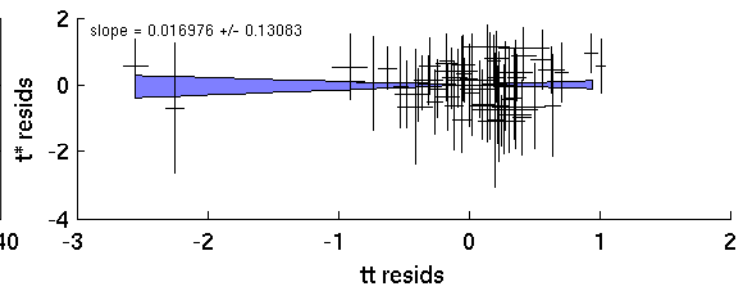
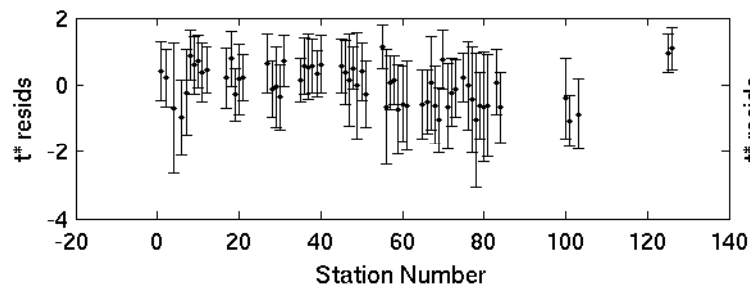
# Event\_2008\_100\_11\_13\_17



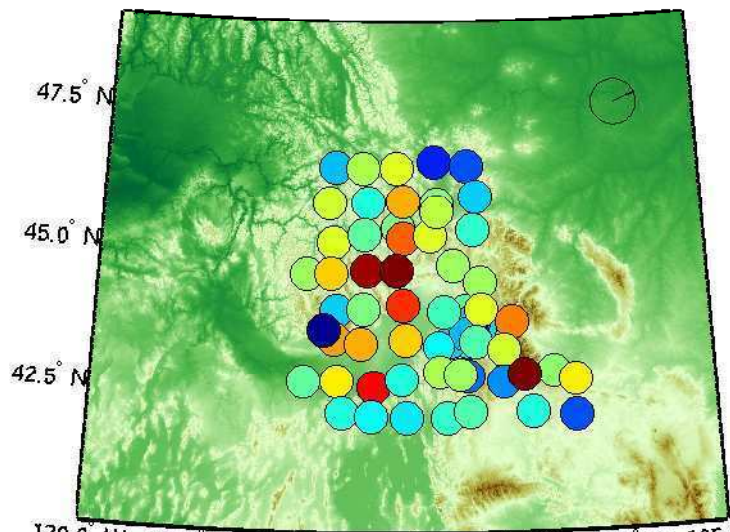
# Event\_2008\_100\_11\_13\_17



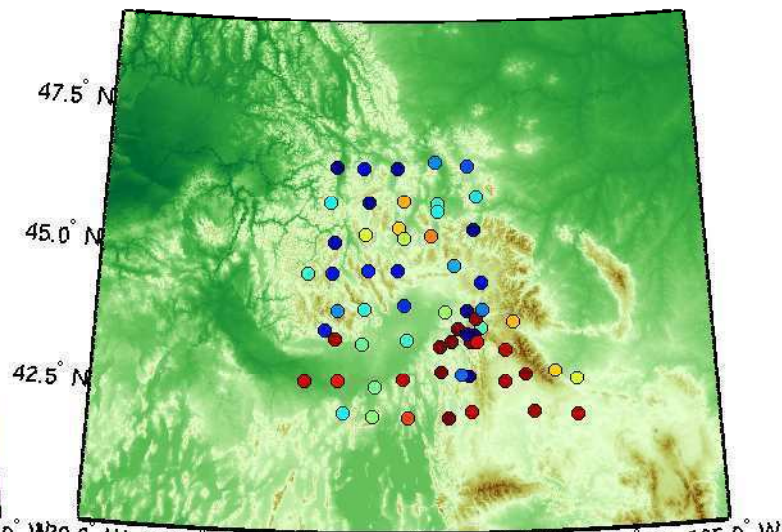
Baz = 248.1354  
 Mean xcor value = 0.84143  
 Range of  $t^*$  values is 2.2175  
 Median  $t^*$  err is 0.94576



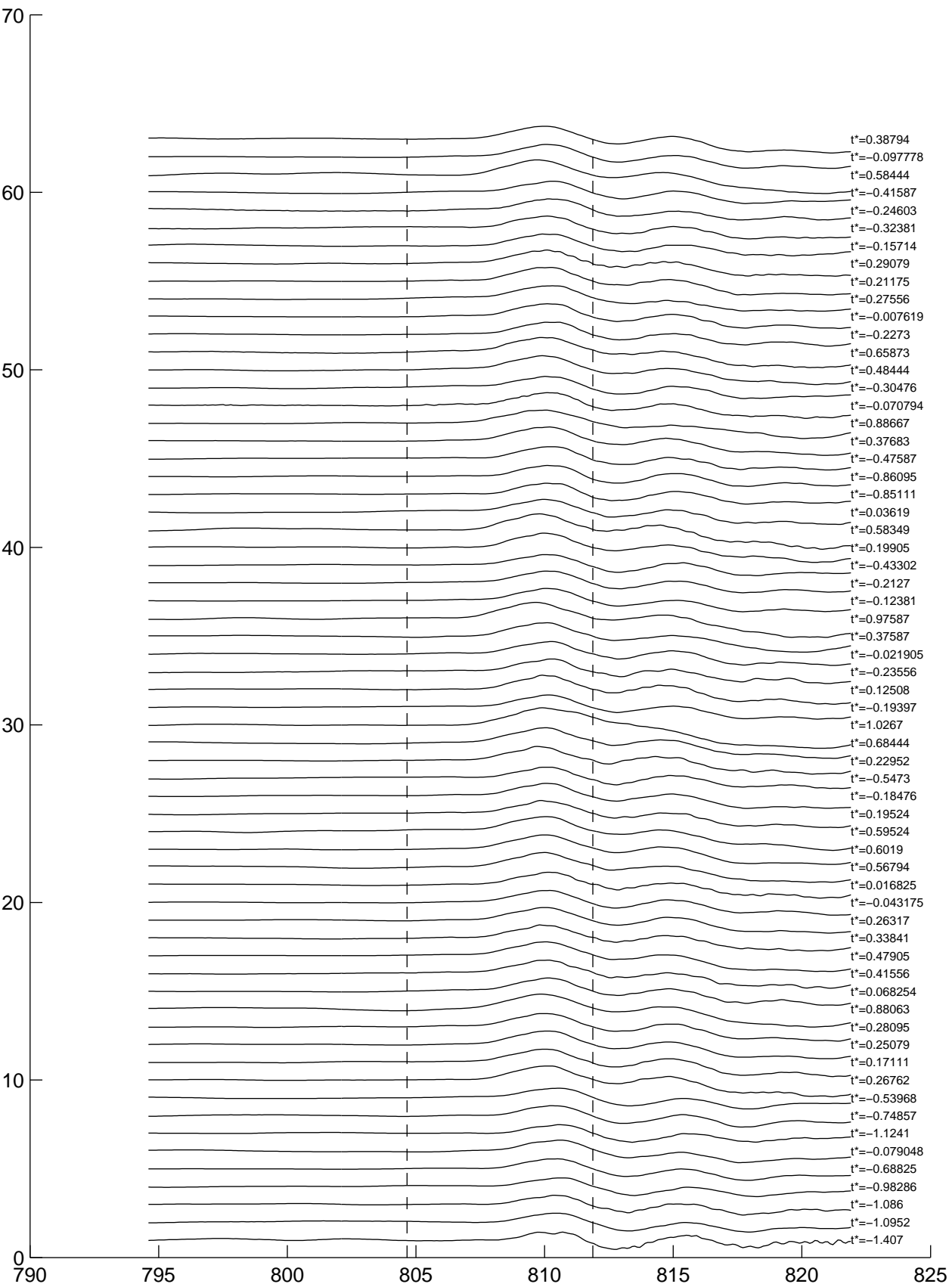
travel time residuals



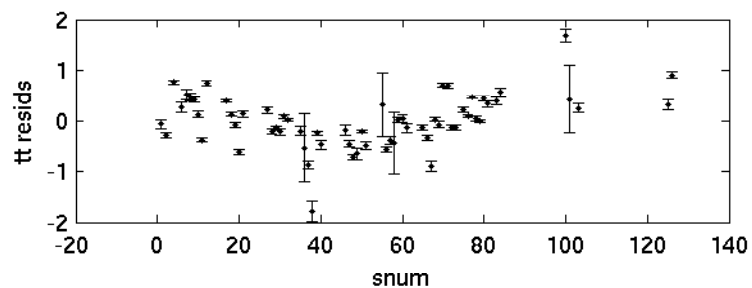
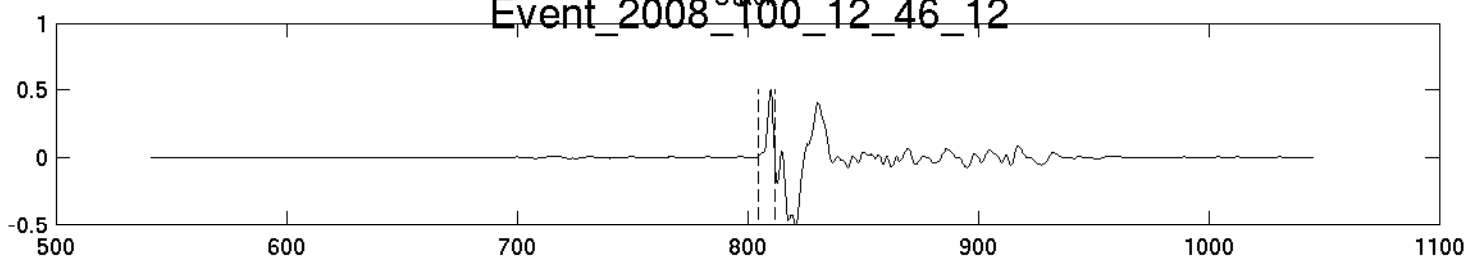
$t^*$  values



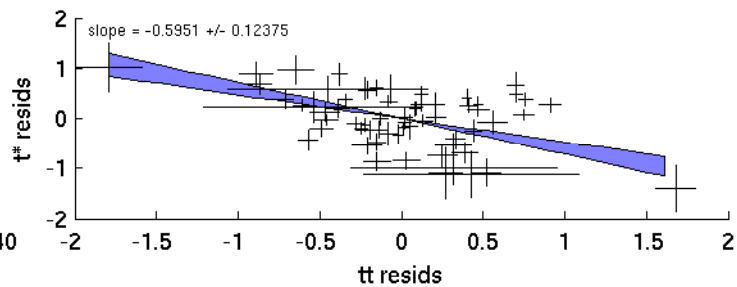
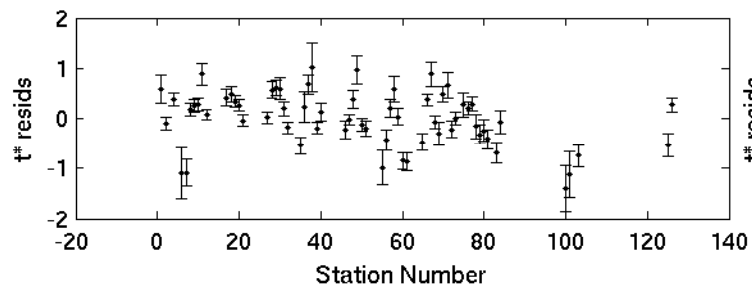
# Event\_2008\_100\_12\_46\_12



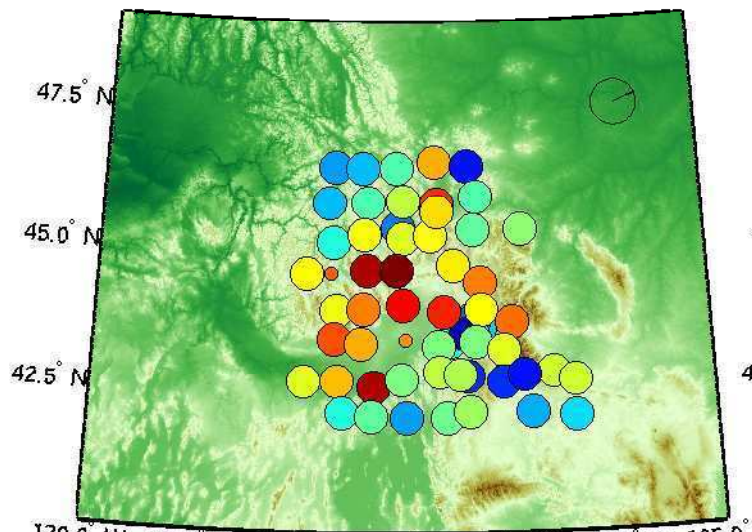
# Event\_2008\_100\_12\_46\_12



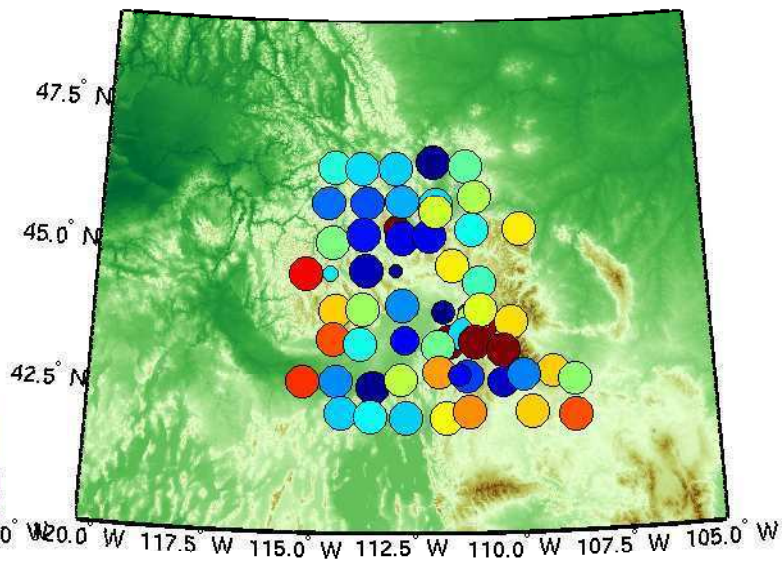
Baz = 248.2155  
 Mean xcor value = 0.89635  
 Range of  $t^*$  values is 2.4337  
 Median  $t^*$  err is 0.16867



travel time residuals

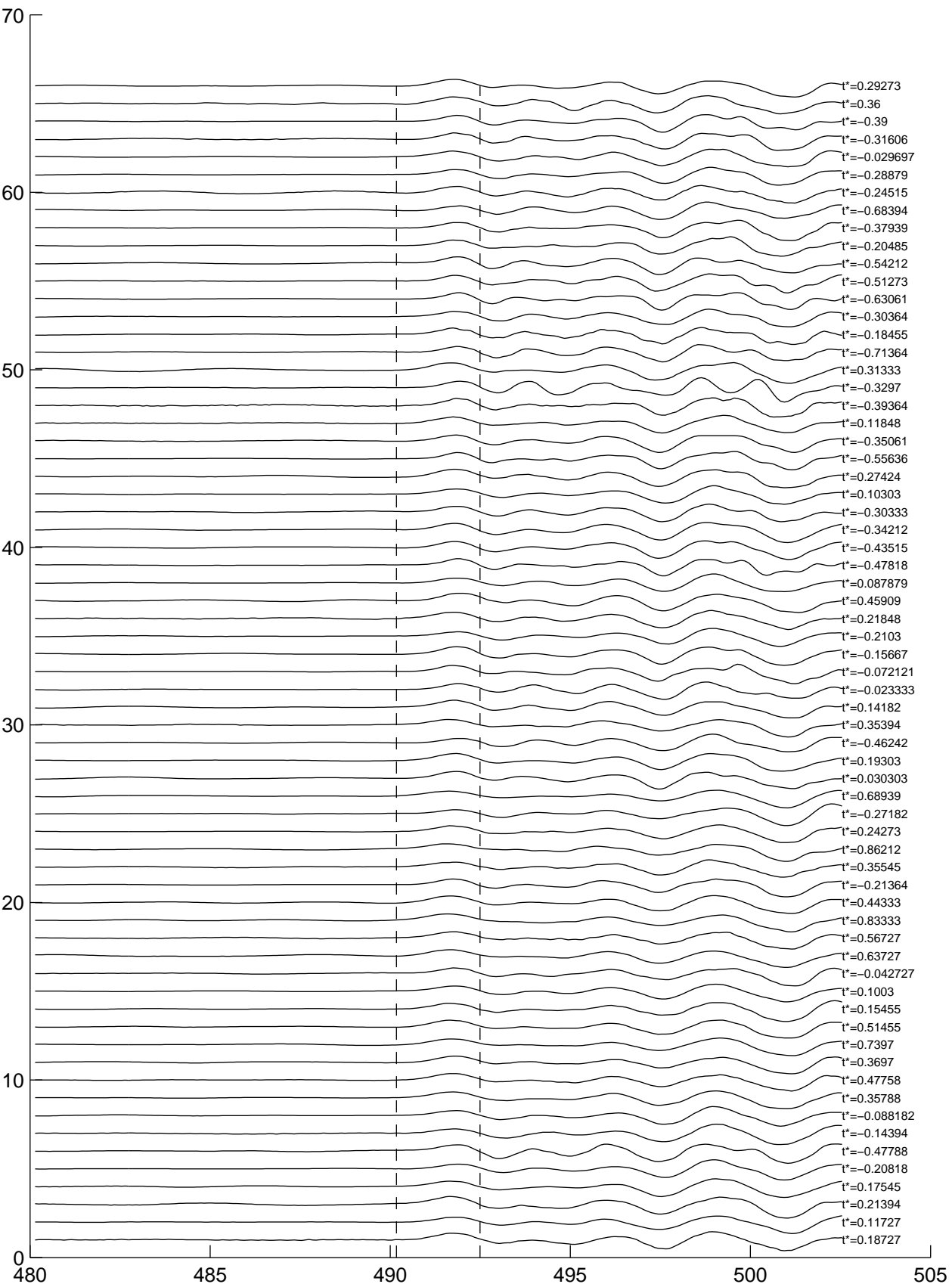


$t^*$  values

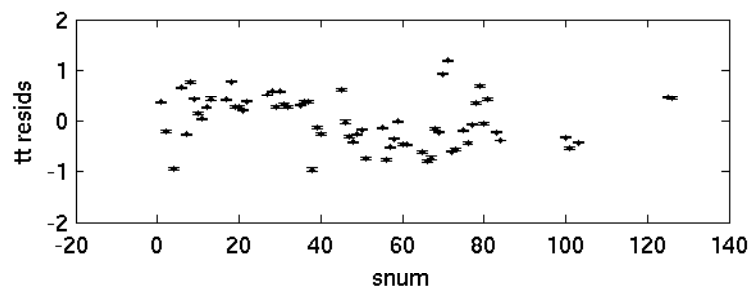
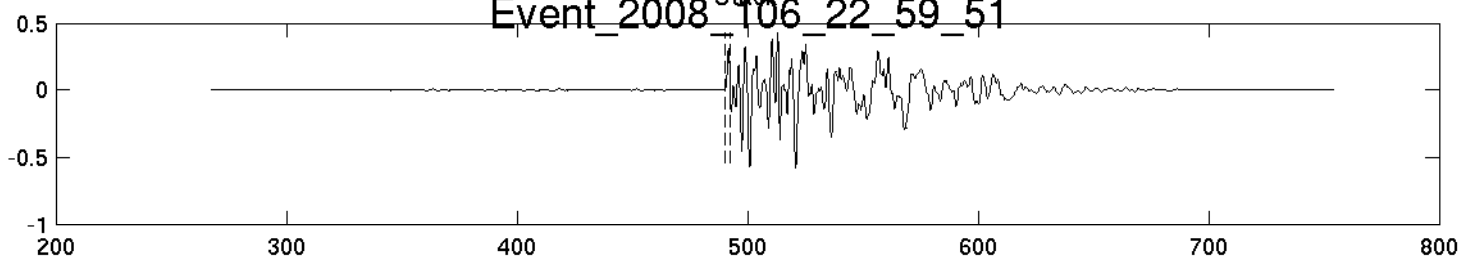




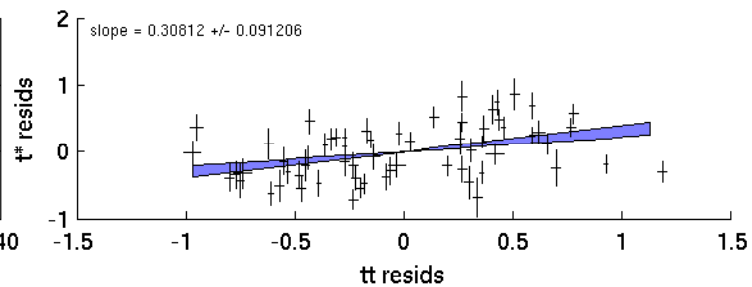
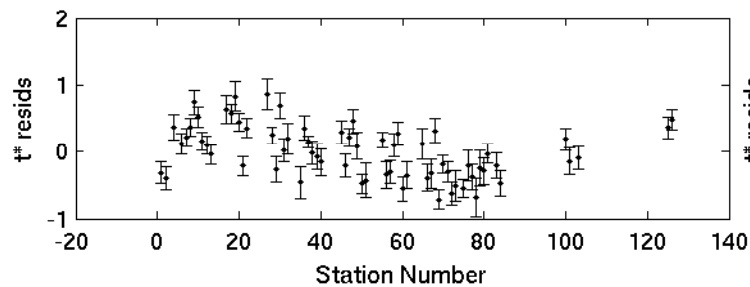
# Event\_2008\_106\_22\_59\_51



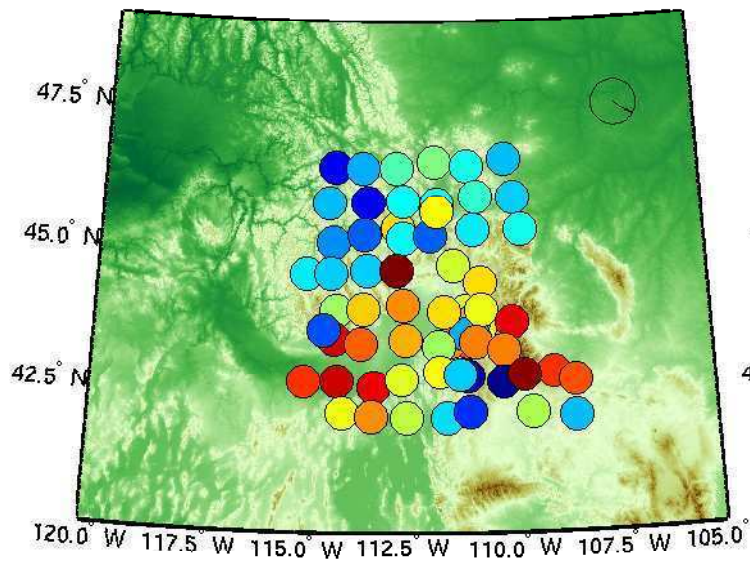
Event\_2008\_106\_22\_59\_51



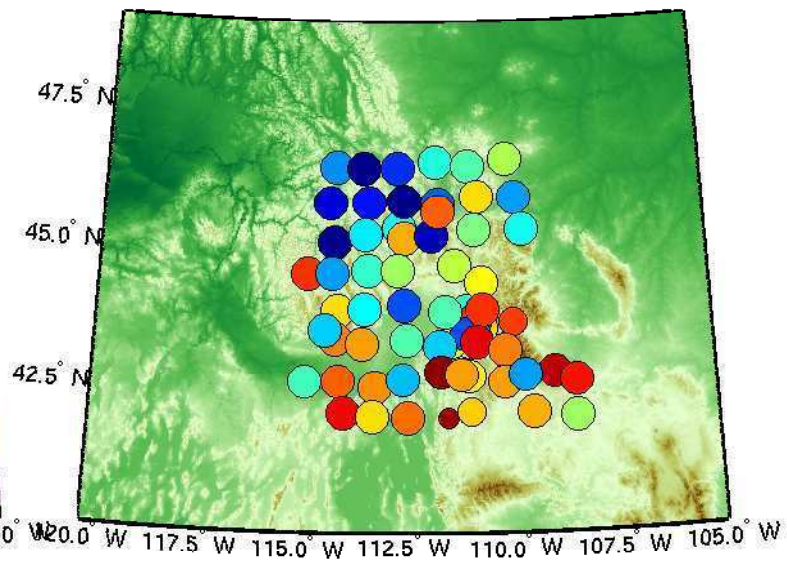
Baz = 305.0497  
Mean xcor value = 0.80894  
Range of  $t^*$  values is 1.5758  
Median  $t^*$  err is 0.17494



travel time residuals

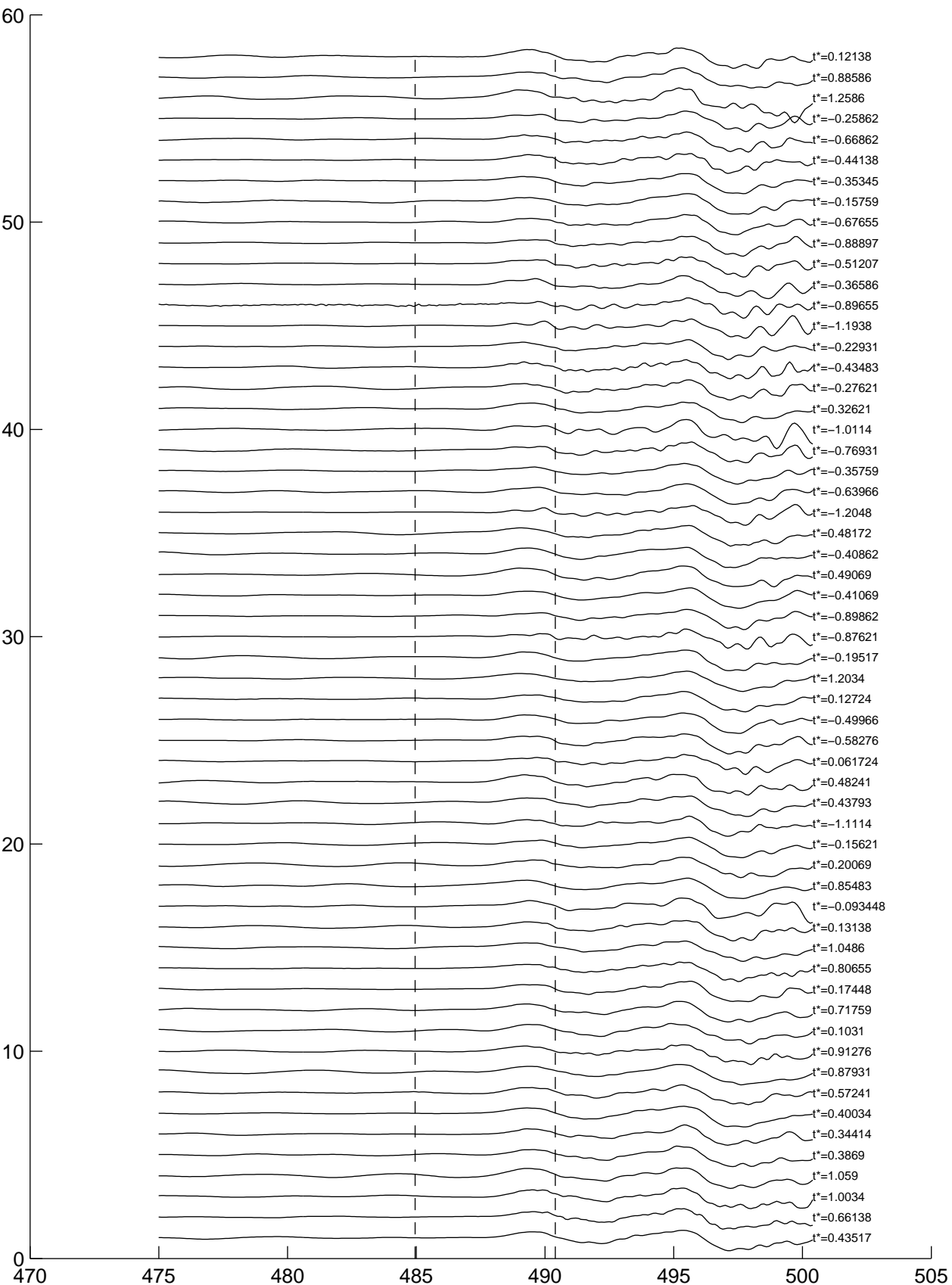


$t^*$  values

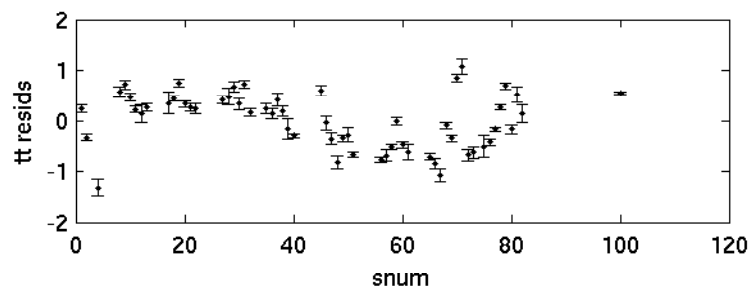
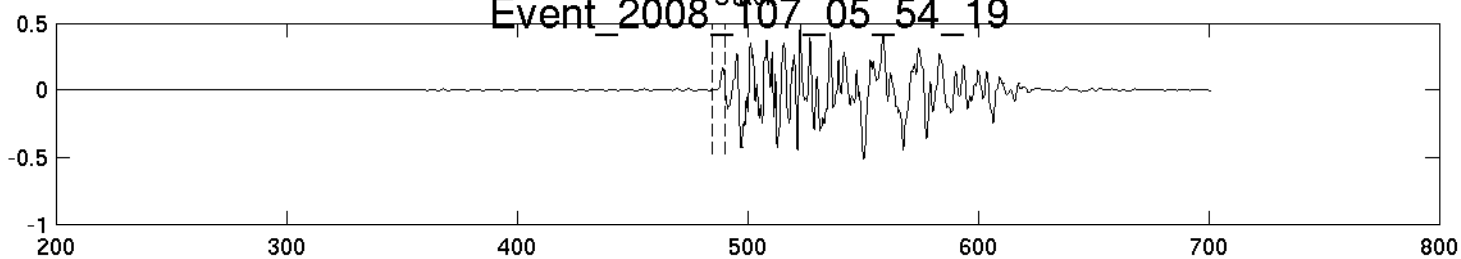




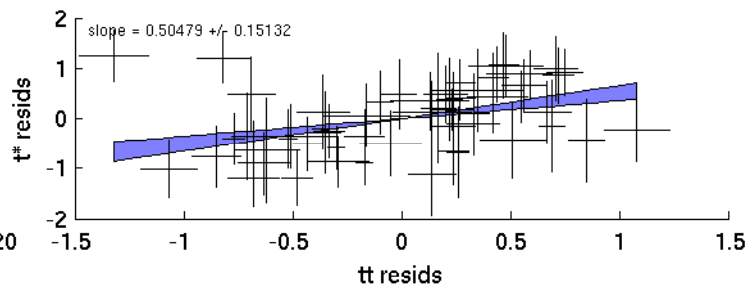
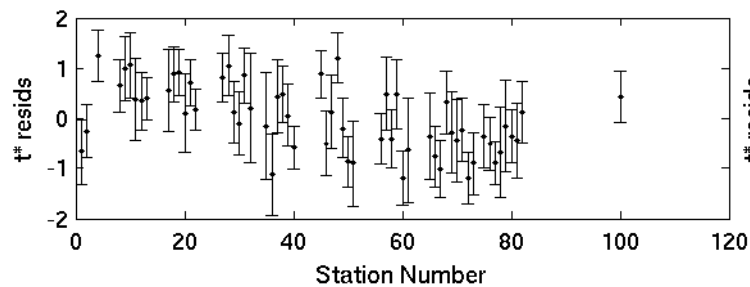
# Event\_2008\_107\_05\_54\_19



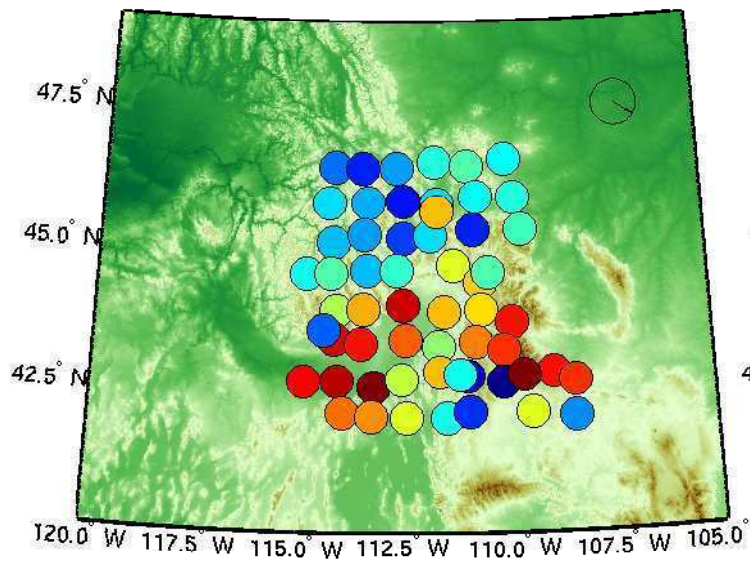
Event\_2008\_107\_05\_54\_19



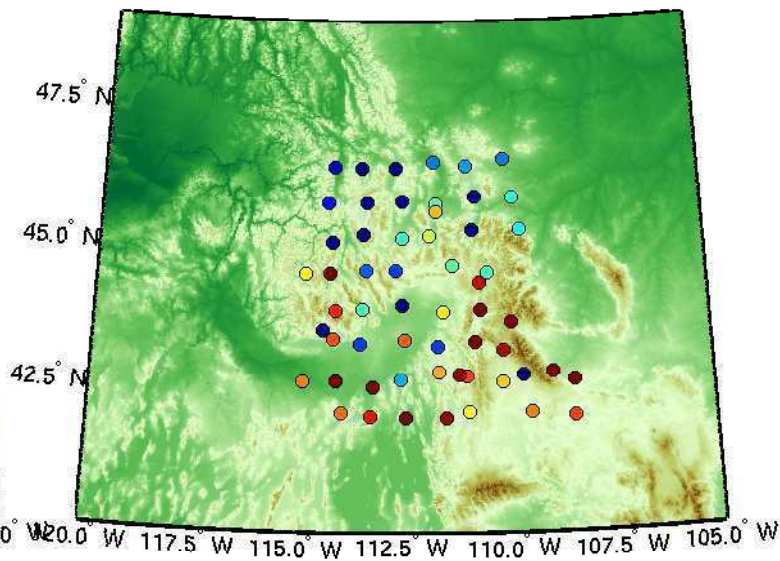
Baz = 304.9594  
Mean xcor value = 0.78466  
Range of  $t^*$  values is 2.4634  
Median  $t^*$  err is 0.61669



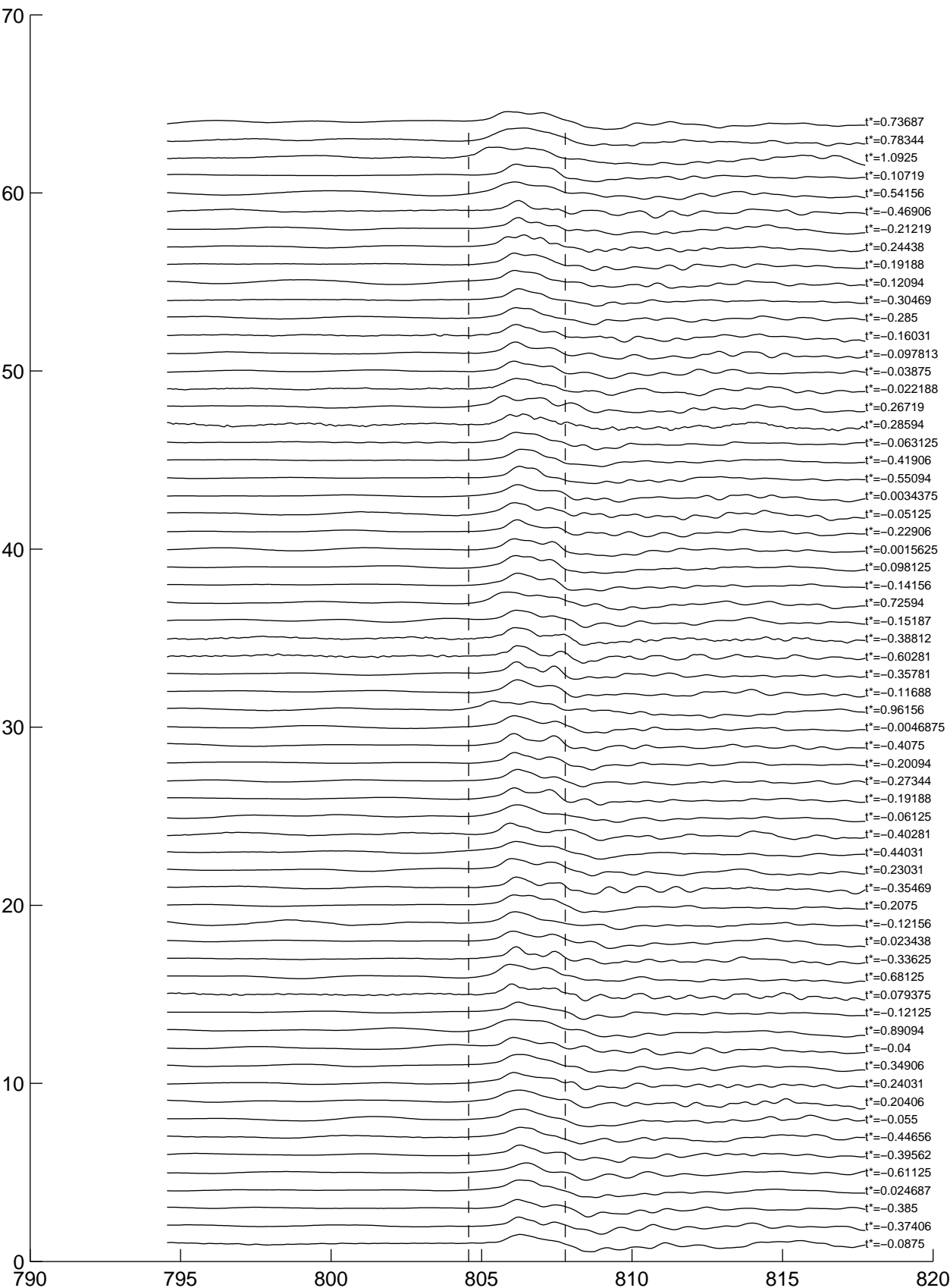
travel time residuals



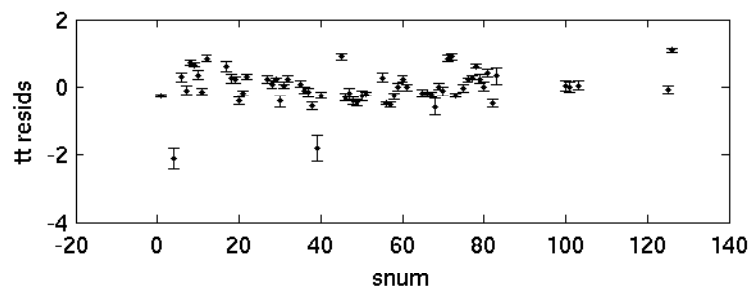
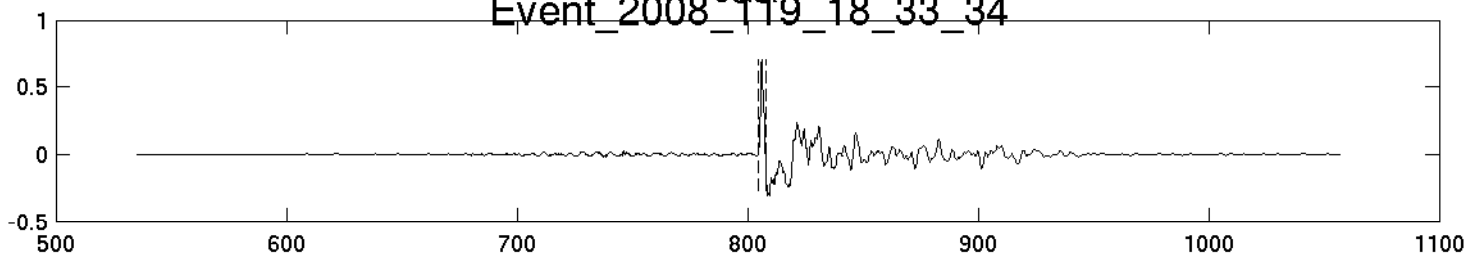
$t^*$  values



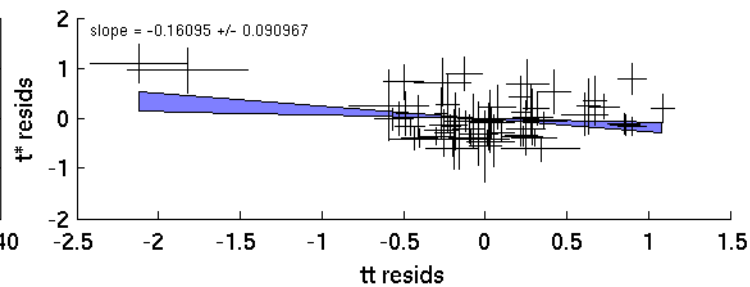
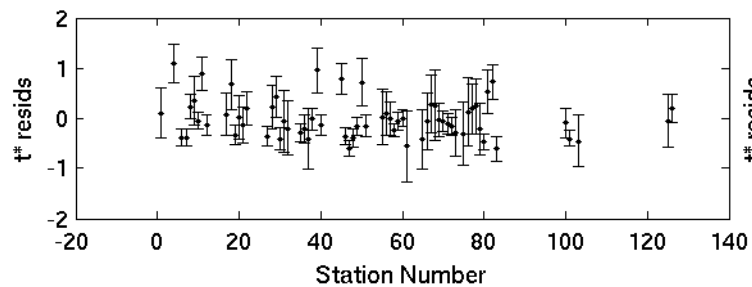
# Event\_2008\_119\_18\_33\_34



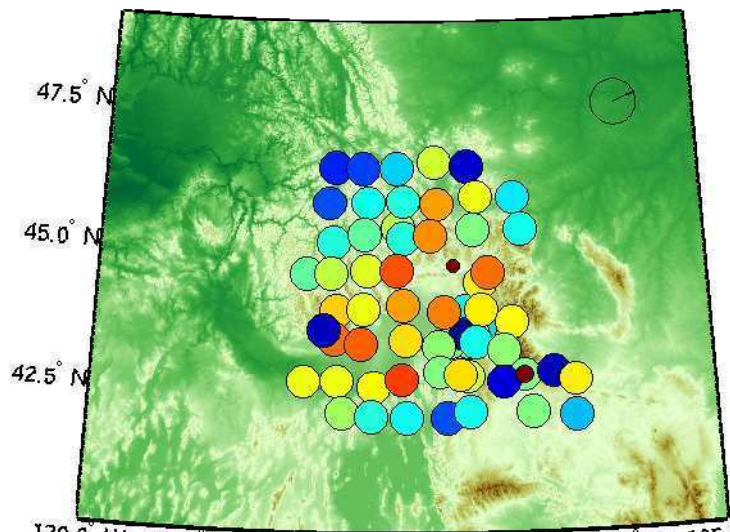
# Event\_2008\_11\_19\_18\_33\_34<sup>Stack</sup>



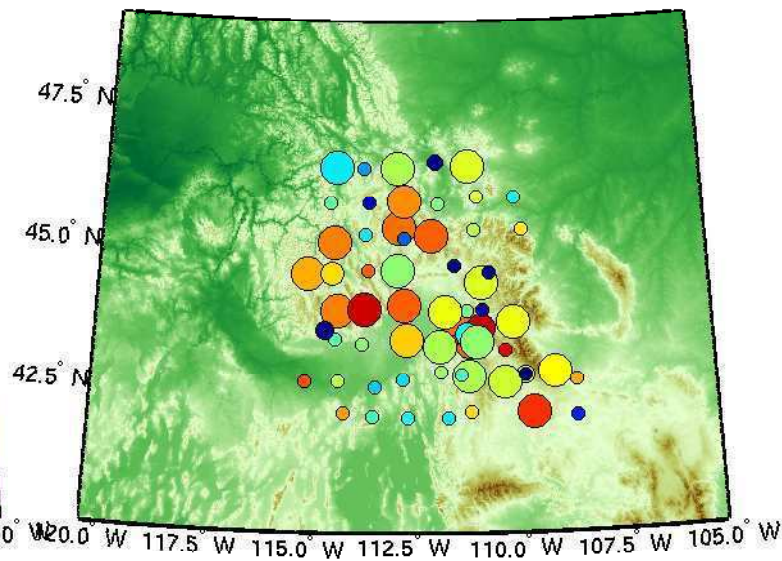
Baz = 248.3058  
 Mean xcor value = 0.78562  
 Range of  $t^*$  values is 1.7037  
 Median  $t^*$  err is 0.33417



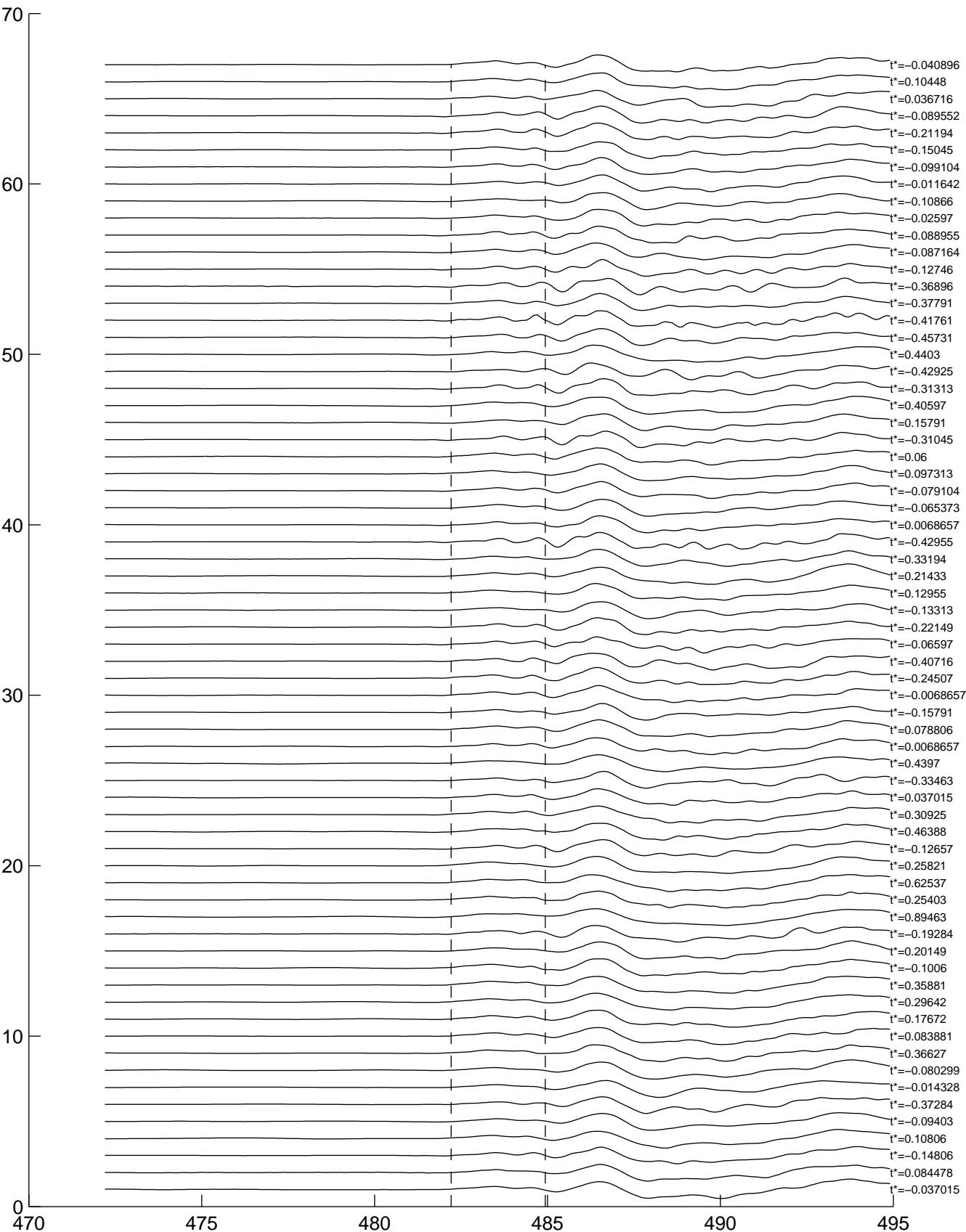
travel time residuals



$t^*$  values

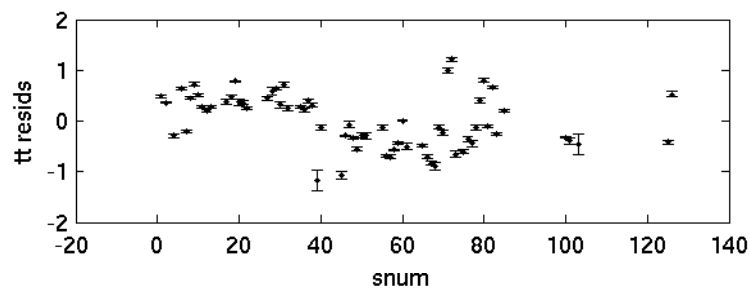
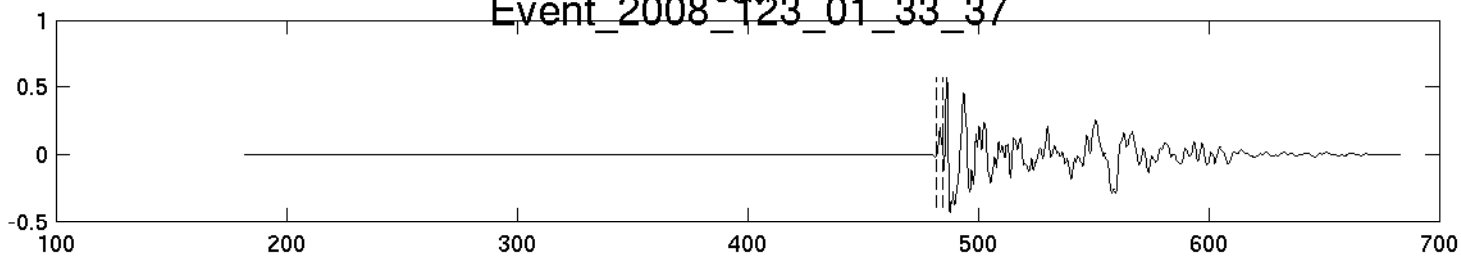


Event\_2008\_123\_01\_33\_37

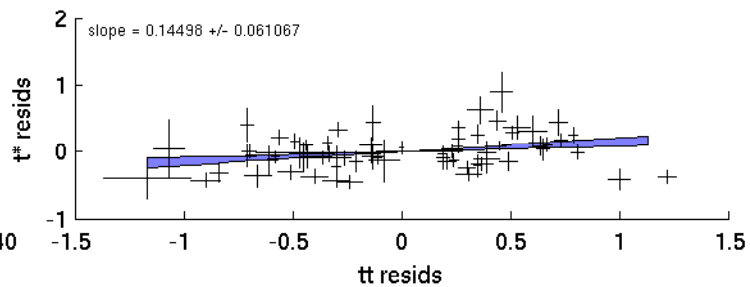
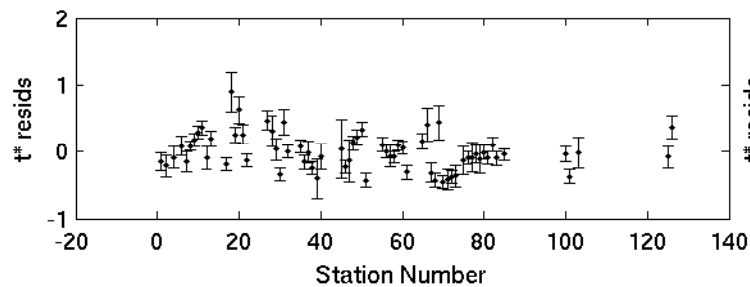




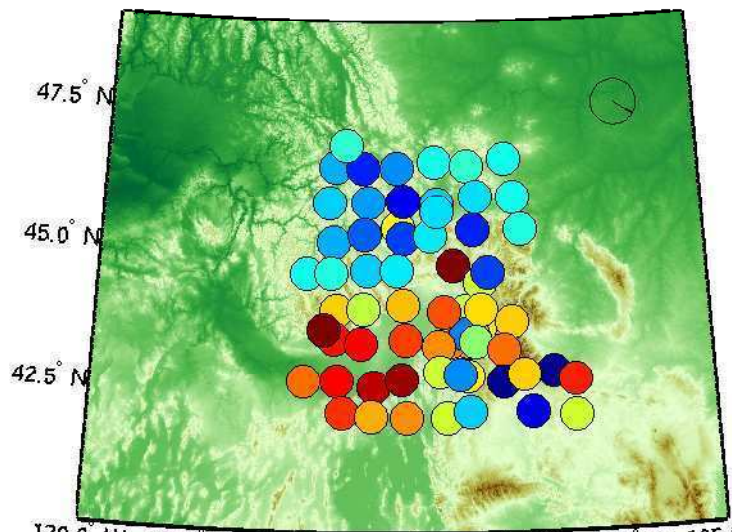
# Event\_2008\_123\_01\_33\_37<sup>Stack</sup>



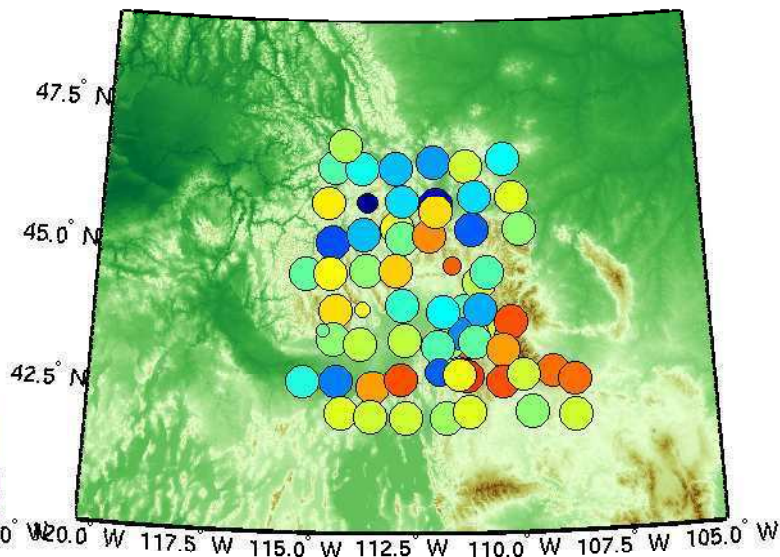
Baz = 304.5659  
 Mean xcor value = 0.85582  
 Range of  $t^*$  values is 1.3519  
 Median  $t^*$  err is 0.11057



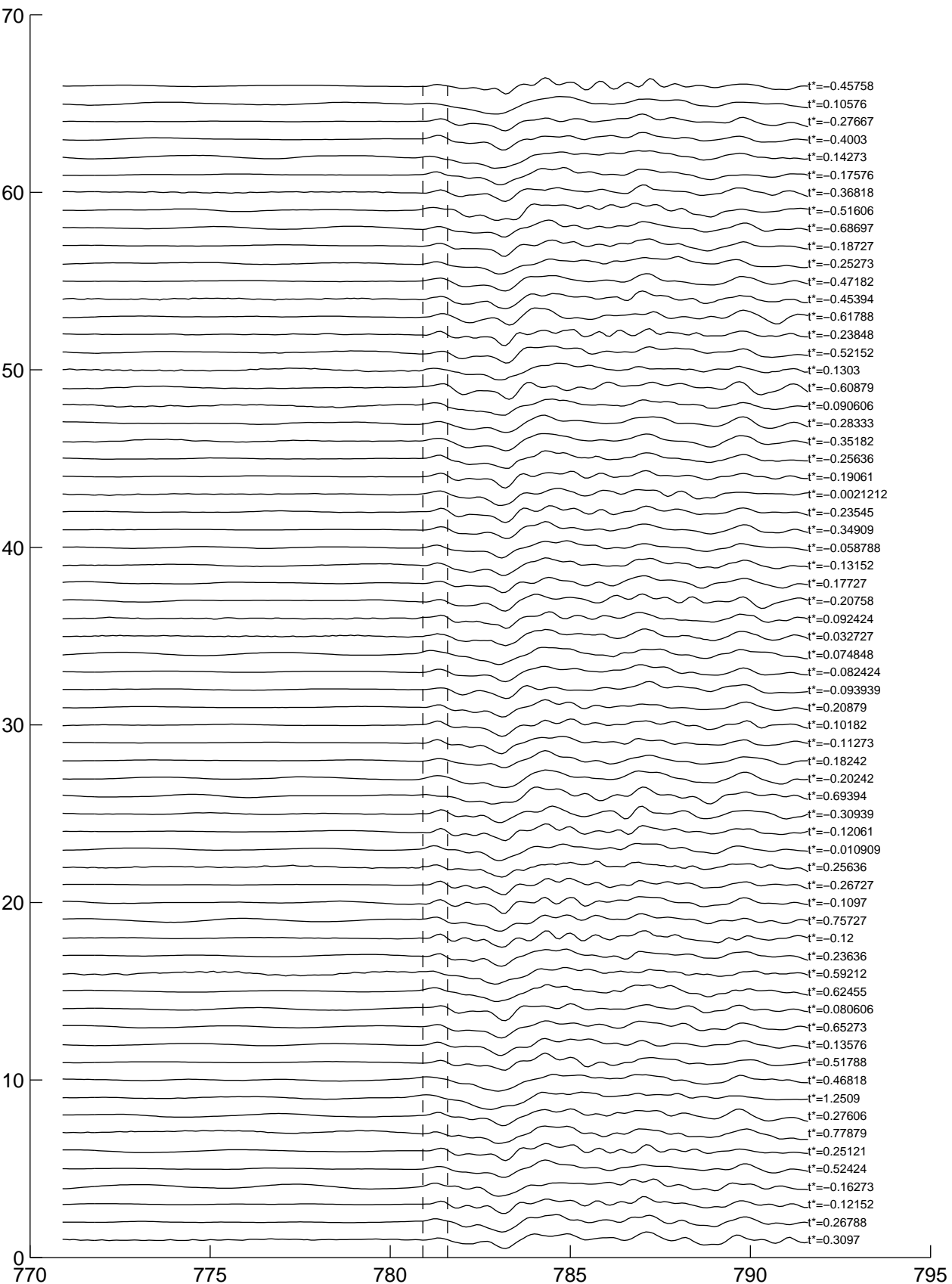
travel time residuals



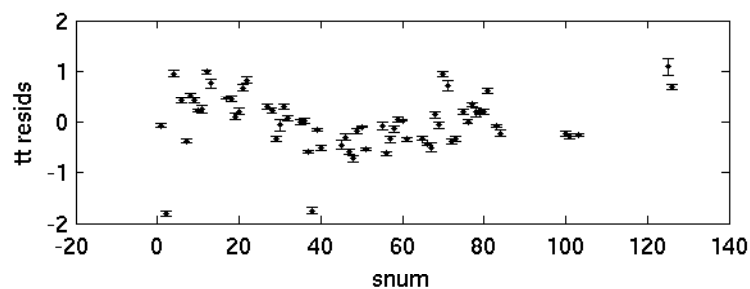
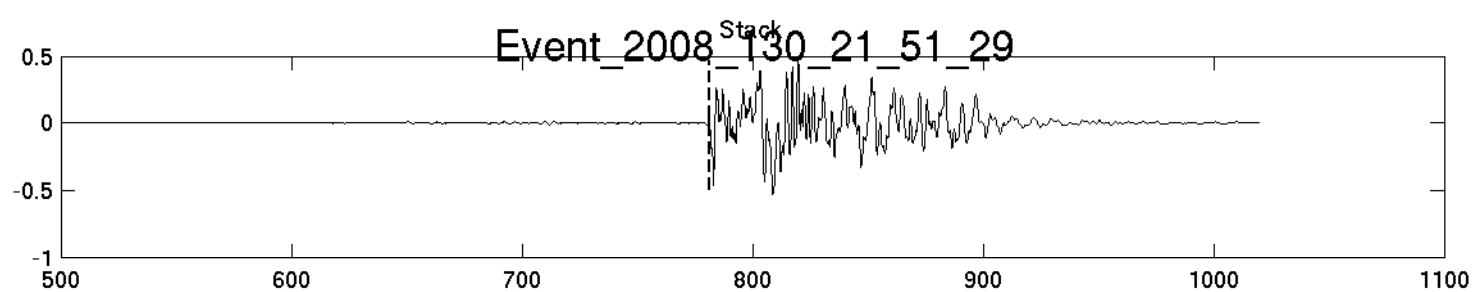
$t^*$  values



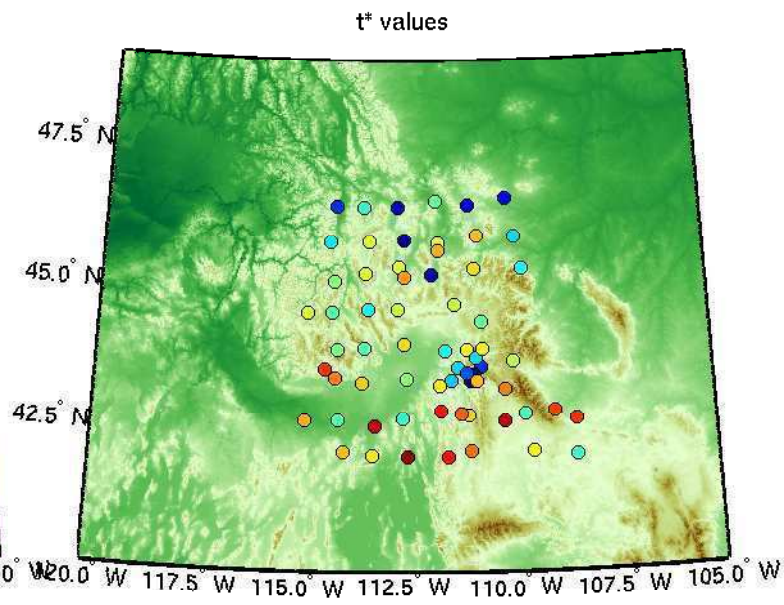
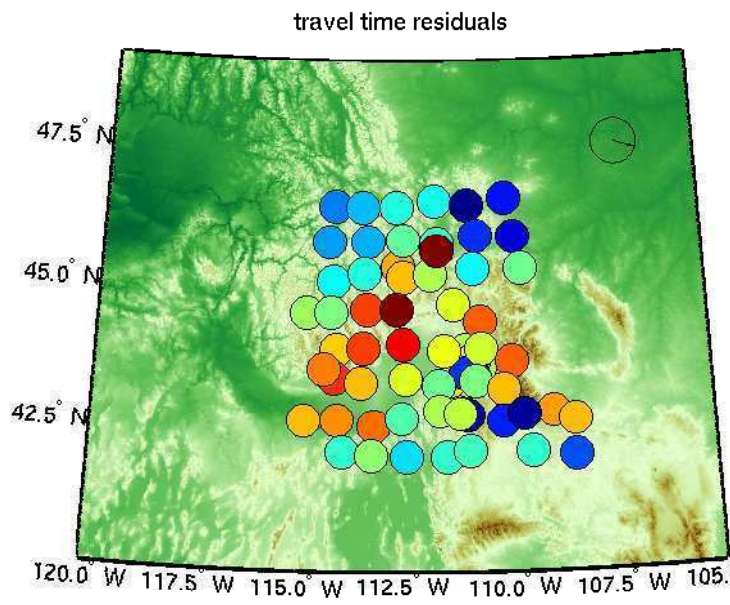
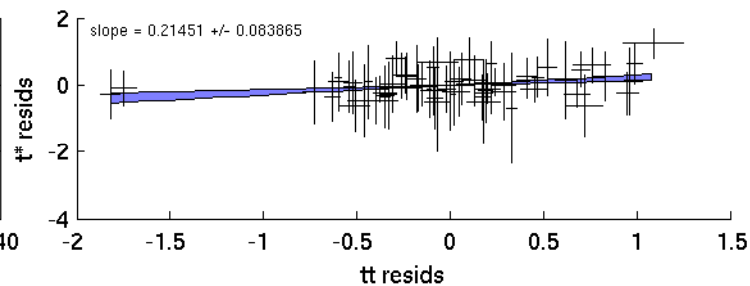
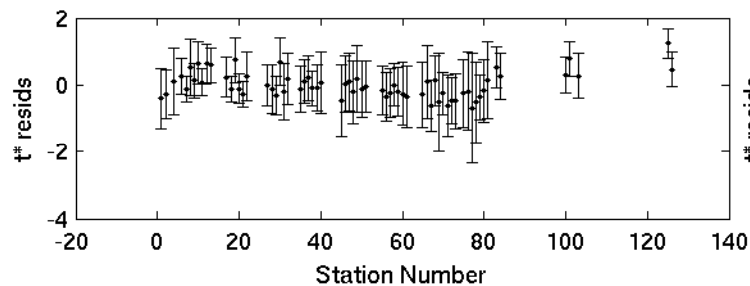
# Event\_2008\_130\_21\_51\_29



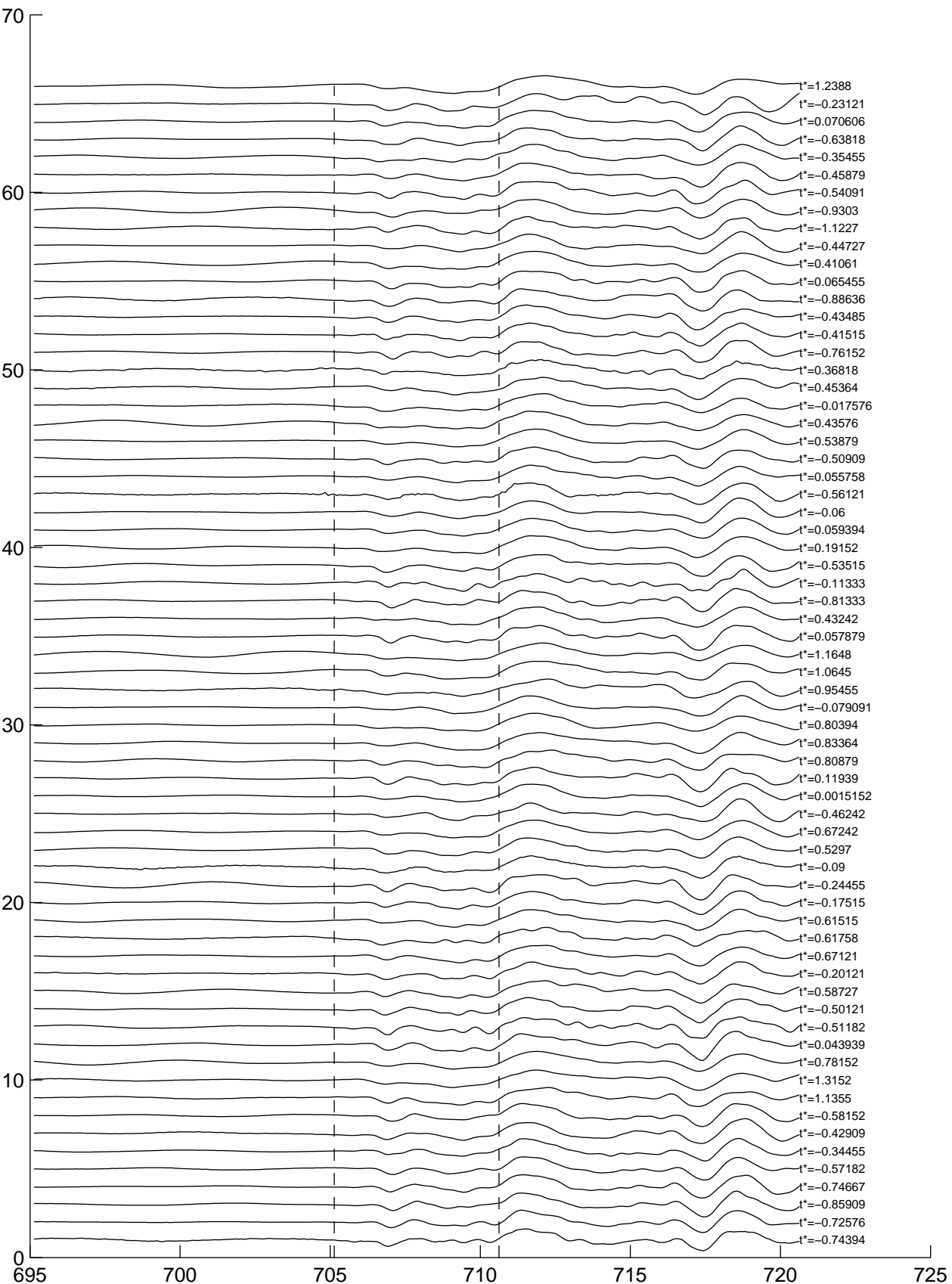




Baz = 289.3926  
Mean xcor value = 0.73727  
Range of  $t^*$  values is 1.9379  
Median  $t^*$  err is 0.71638

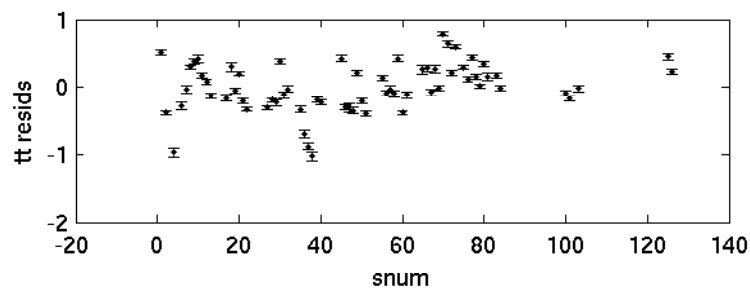
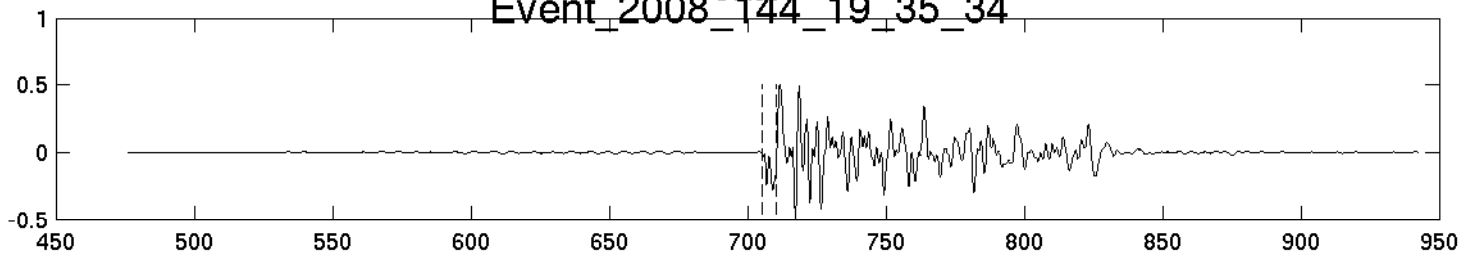


# Event\_2008\_144\_19\_35\_34

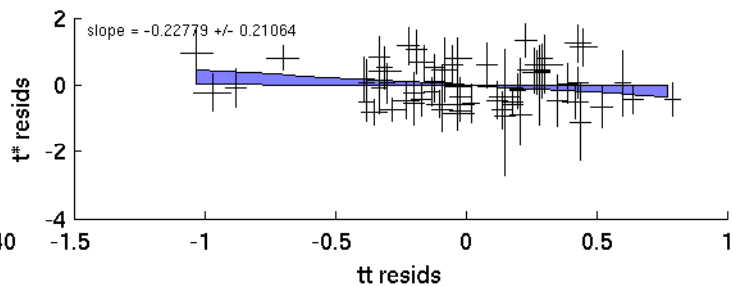
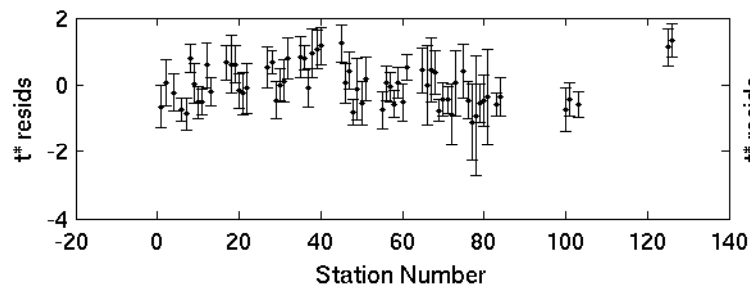


# Event\_2008\_144\_19\_35\_34

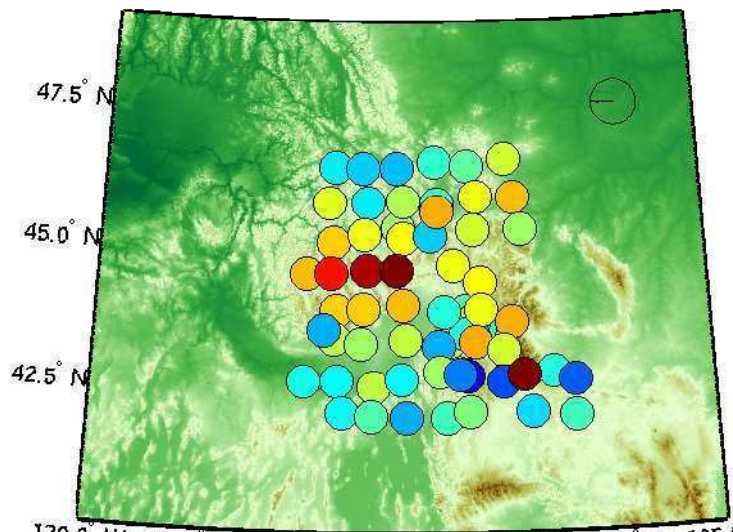
Stack



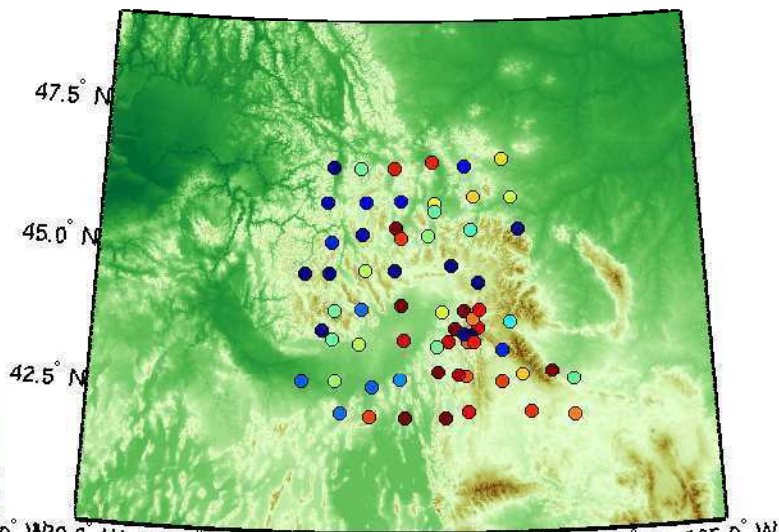
Baz = 93.8631  
Mean xcor value = 0.82364  
Range of  $t^*$  values is 2.4379  
Median  $t^*$  err is 0.56832



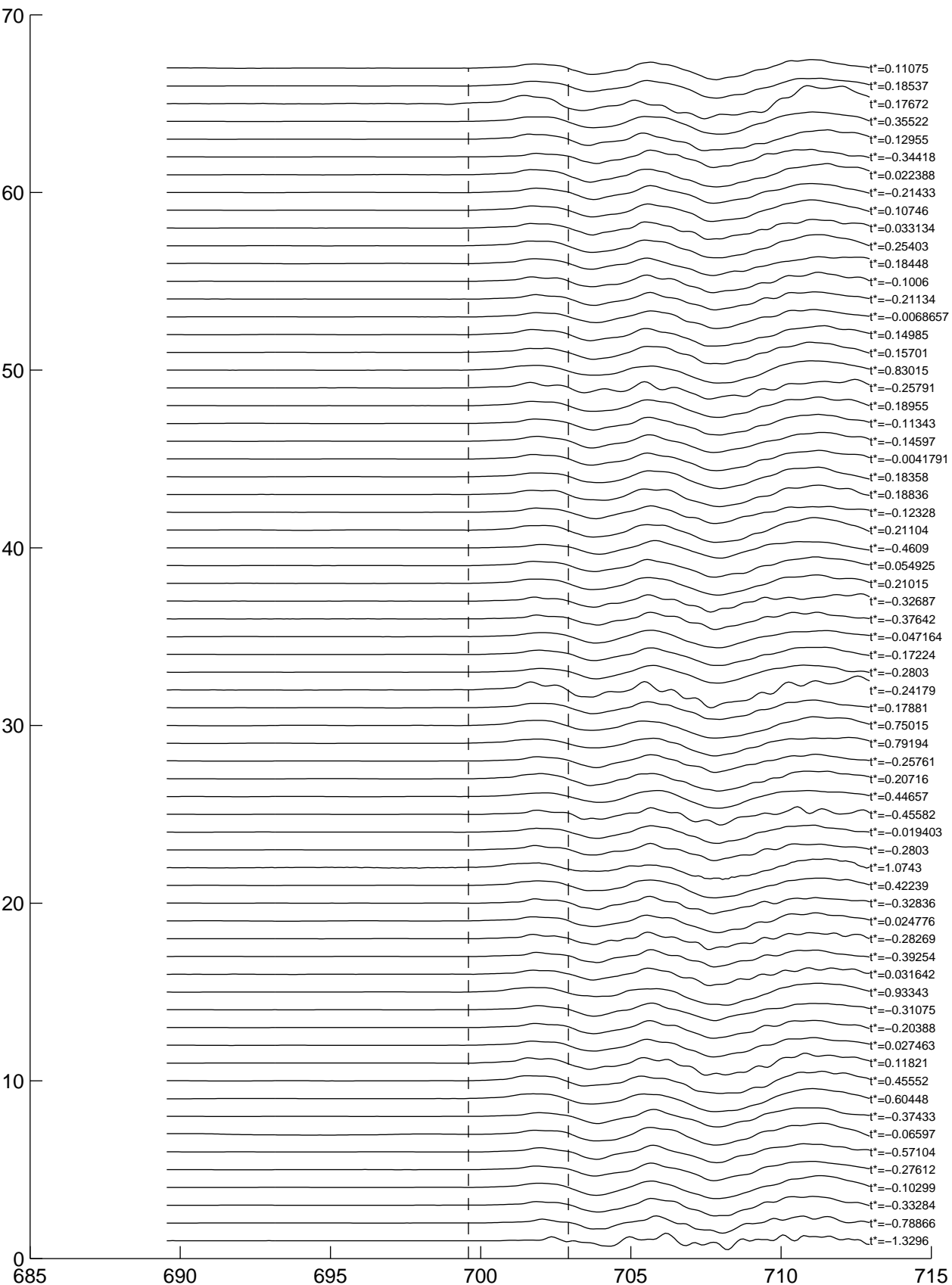
travel time residuals



$t^*$  values

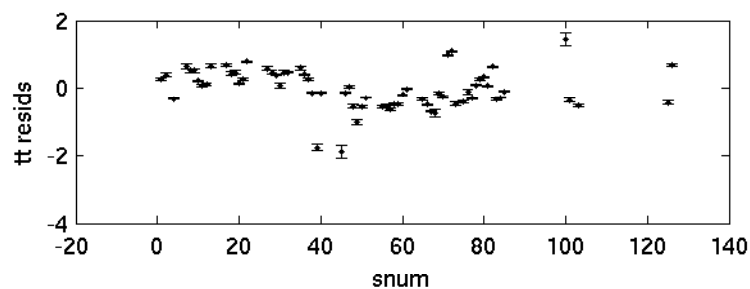
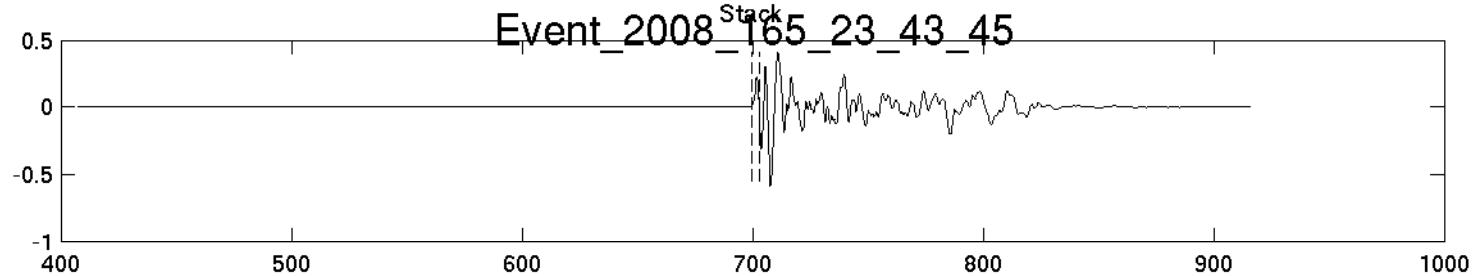


# Event\_2008\_165\_23\_43\_45

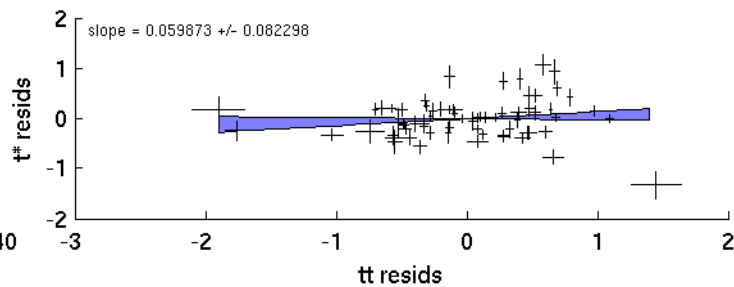
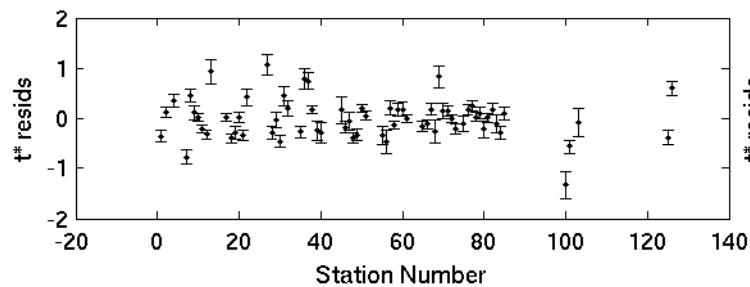




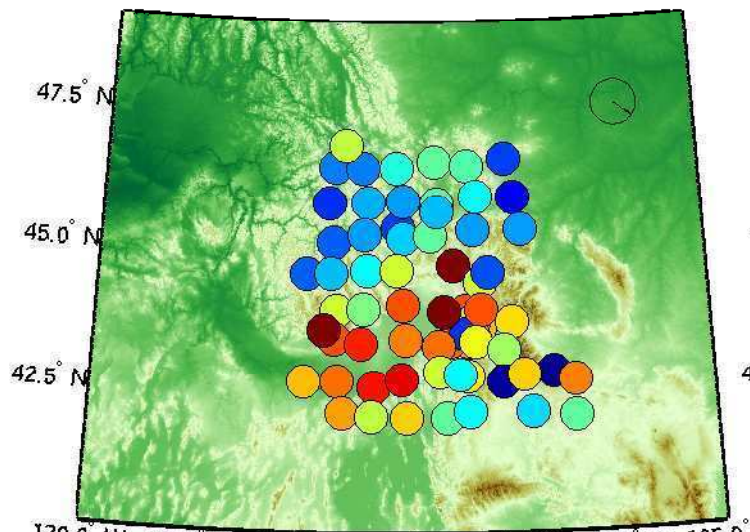
# Event\_2008\_165\_23\_43\_45



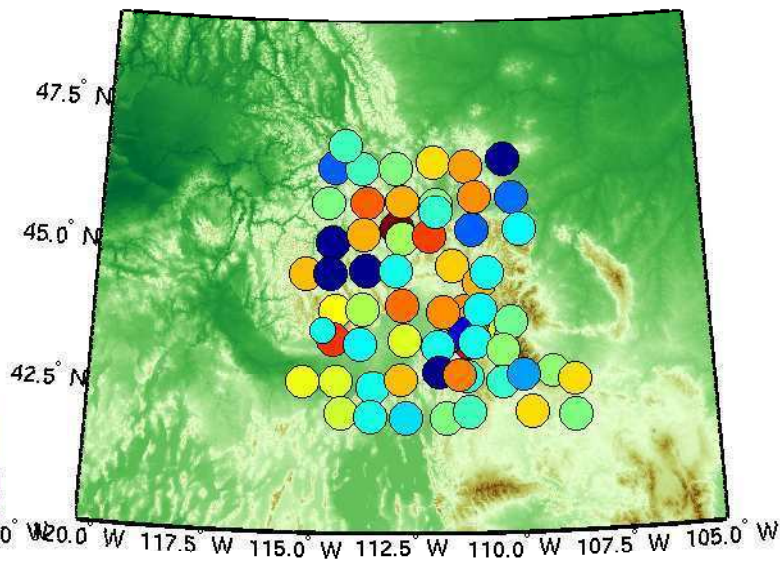
Baz = 309.5841  
 Mean xcor value = 0.89478  
 Range of  $t^*$  values is 2.4039  
 Median  $t^*$  err is 0.12969



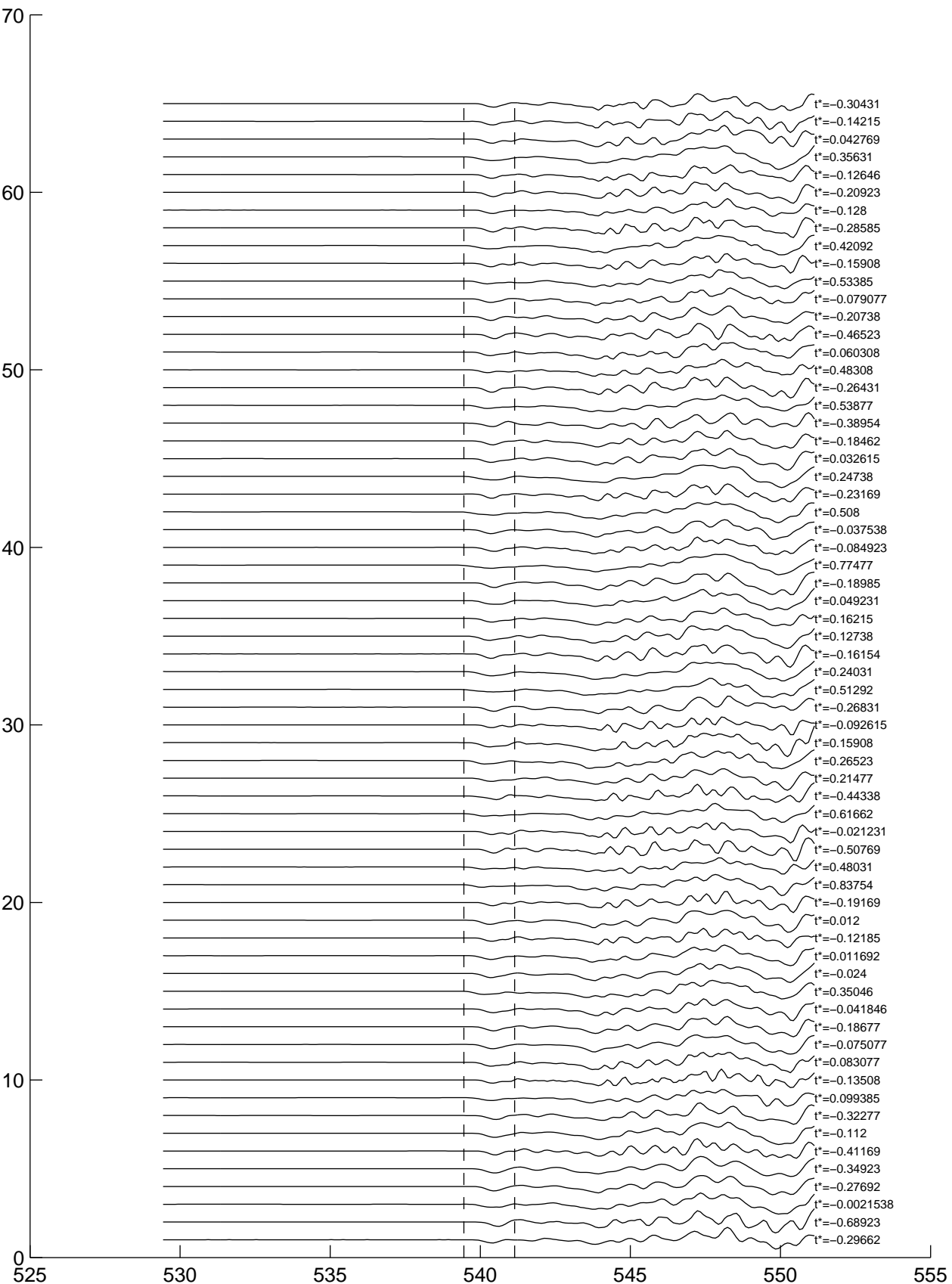
travel time residuals



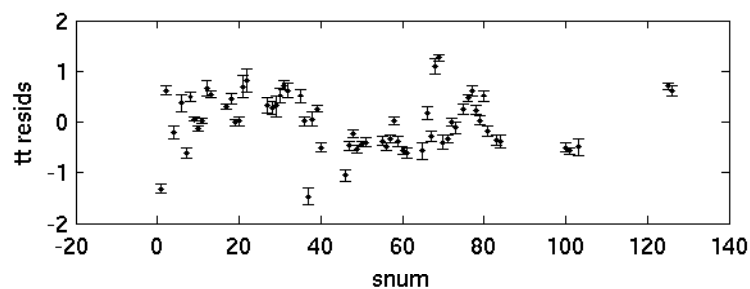
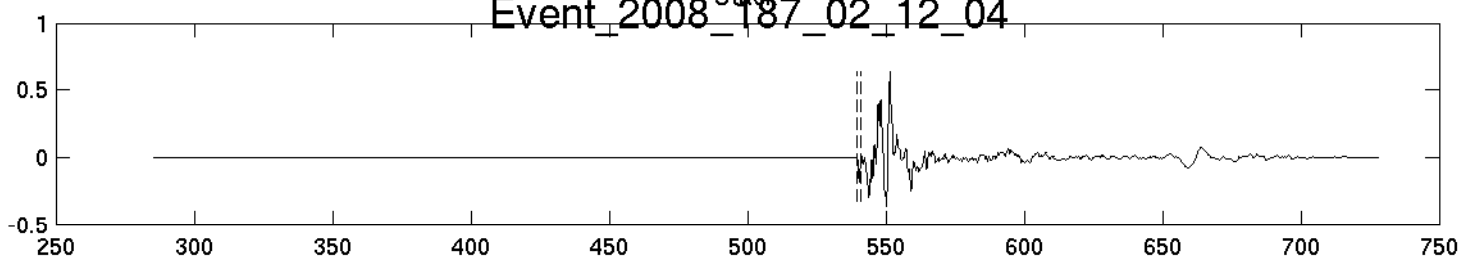
$t^*$  values



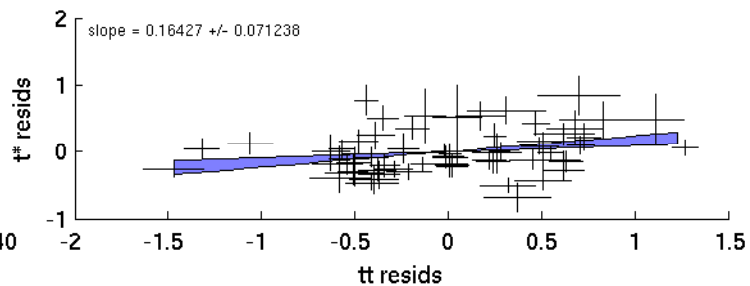
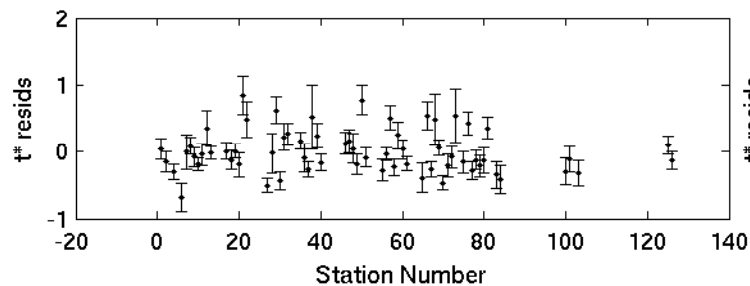
# Event\_2008\_187\_02\_12\_04



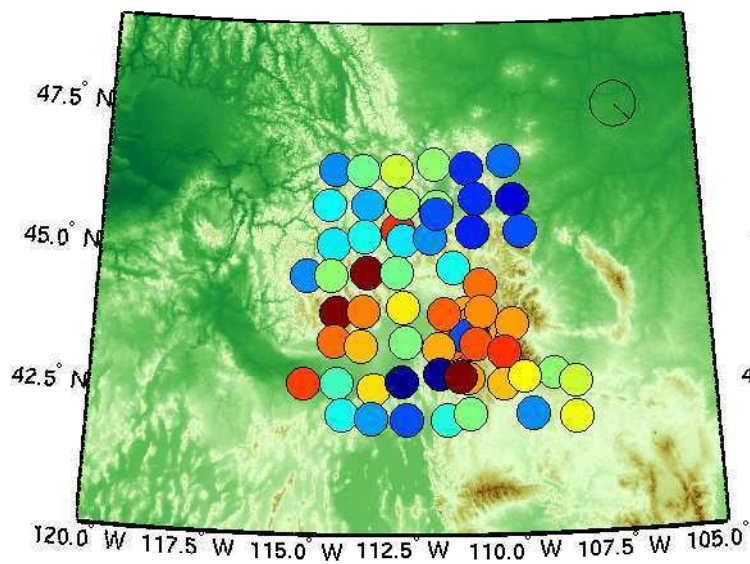
# Event\_2008\_187\_02\_12\_04



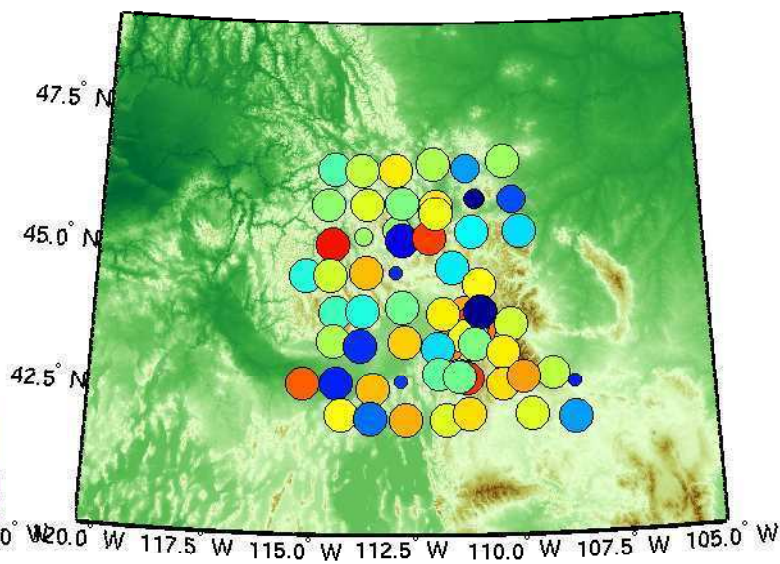
Baz = 316.4808  
 Mean xcor value = 0.74323  
 Range of  $t^*$  values is 1.5268  
 Median  $t^*$  err is 0.16115



travel time residuals

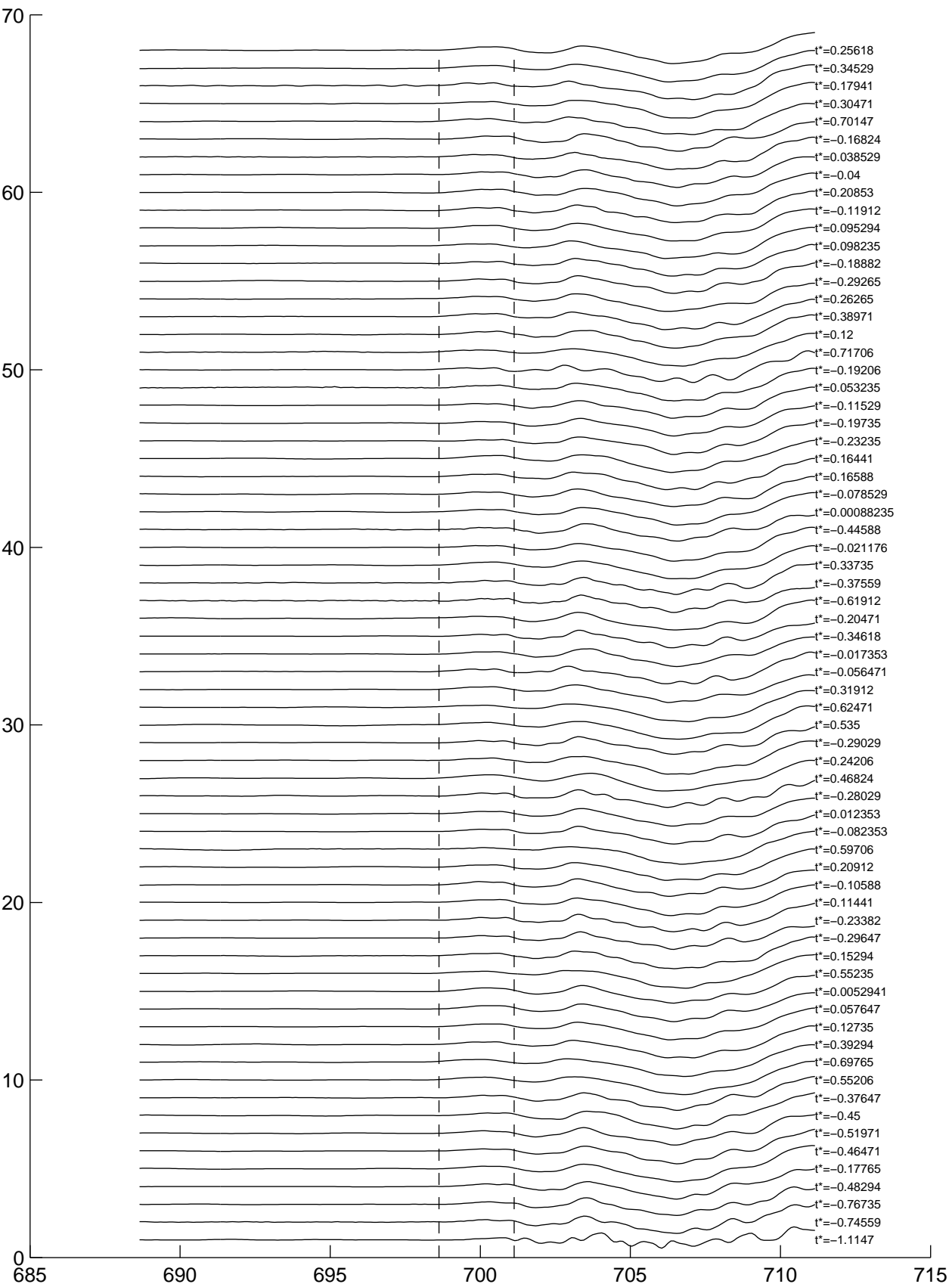


$t^*$  values

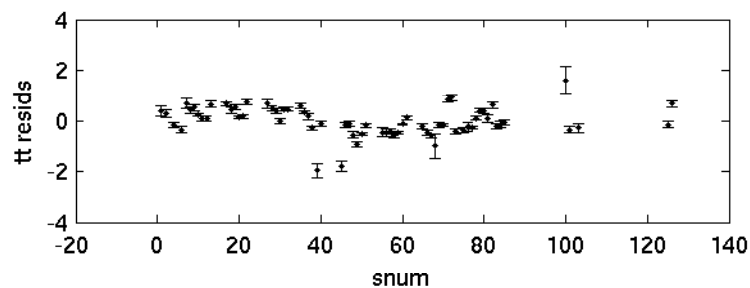
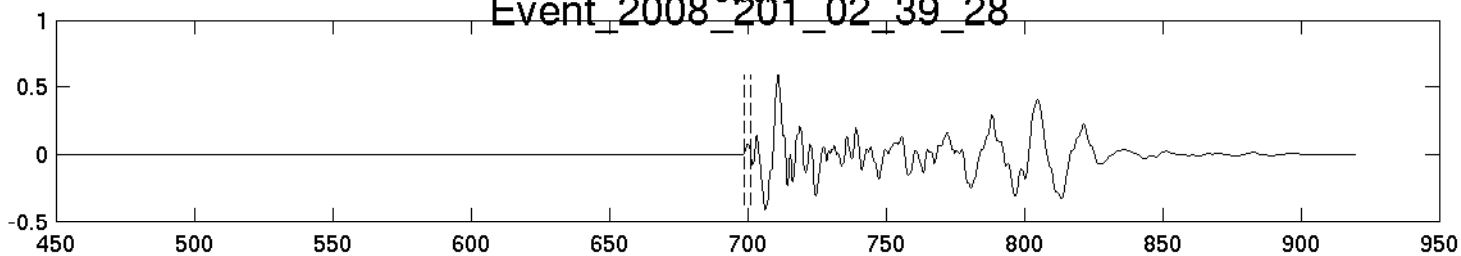




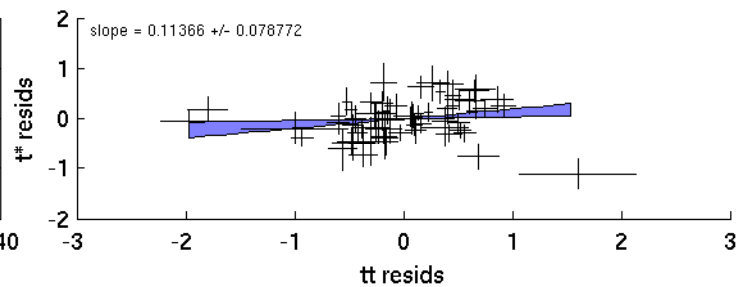
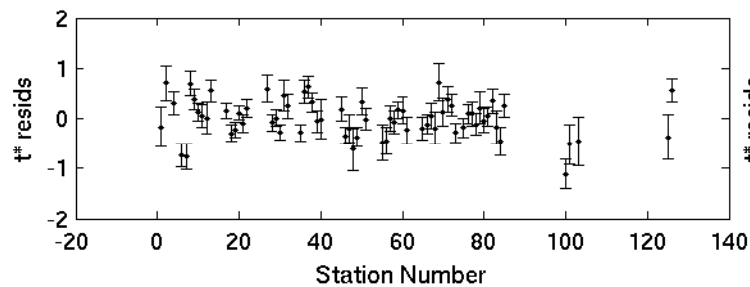
# Event\_2008\_201\_02\_39\_28



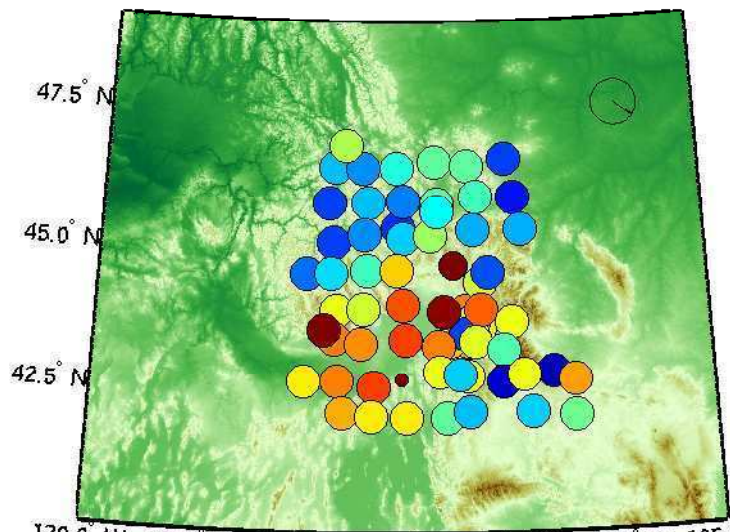
Event\_2008\_201\_02\_39\_28



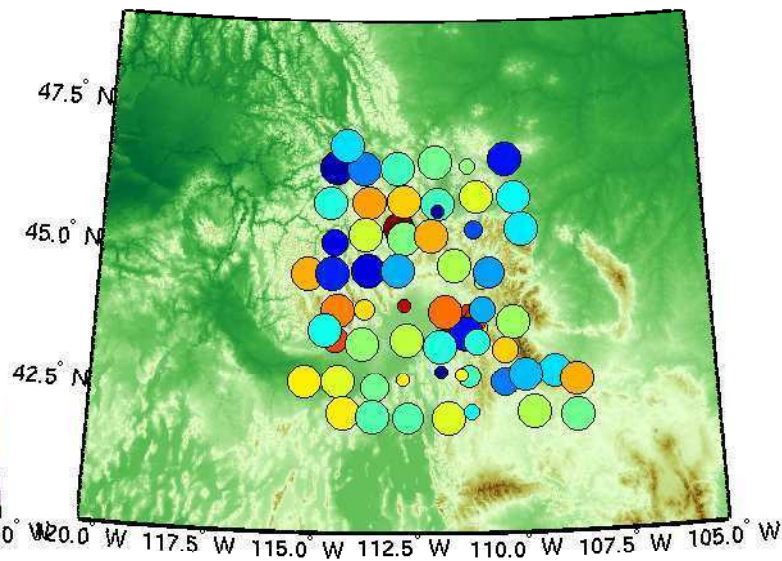
Baz = 307.734  
Mean xcor value = 0.90265  
Range of  $t^*$  values is 1.8318  
Median  $t^*$  err is 0.23643



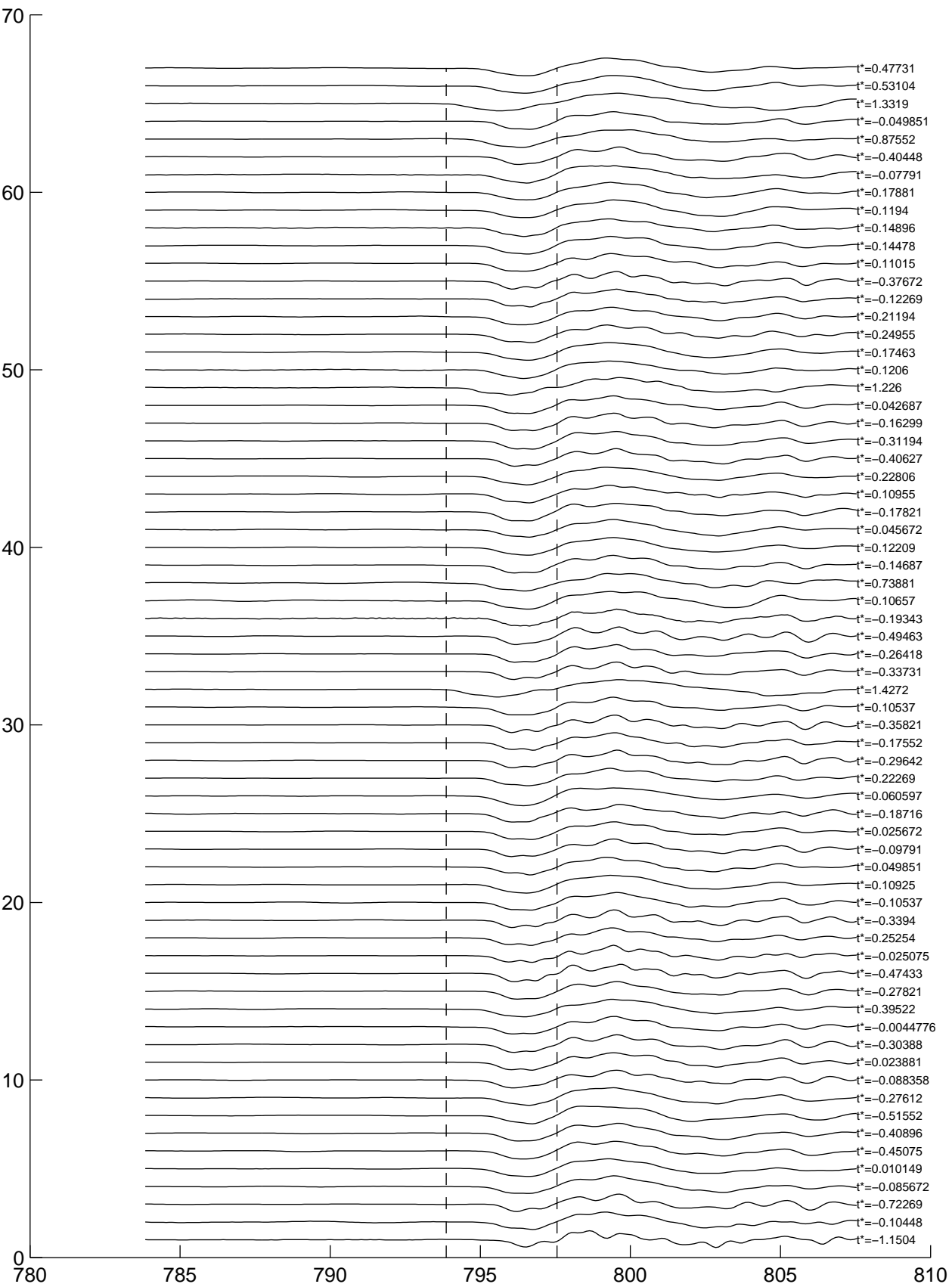
travel time residuals



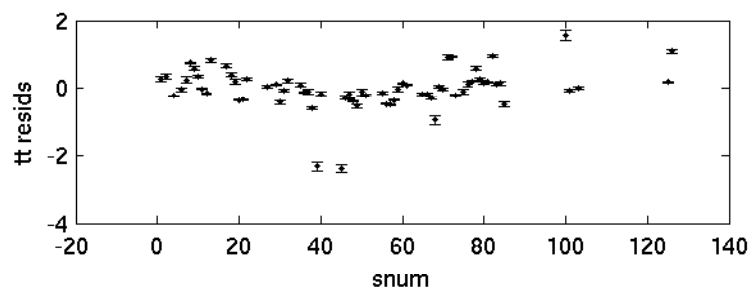
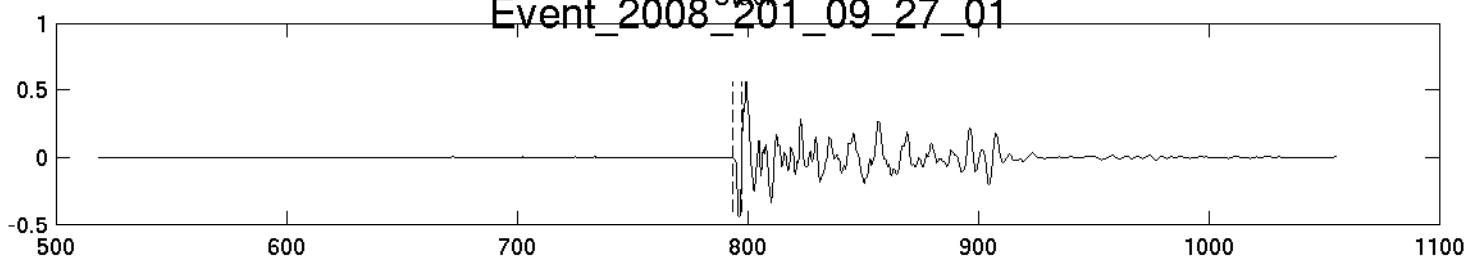
$t^*$  values



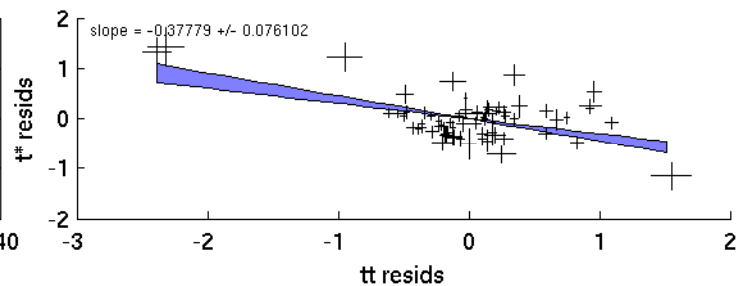
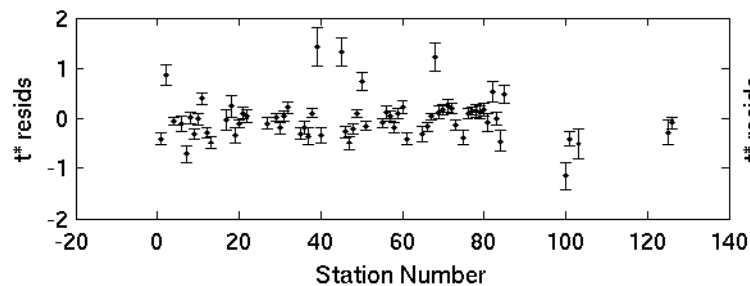
# Event\_2008\_201\_09\_27\_01



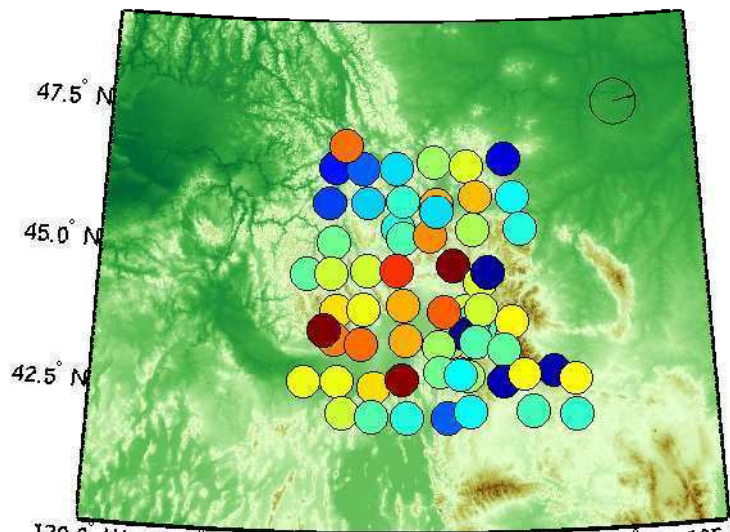
# Event\_2008\_201\_09\_27\_01



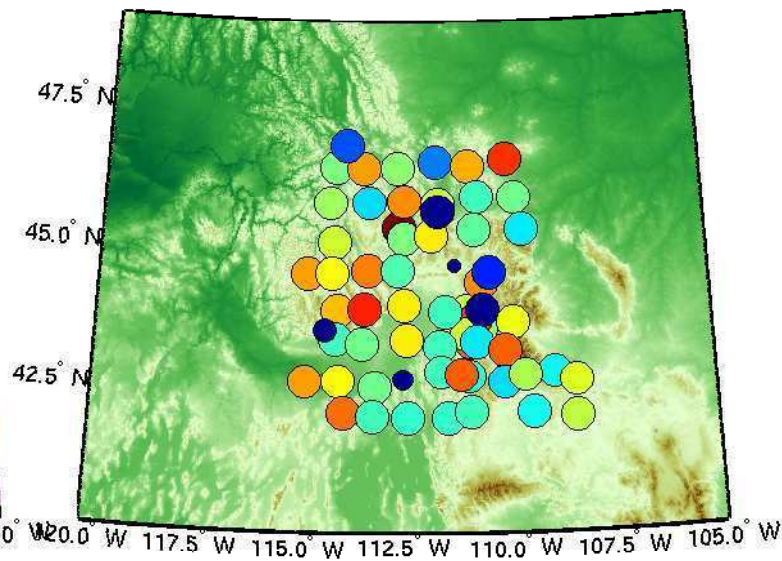
Baz = 257.7474  
 Mean xcor value = 0.90224  
 Range of  $t^*$  values is 2.5776  
 Median  $t^*$  err is 0.12408



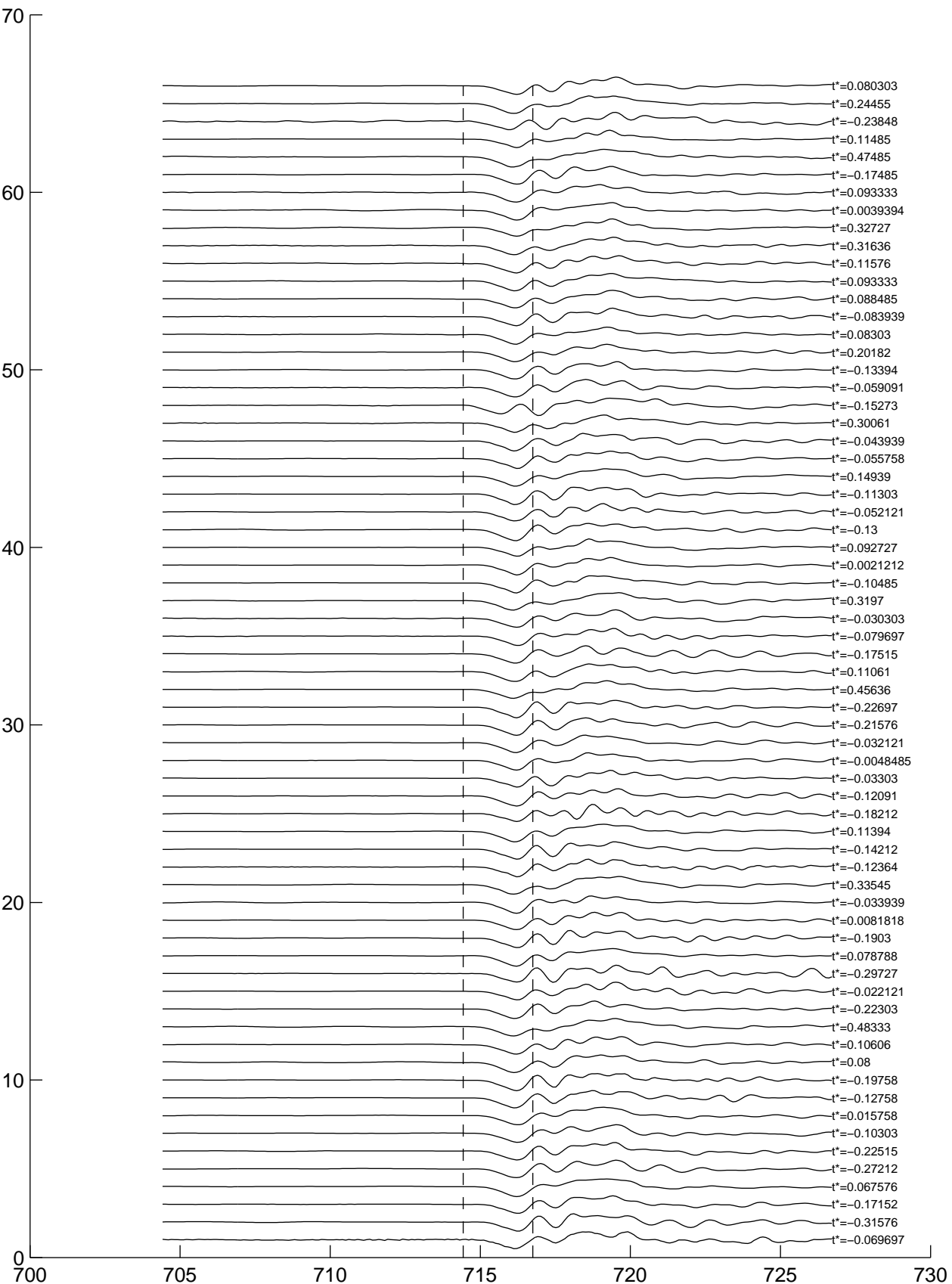
travel time residuals



$t^*$  values

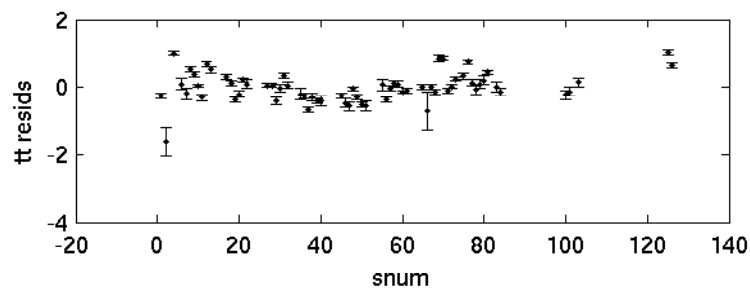
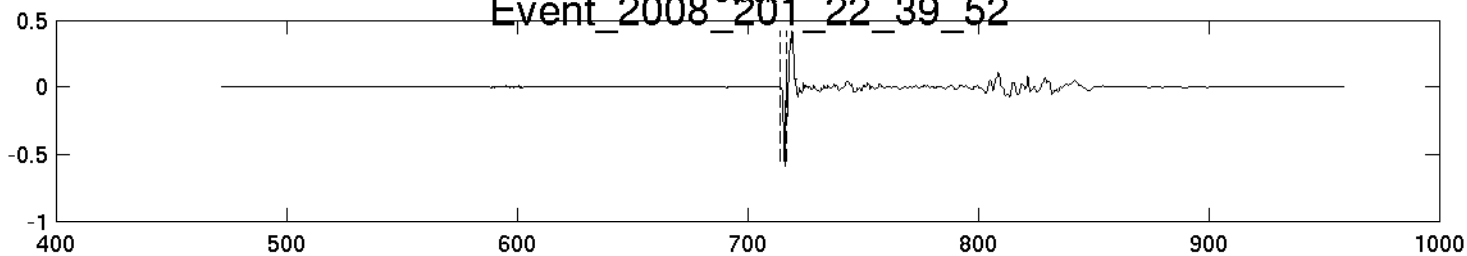


# Event\_2008\_201\_22\_39\_52

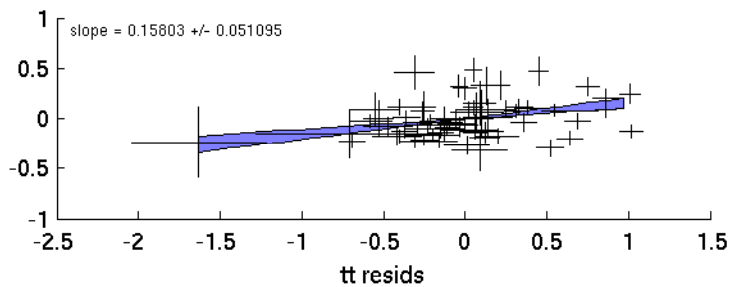
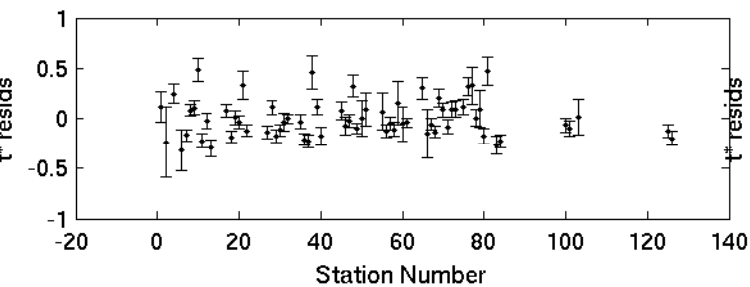




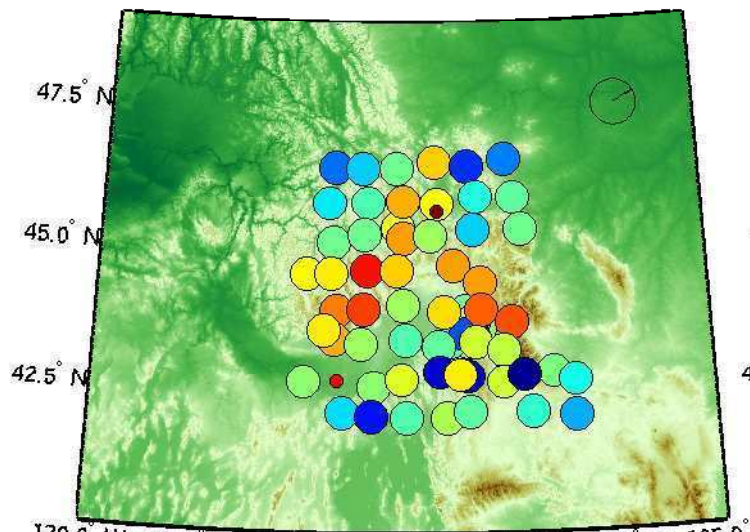
Event\_2008\_201\_22\_39\_52



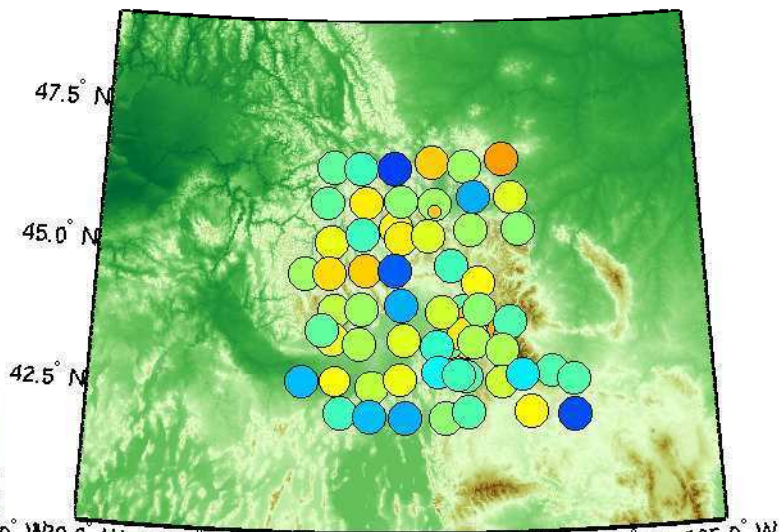
Baz = 240.6229  
Mean xcor value = 0.80667  
Range of  $t^*$  values is 0.79909  
Median  $t^*$  err is 0.074046



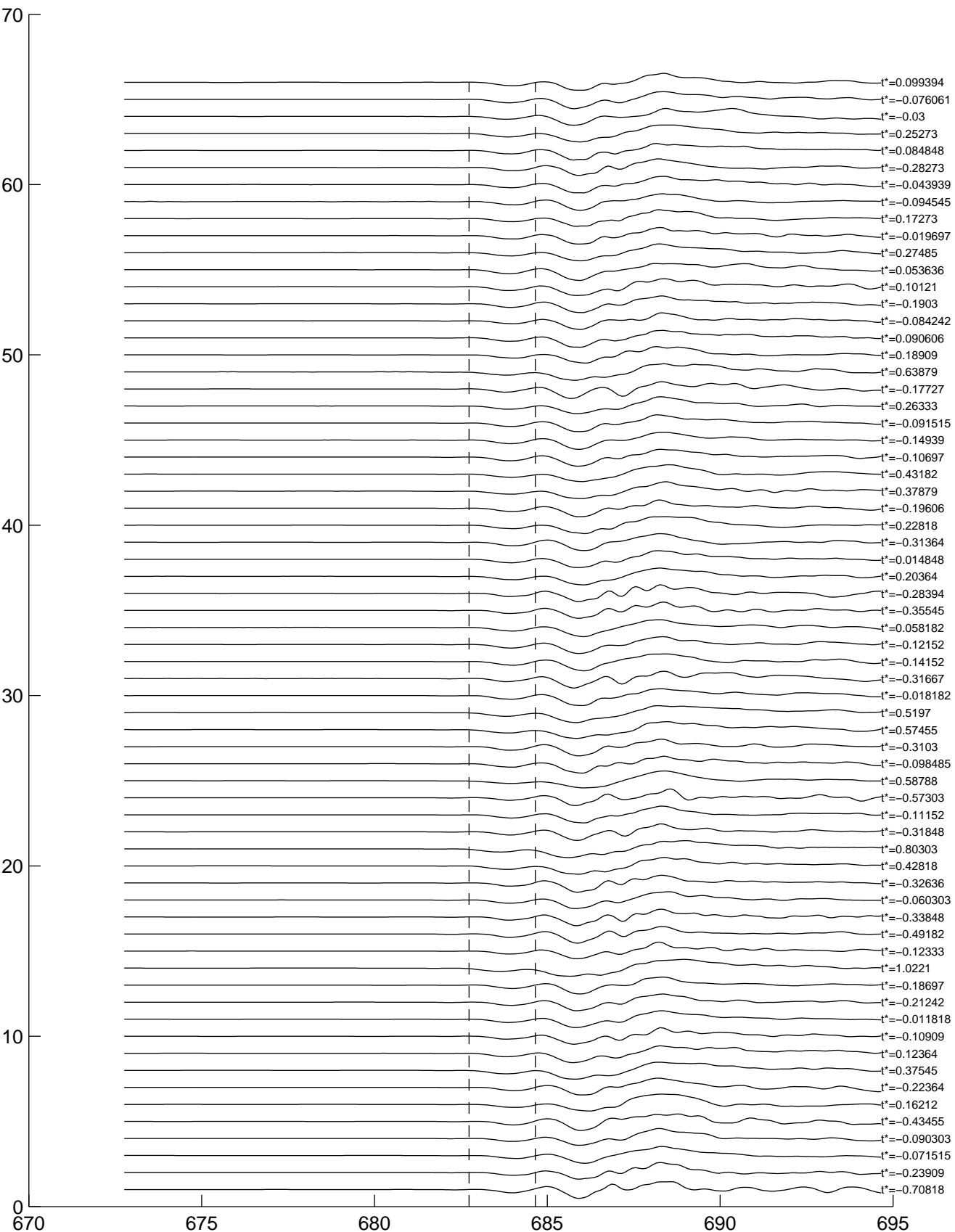
travel time residuals



$t^*$  values

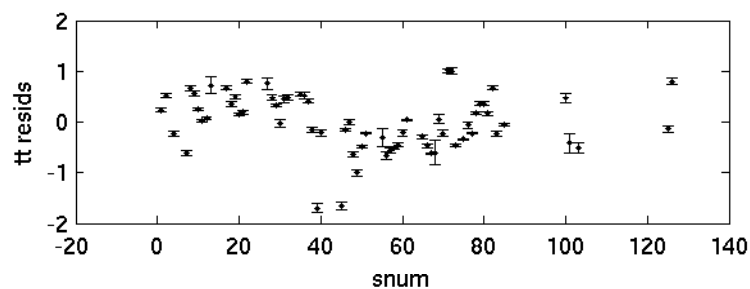
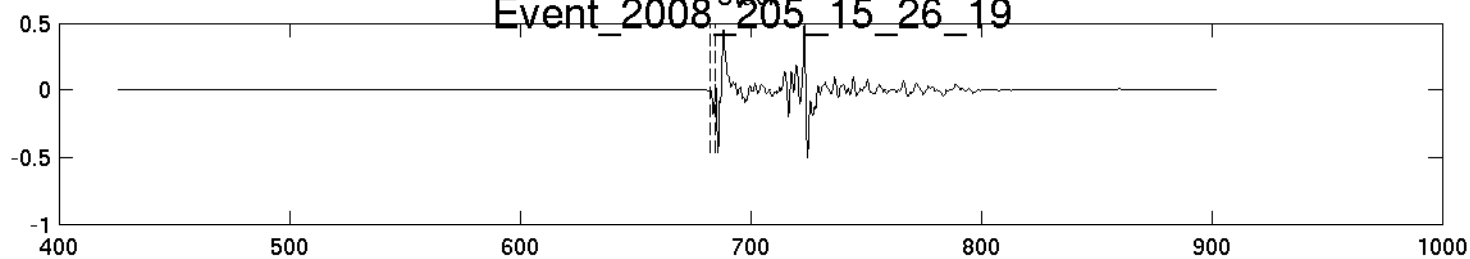


# Event\_2008\_205\_15\_26\_19

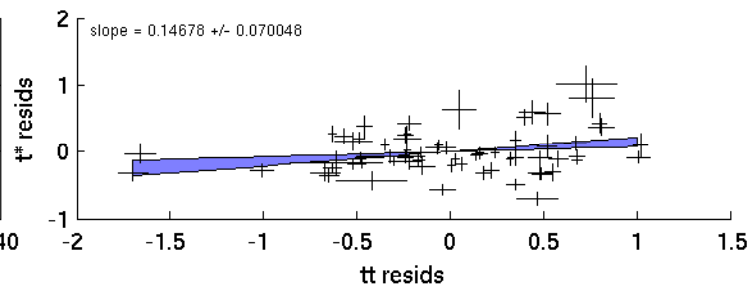
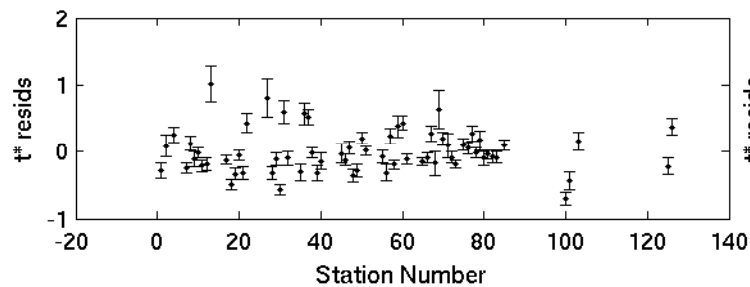




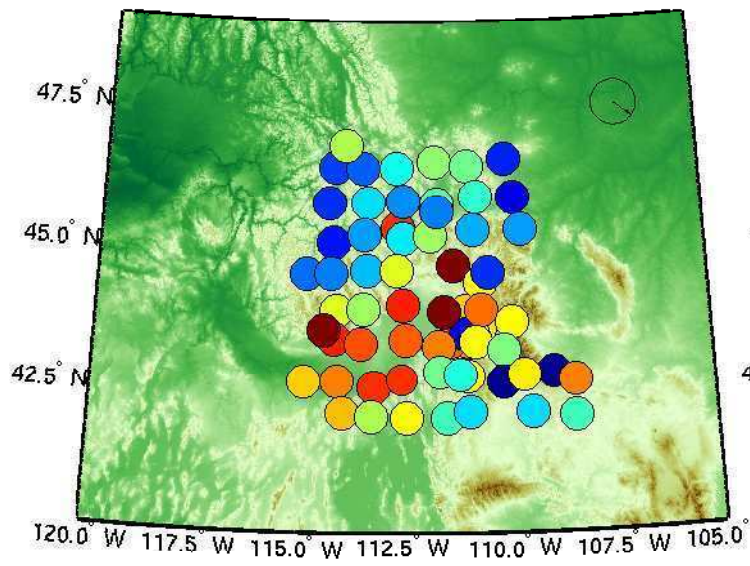
# Event\_2008\_205\_15\_26\_19



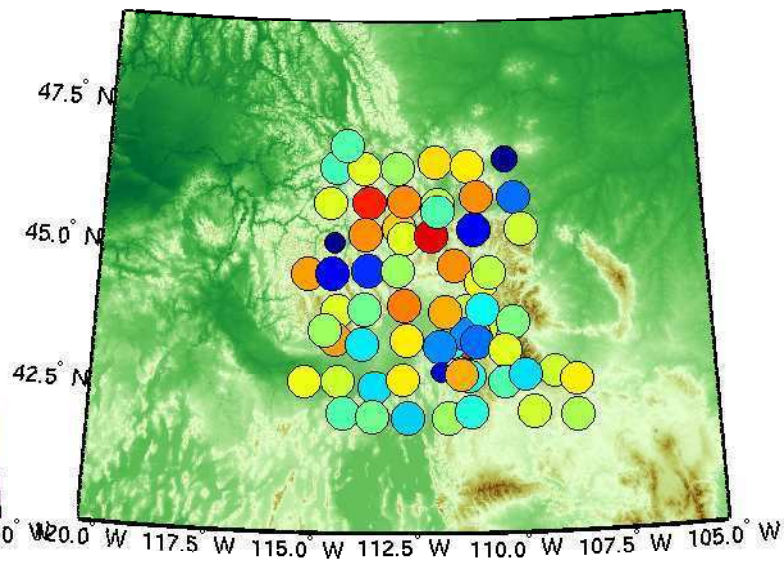
Baz = 309.8209  
 Mean xcor value = 0.84864  
 Range of  $t^*$  values is 1.7303  
 Median  $t^*$  err is 0.097428



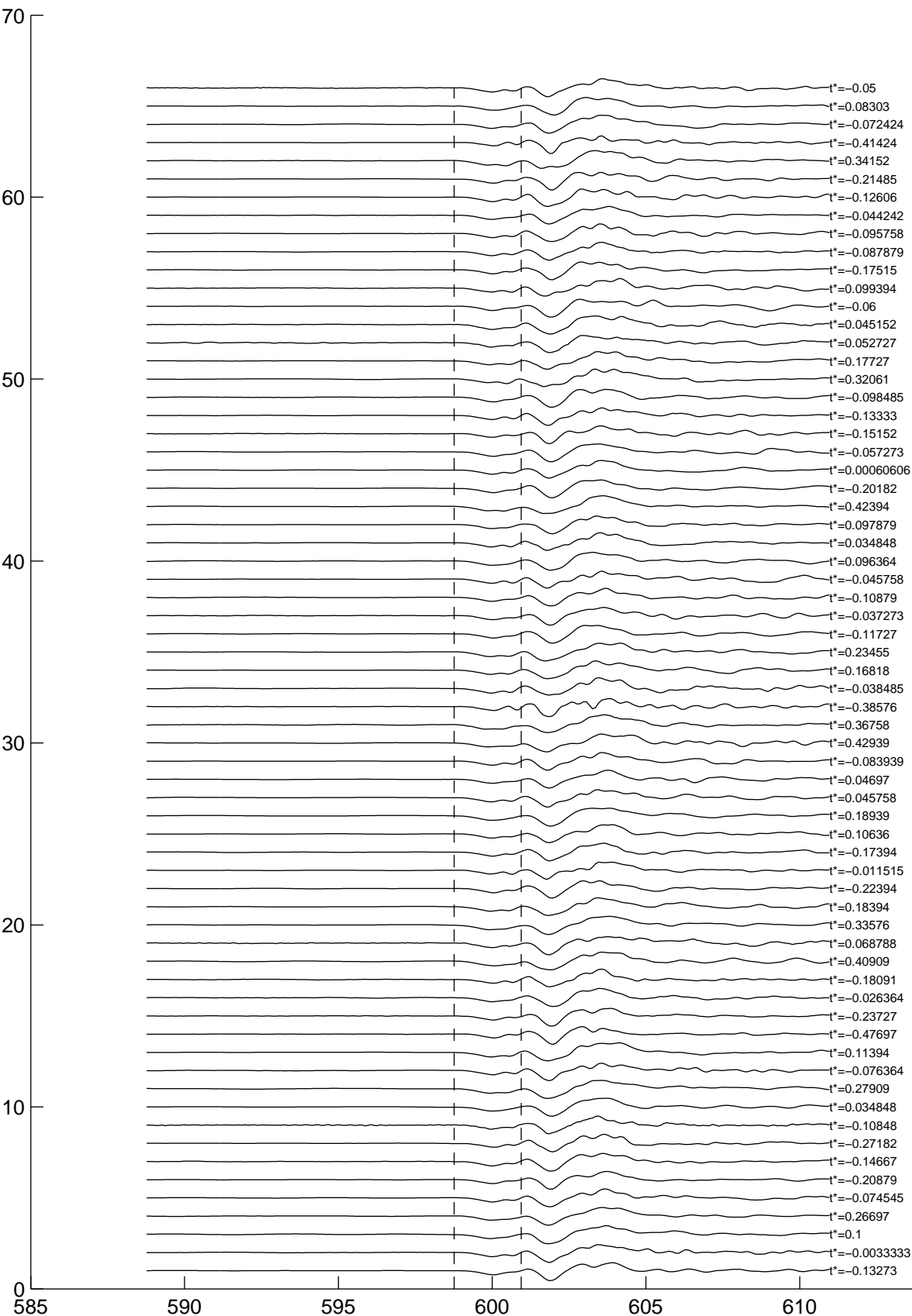
travel time residuals



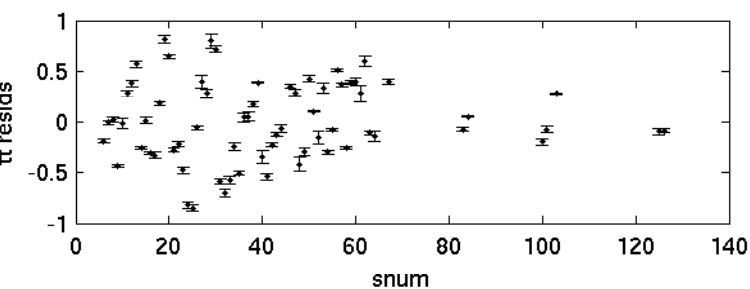
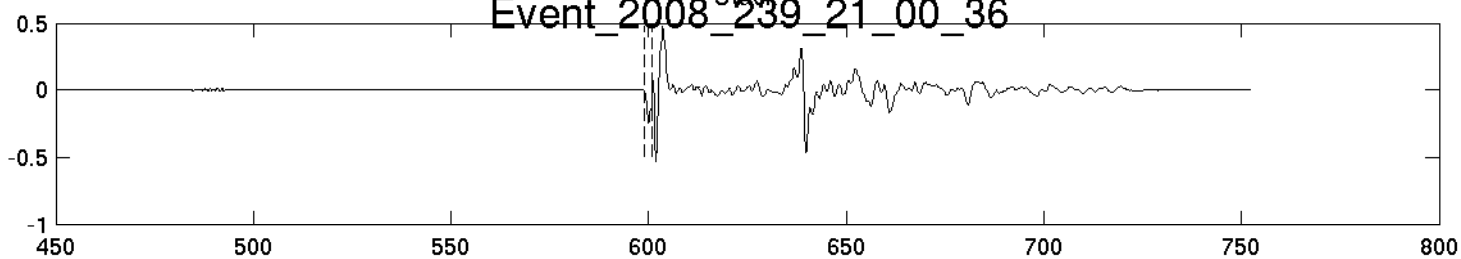
$t^*$  values



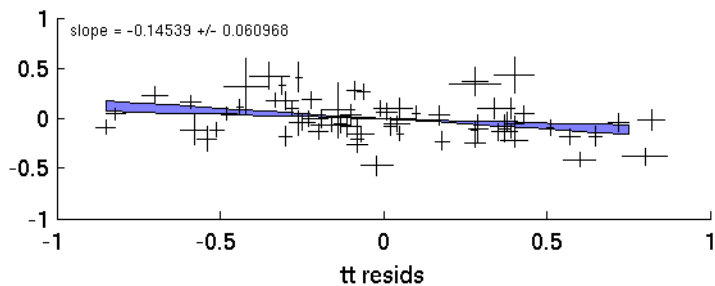
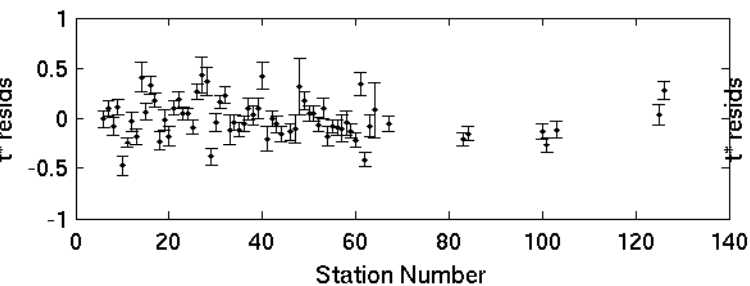
# Event\_2008\_239\_21\_00\_36



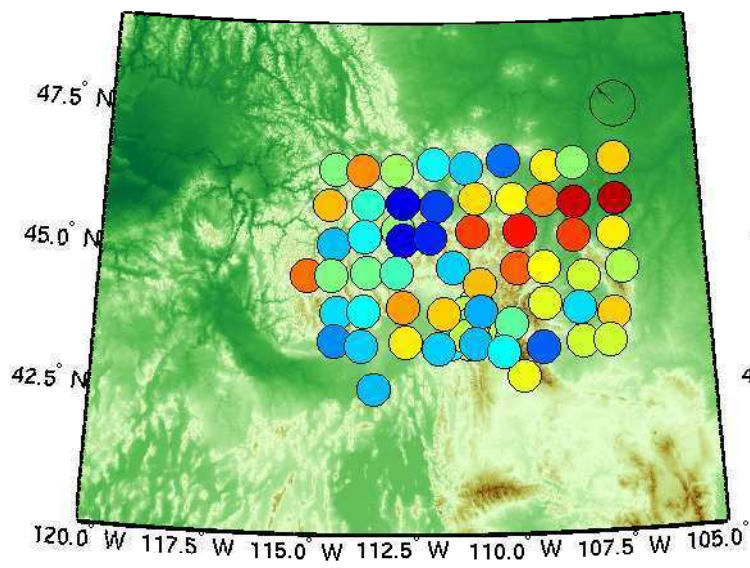
Event\_2008\_239\_21\_00\_36



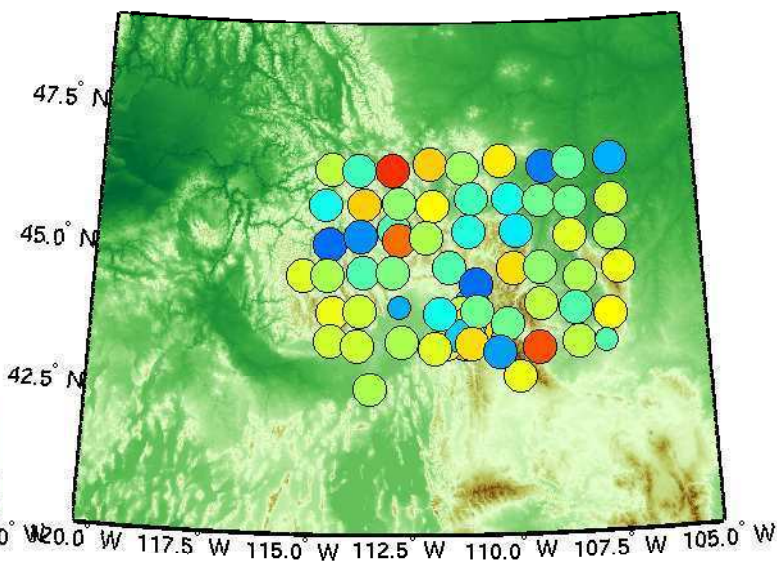
Baz = 137.89  
Mean xcor value = 0.67621  
Range of  $t^*$  values is 0.90636  
Median  $t^*$  err is 0.083549



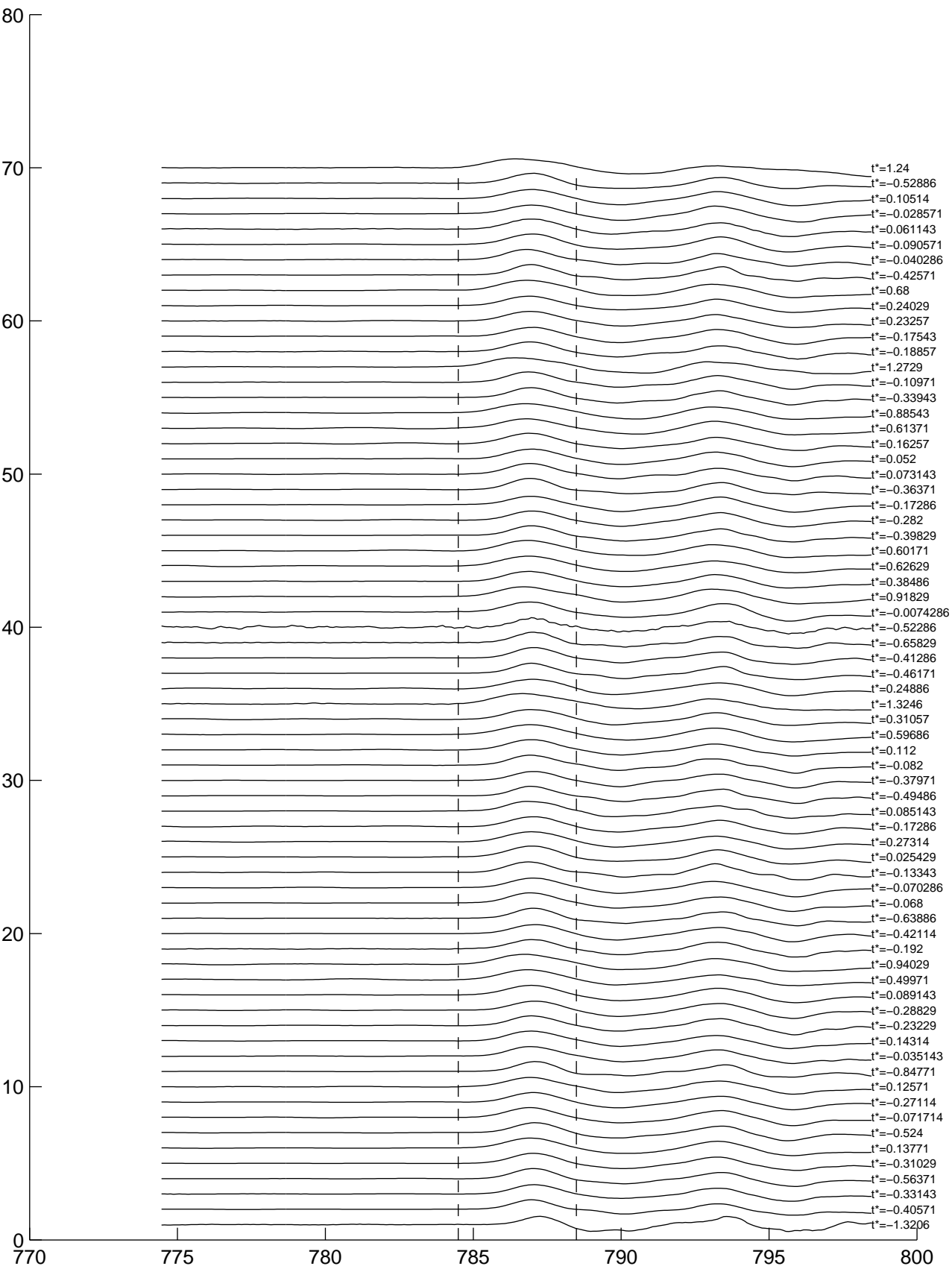
travel time residuals



$t^*$  values

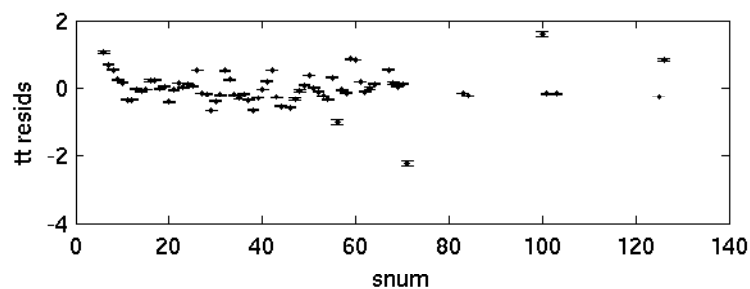
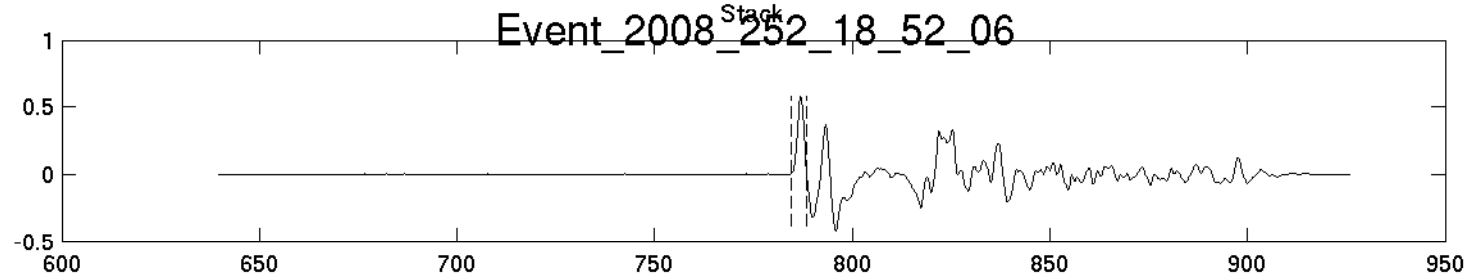


# Event\_2008\_252\_18\_52\_06

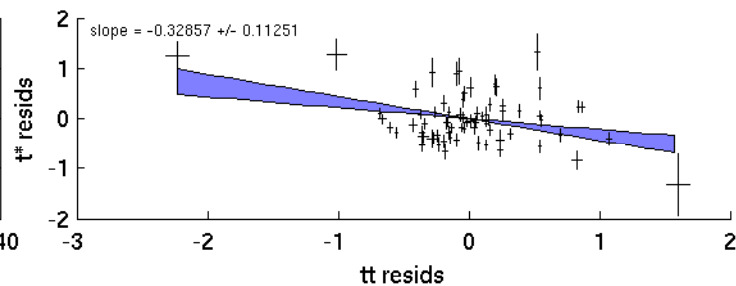
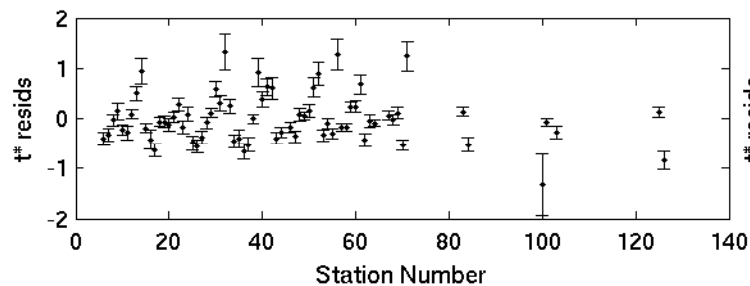




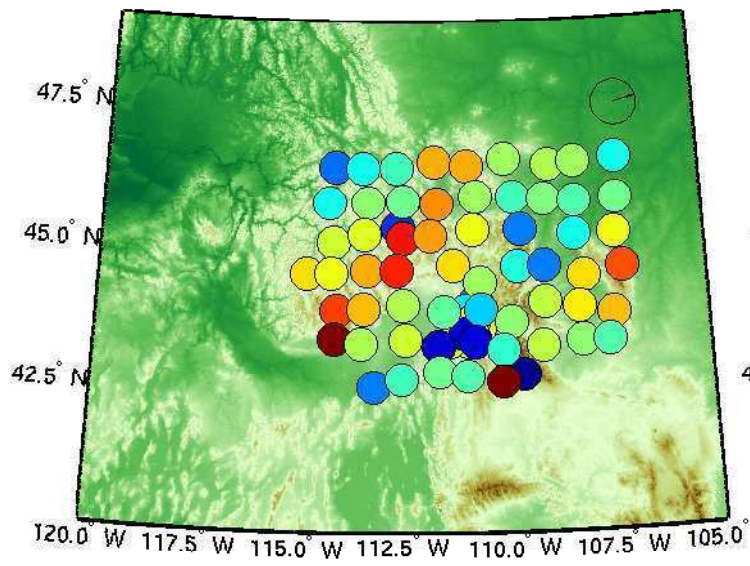
# Event\_2008\_252\_18\_52\_06



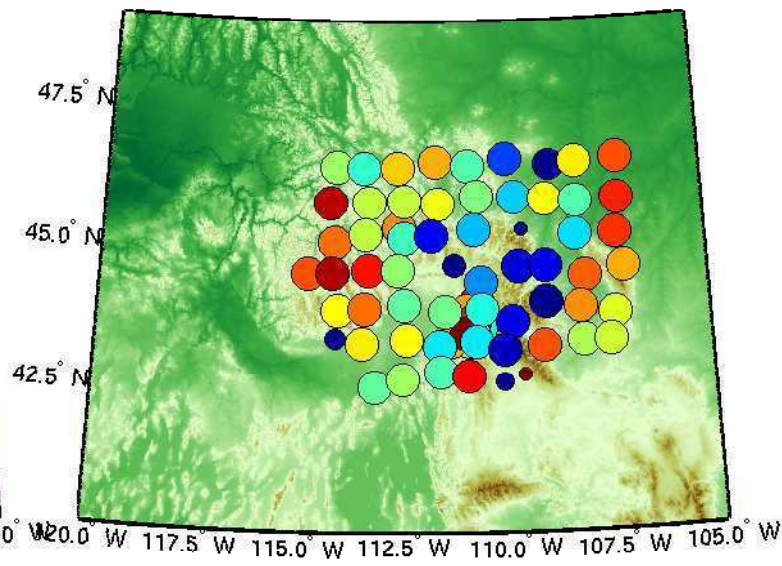
Baz = 254.9193  
 Mean xcor value = 0.776  
 Range of  $t^*$  values is 2.6451  
 Median  $t^*$  err is 0.12454



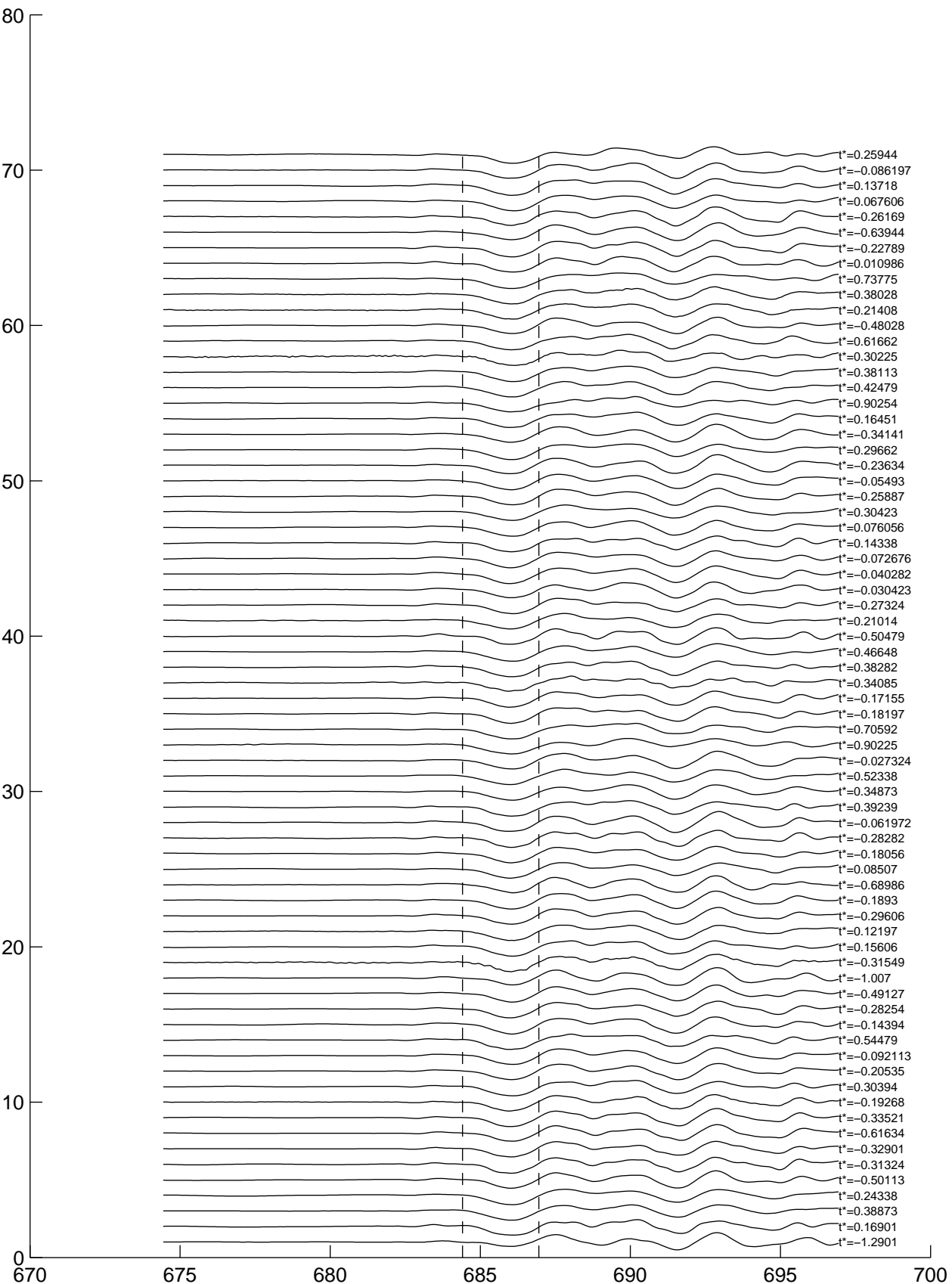
travel time residuals



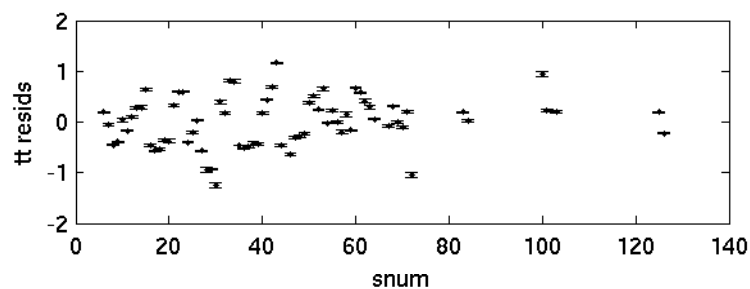
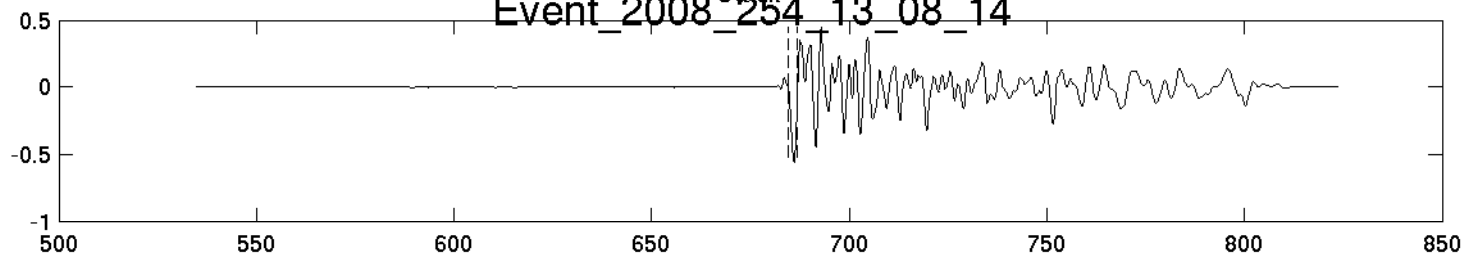
$t^*$  values



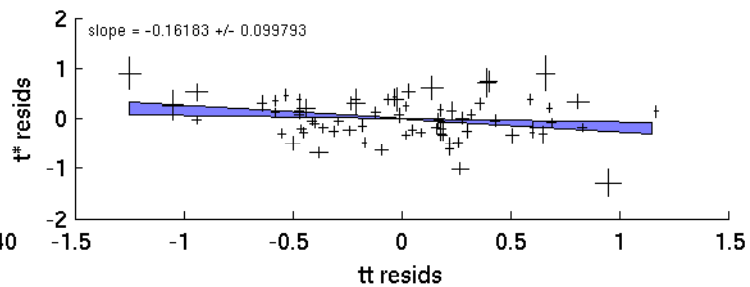
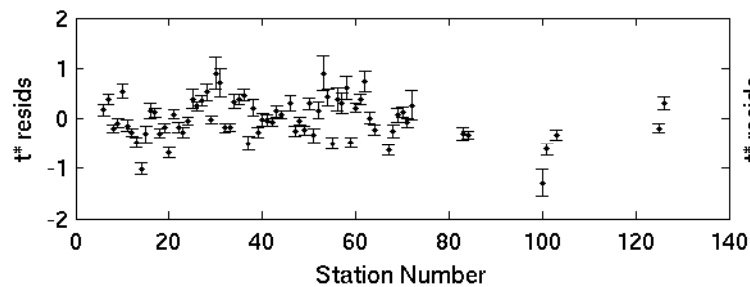
# Event\_2008\_254\_13\_08\_14



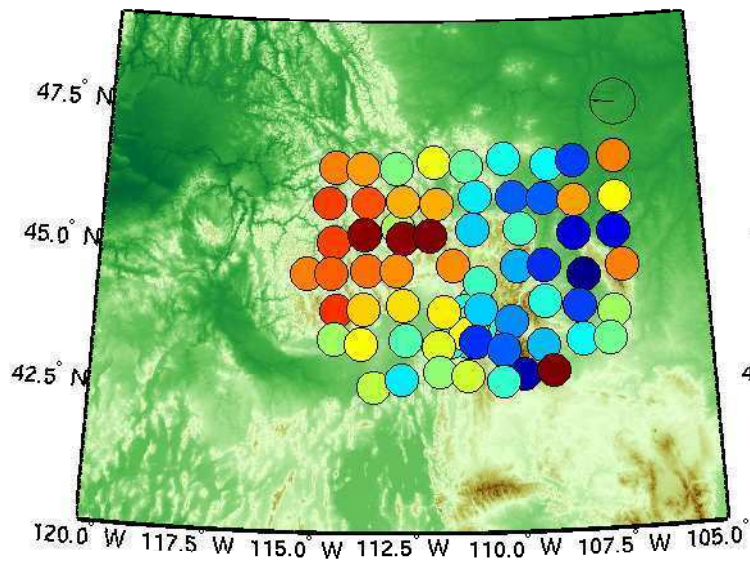
# Event\_2008\_254\_13\_08\_14



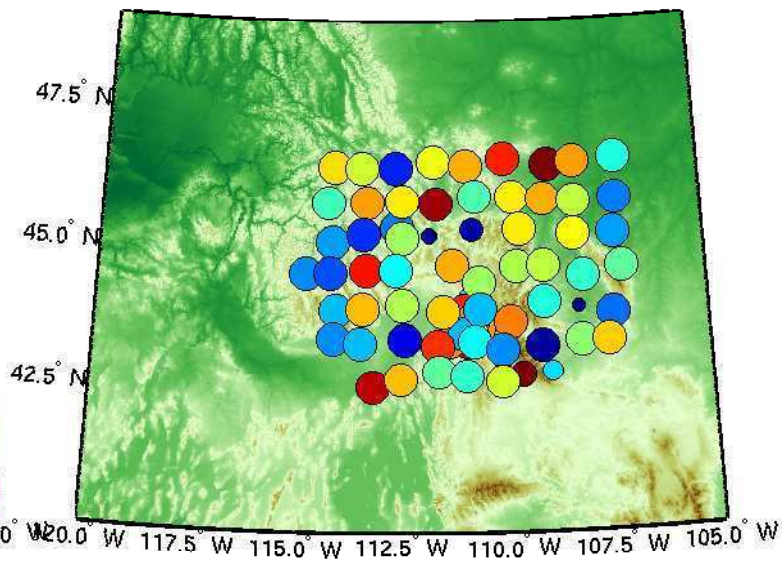
Baz = 96.7413  
 Mean xcor value = 0.72915  
 Range of  $t^*$  values is 2.1927  
 Median  $t^*$  err is 0.10986



travel time residuals

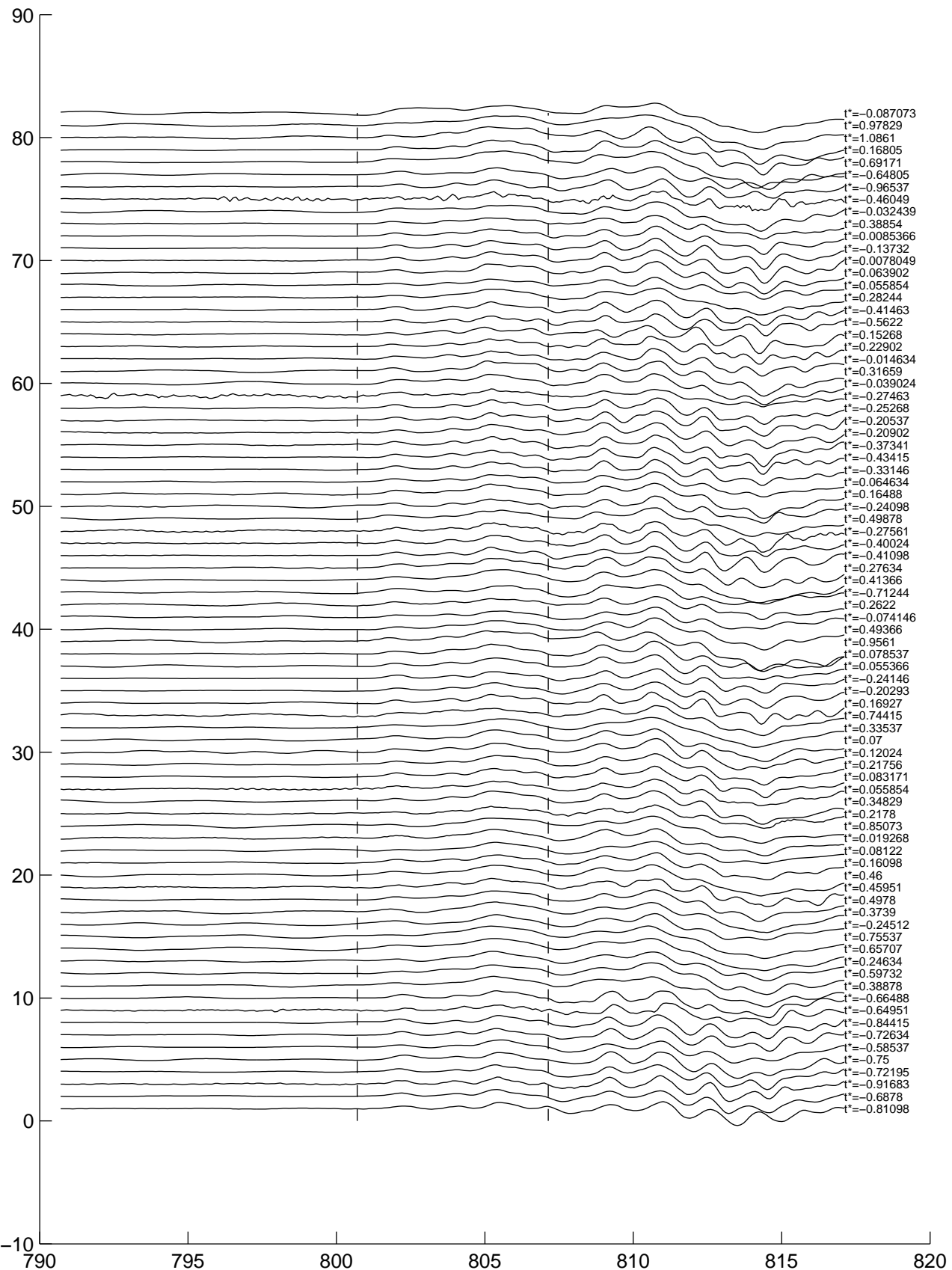


$t^*$  values

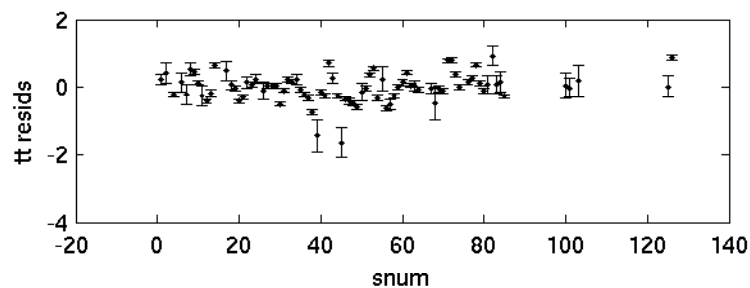
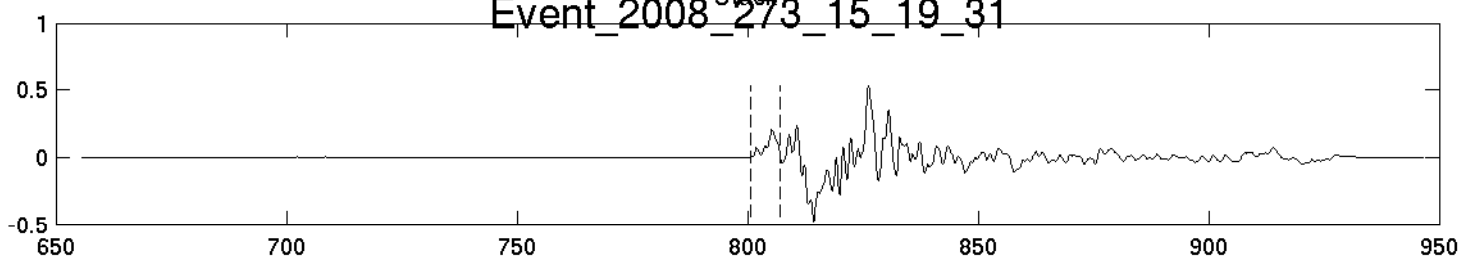




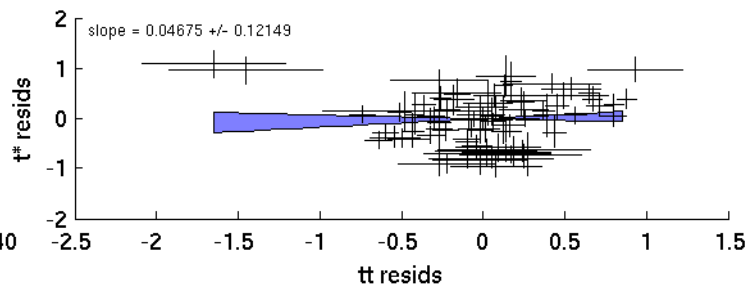
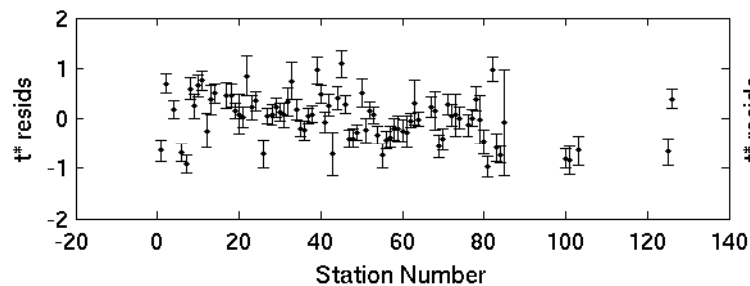
# Event\_2008\_273\_15\_19\_31



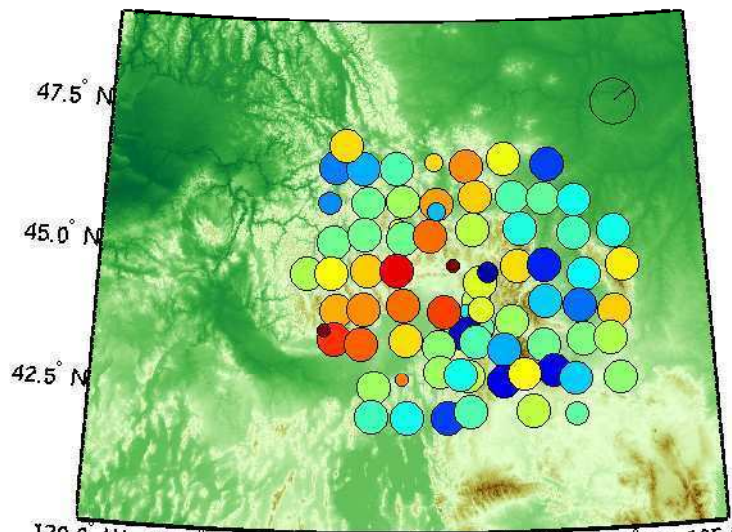
# Event\_2008\_273\_15\_19\_31



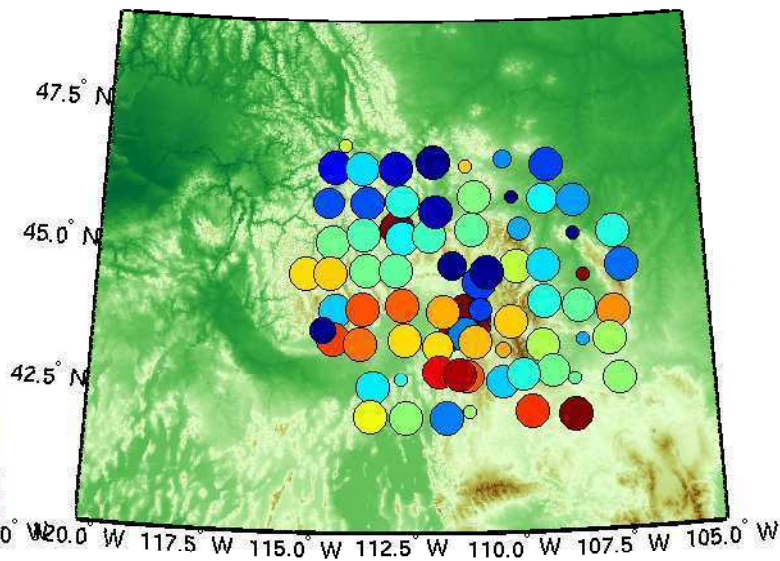
Baz = 233.2587  
 Mean xcor value = 0.87122  
 Range of  $t^*$  values is 2.0515  
 Median  $t^*$  err is 0.21598



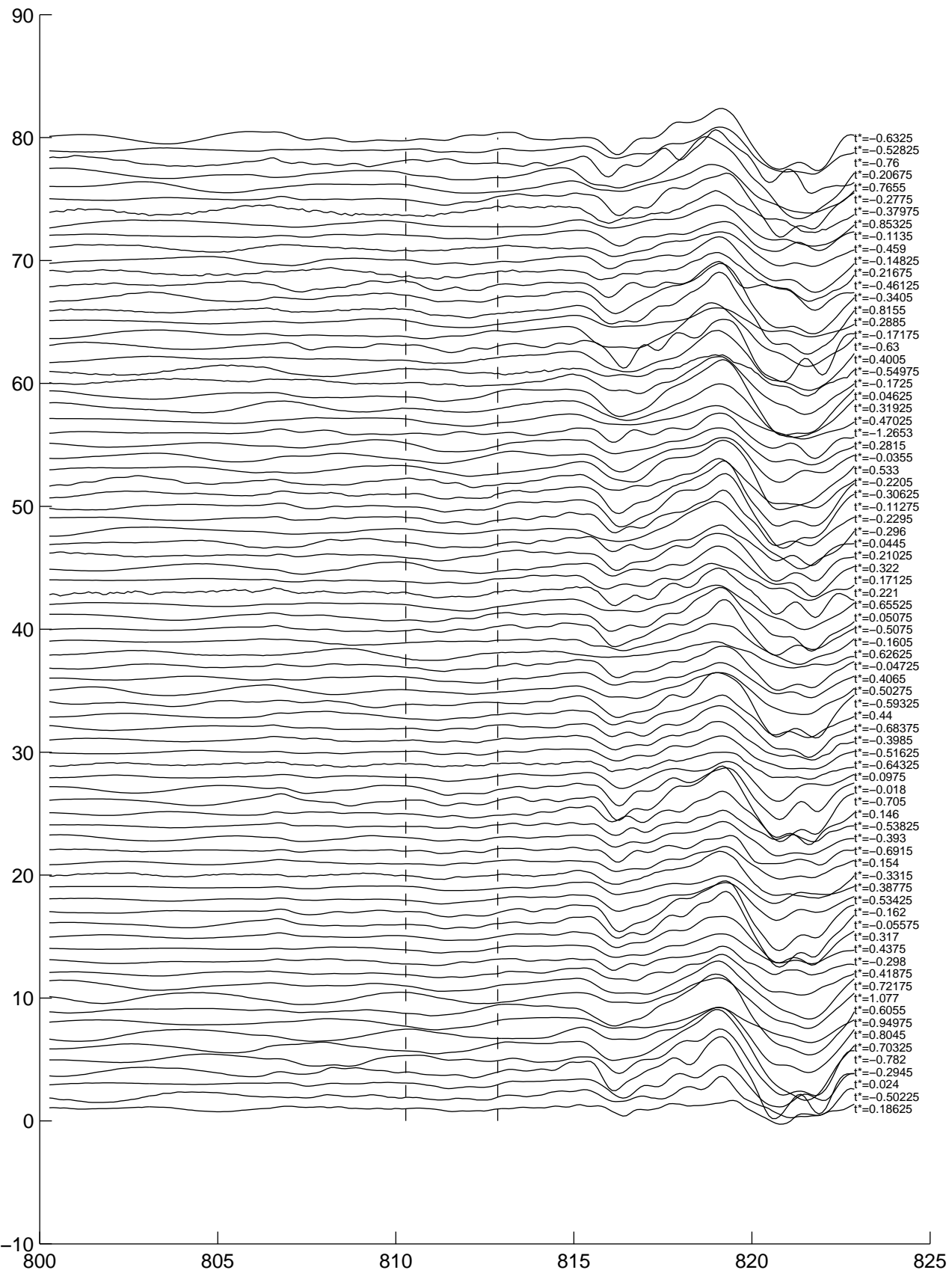
travel time residuals



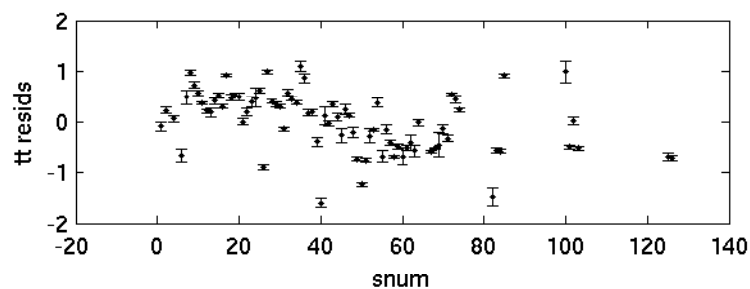
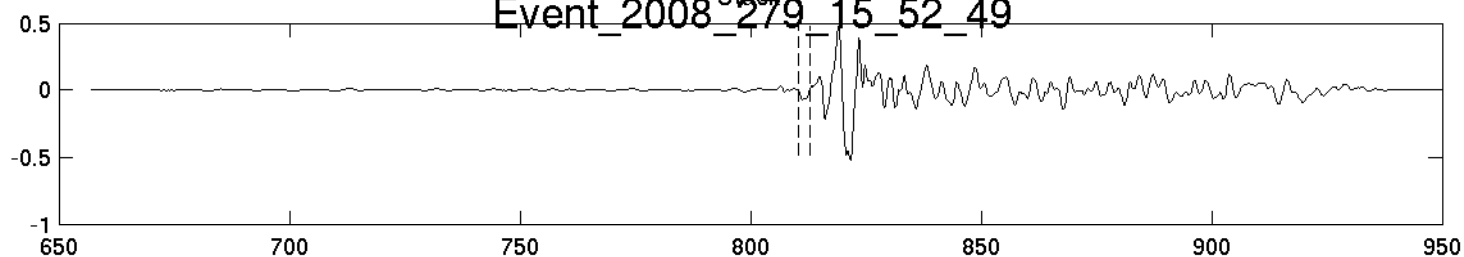
$t^*$  values



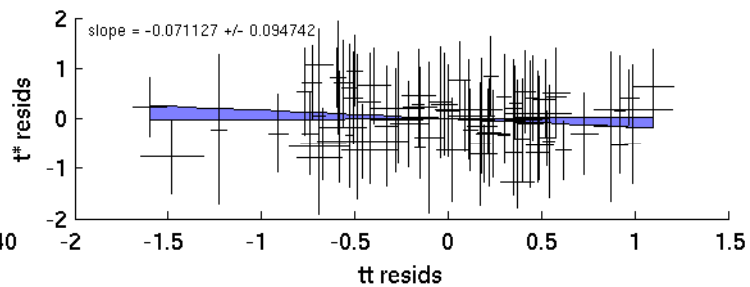
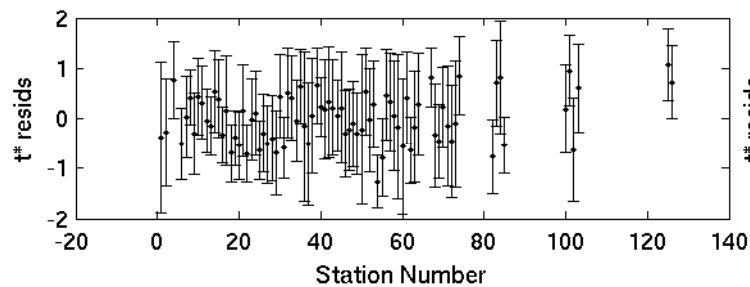
# Event\_2008\_279\_15\_52\_49



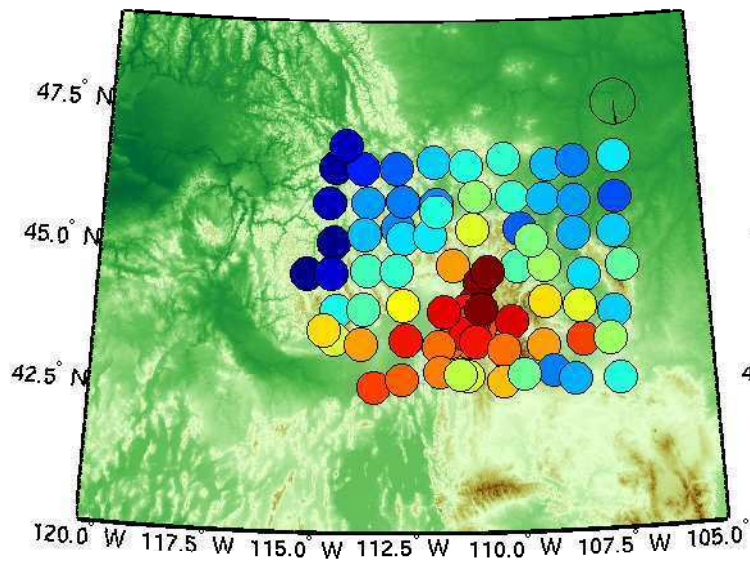
# Event\_2008\_279\_15\_52\_49



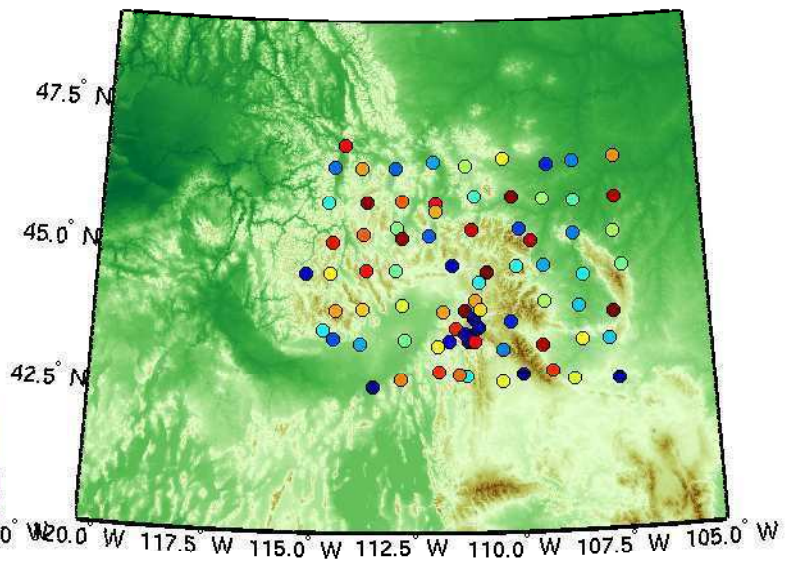
Baz = 356.3771  
Mean xcor value = 0.86225  
Range of  $t^*$  values is 2.3423  
Median  $t^*$  err is 0.62048



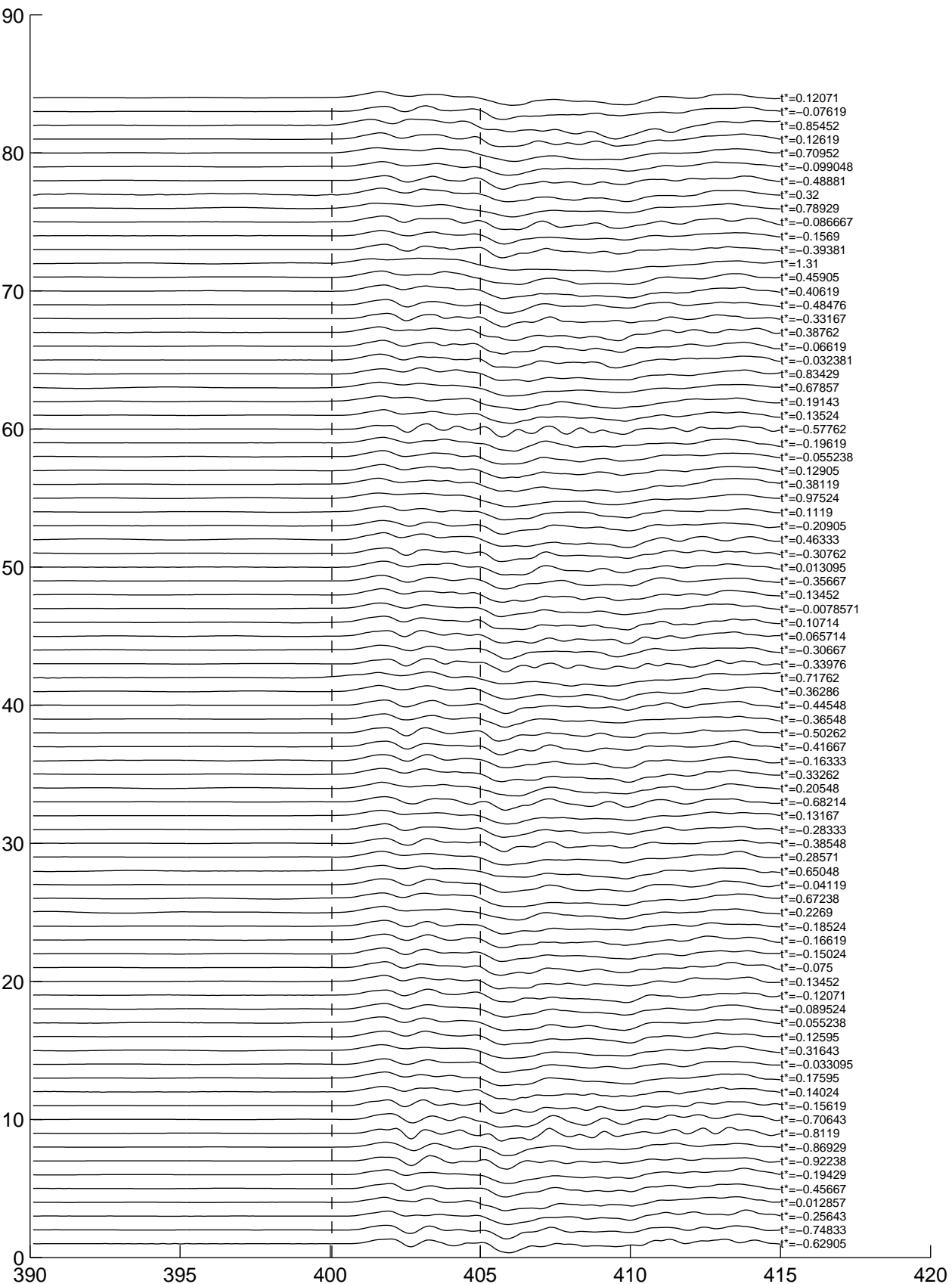
travel time residuals



$t^*$  values

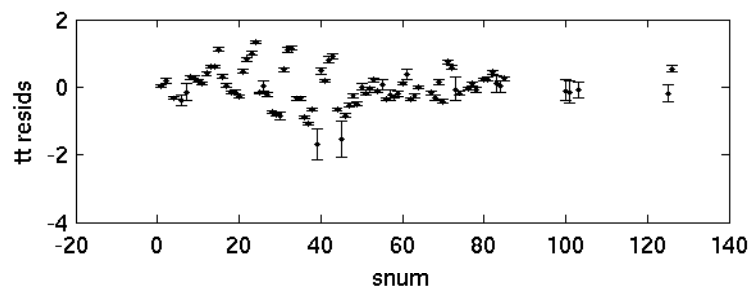
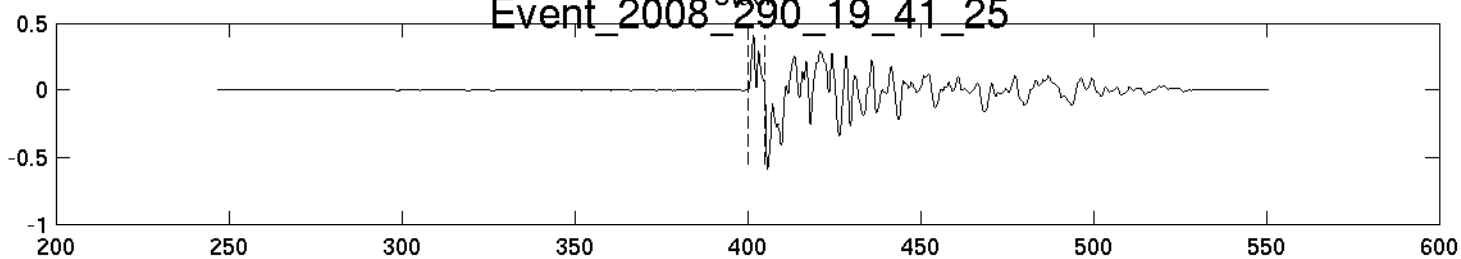


# Event\_2008\_290\_19\_41\_25

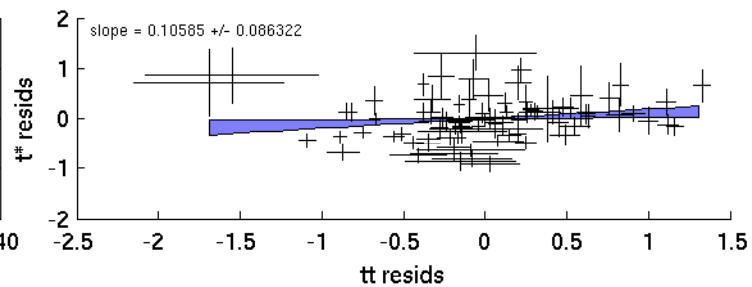
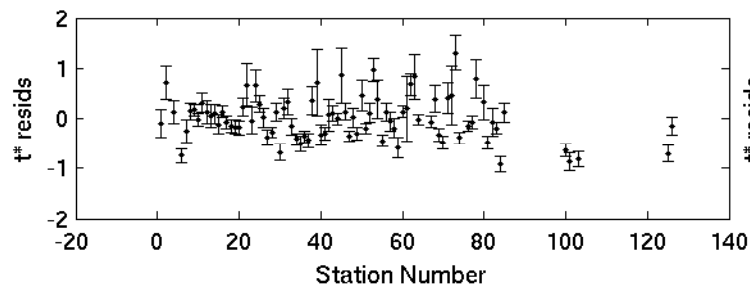




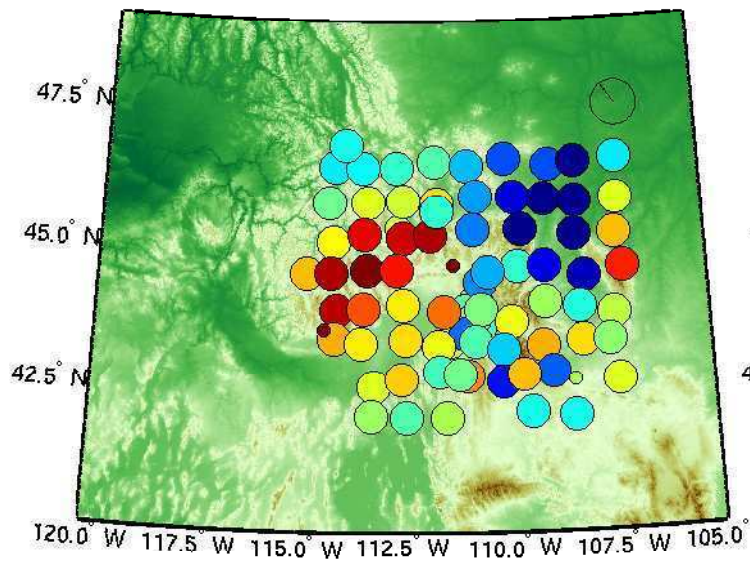
# Event\_2008\_290\_19\_41\_25



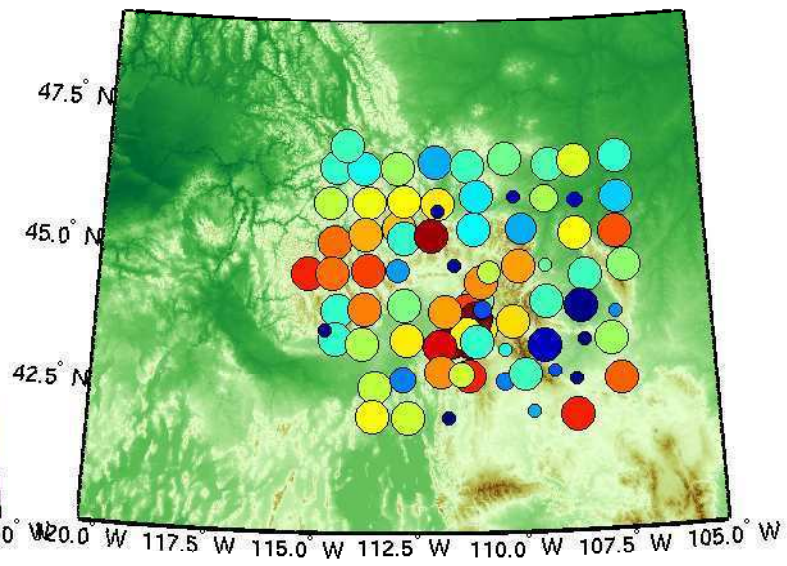
Baz = 146.4952  
 Mean xcor value = 0.84107  
 Range of  $t^*$  values is 2.2324  
 Median  $t^*$  err is 0.17371



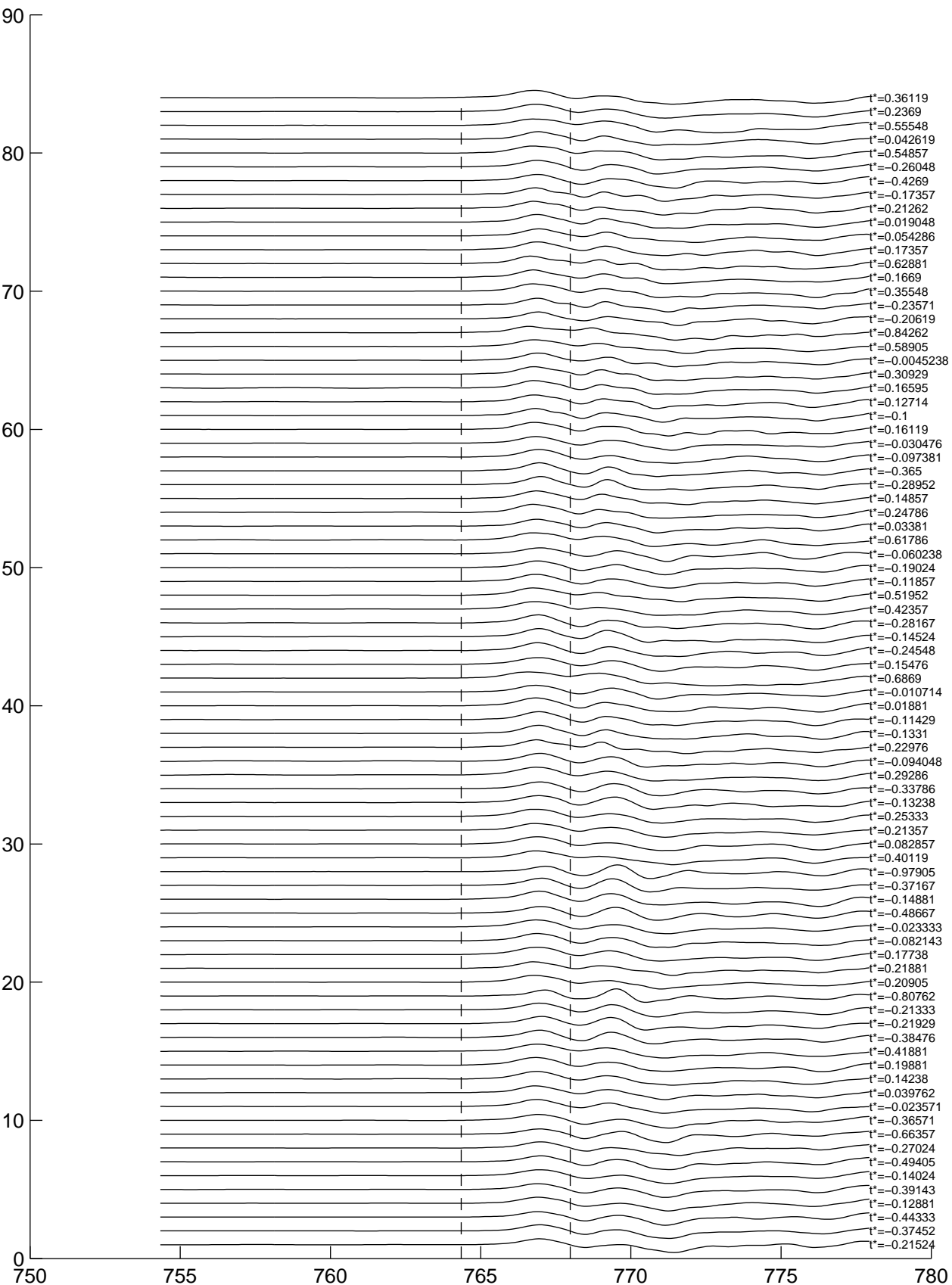
travel time residuals



$t^*$  values

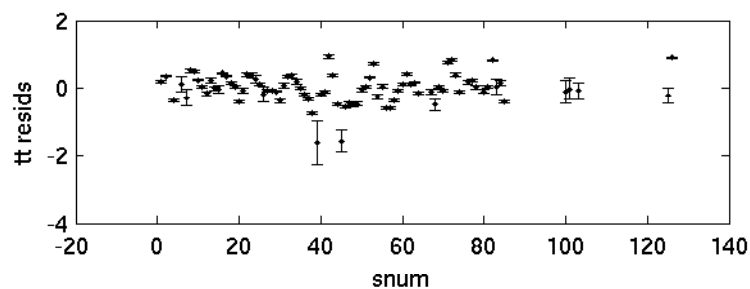
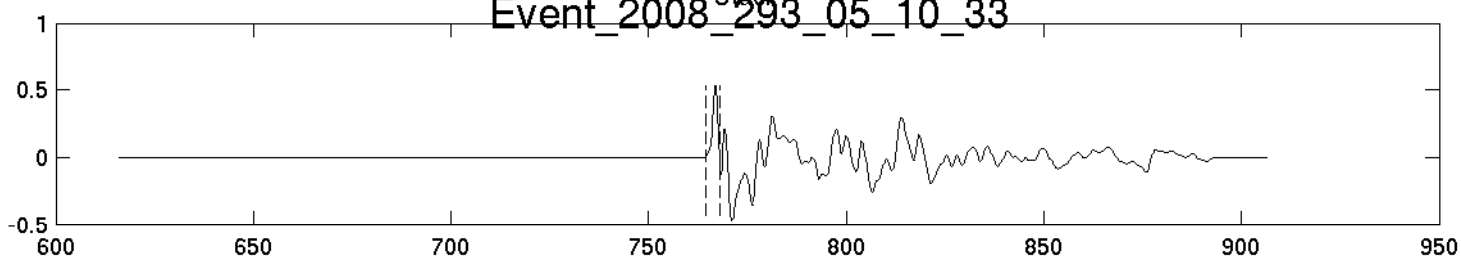


# Event\_2008\_293\_05\_10\_33

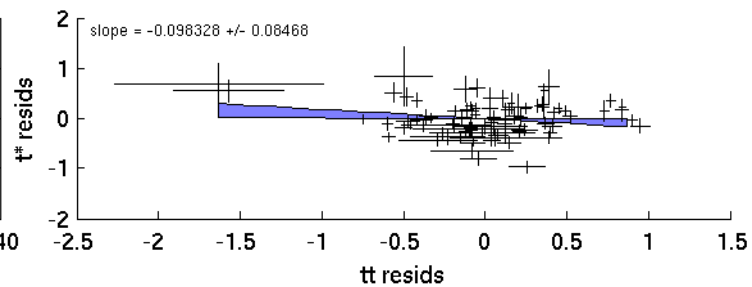
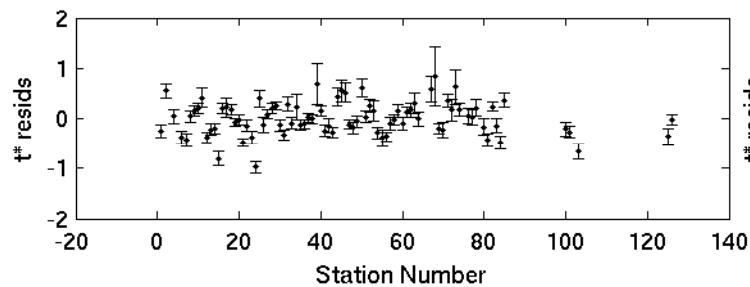




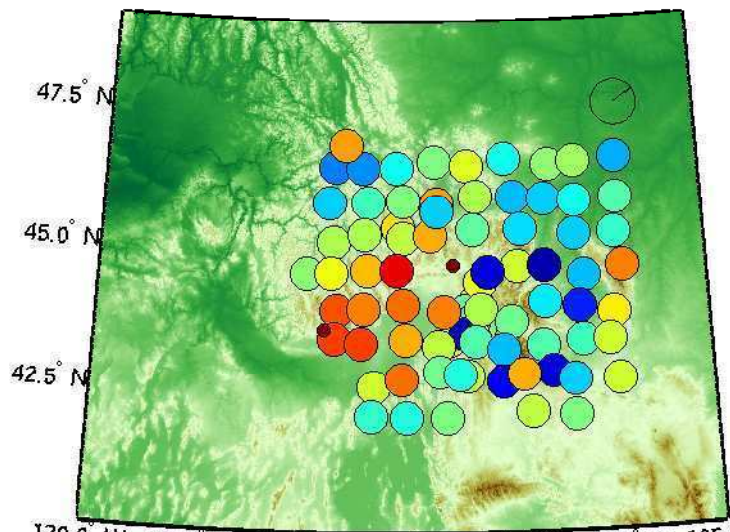
# Event\_2008\_293\_05\_10\_33



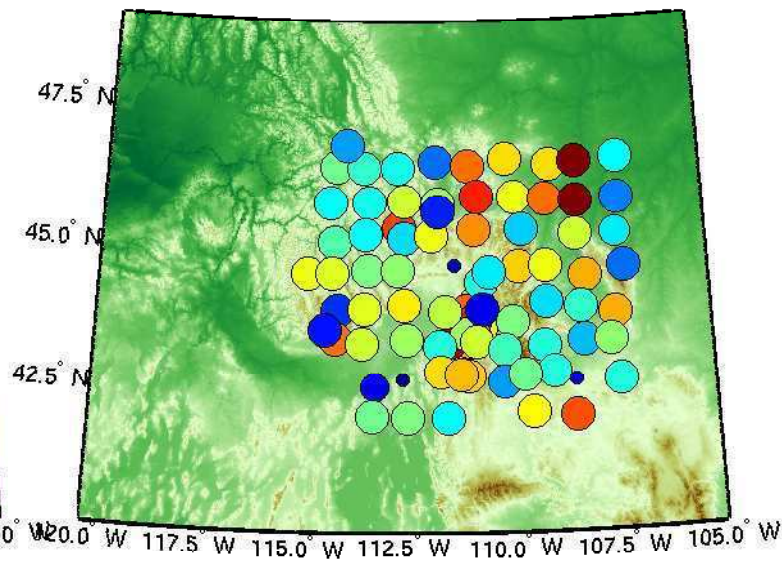
Baz = 235.8244  
 Mean xcor value = 0.88429  
 Range of  $t^*$  values is 1.8217  
 Median  $t^*$  err is 0.12507



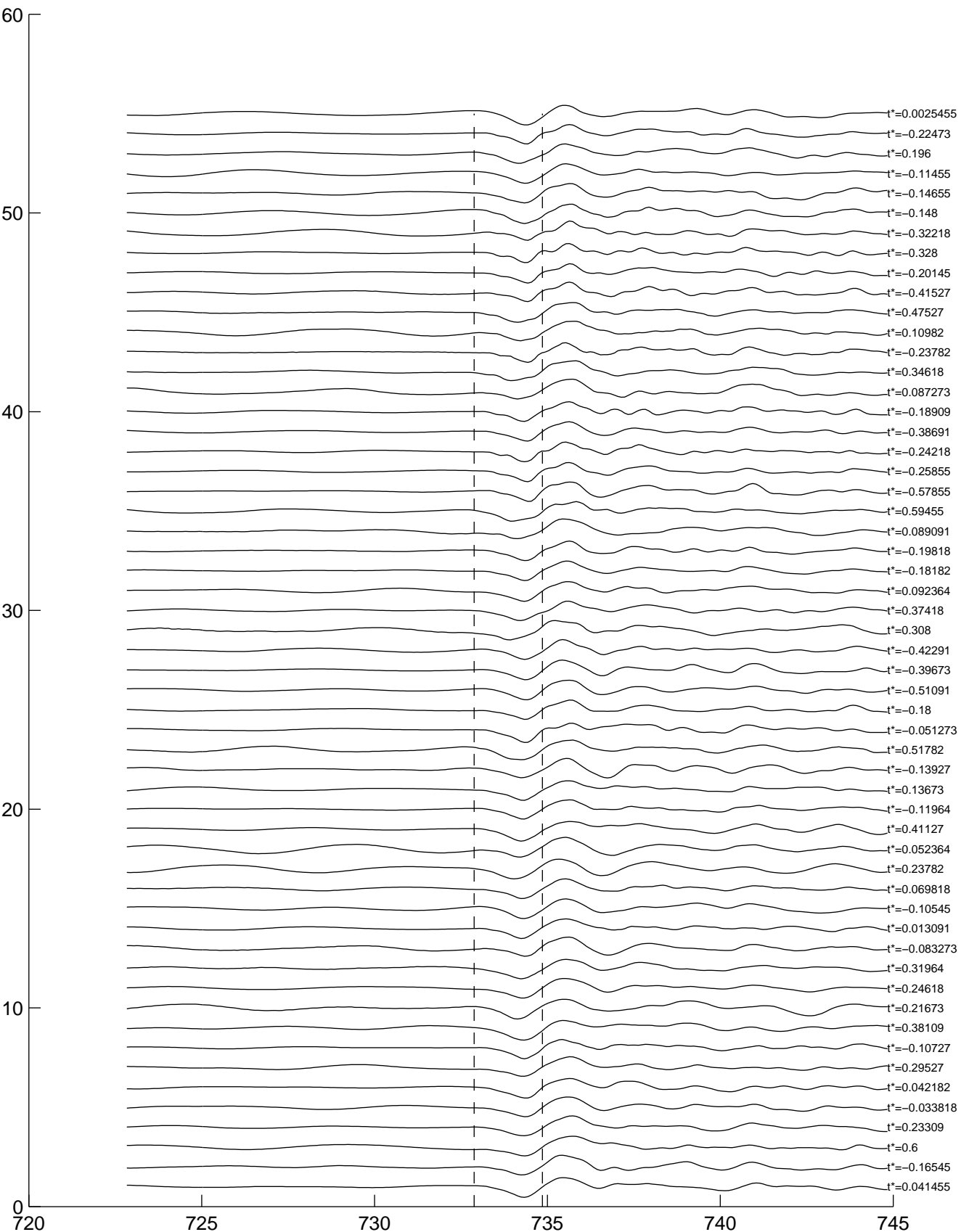
travel time residuals



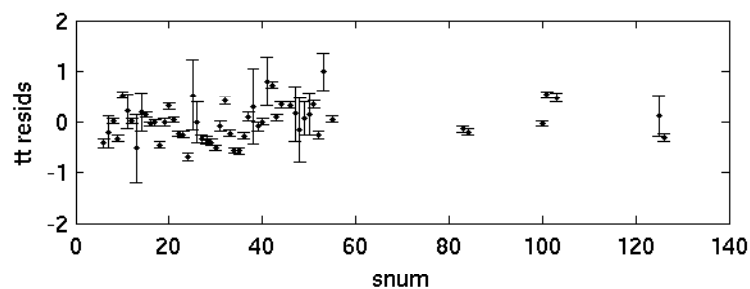
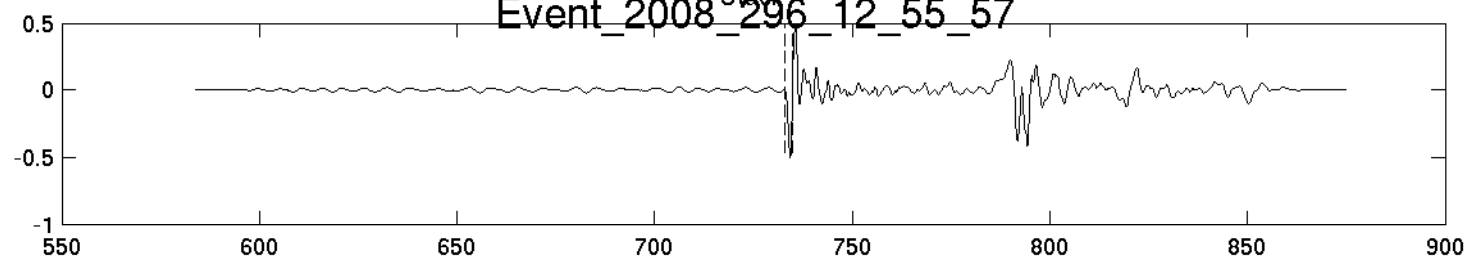
$t^*$  values



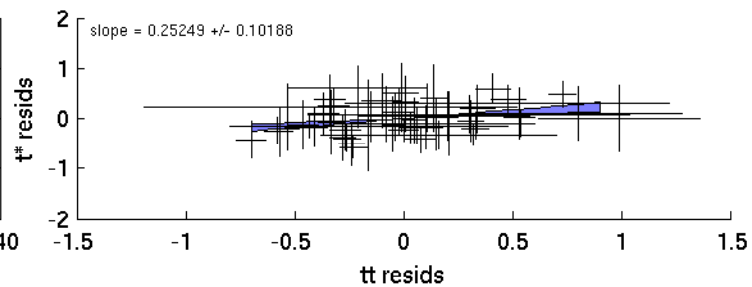
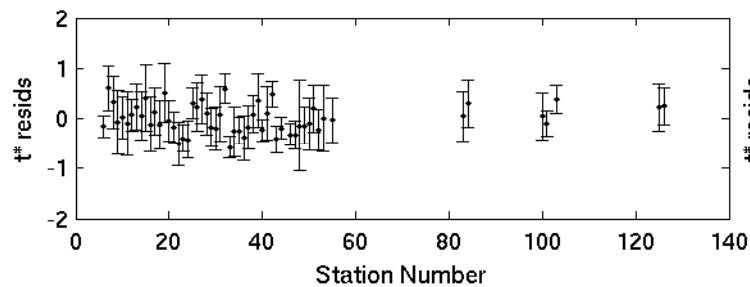
# Event\_2008\_296\_12\_55\_57



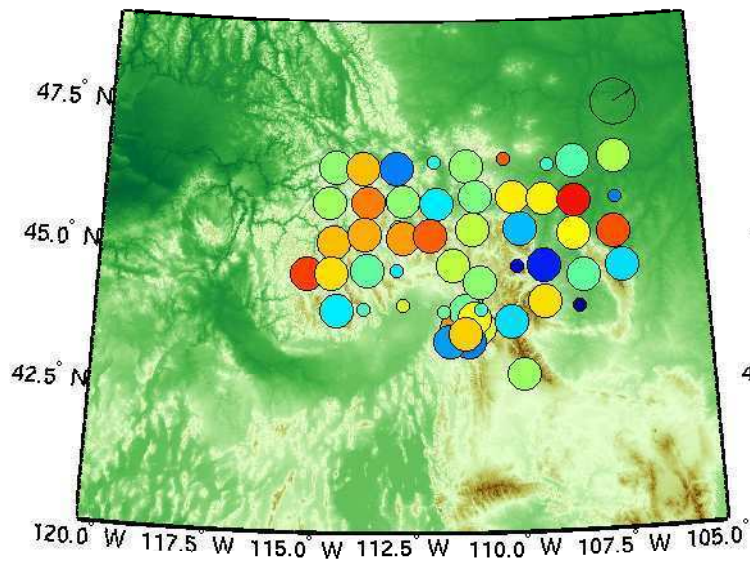
# Event\_2008\_296\_12\_55\_57



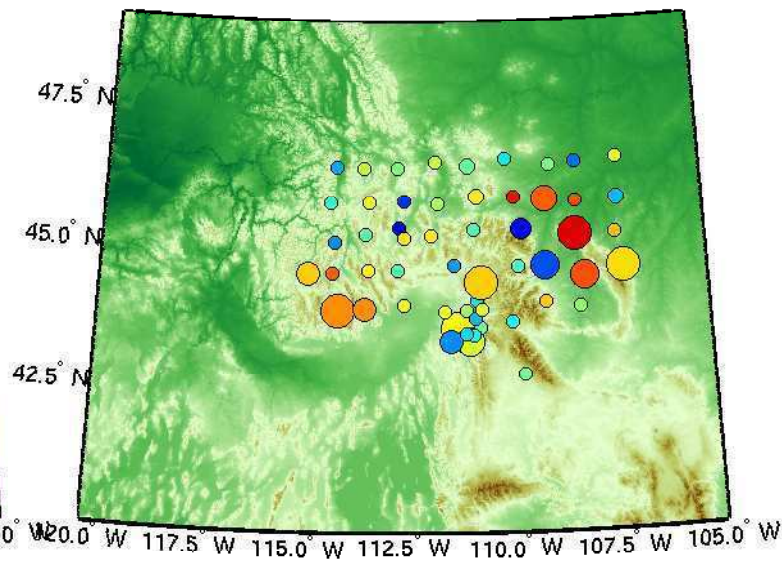
Baz = 239.1475  
 Mean xcor value = 0.66255  
 Range of  $t^*$  values is 1.1785  
 Median  $t^*$  err is 0.43675



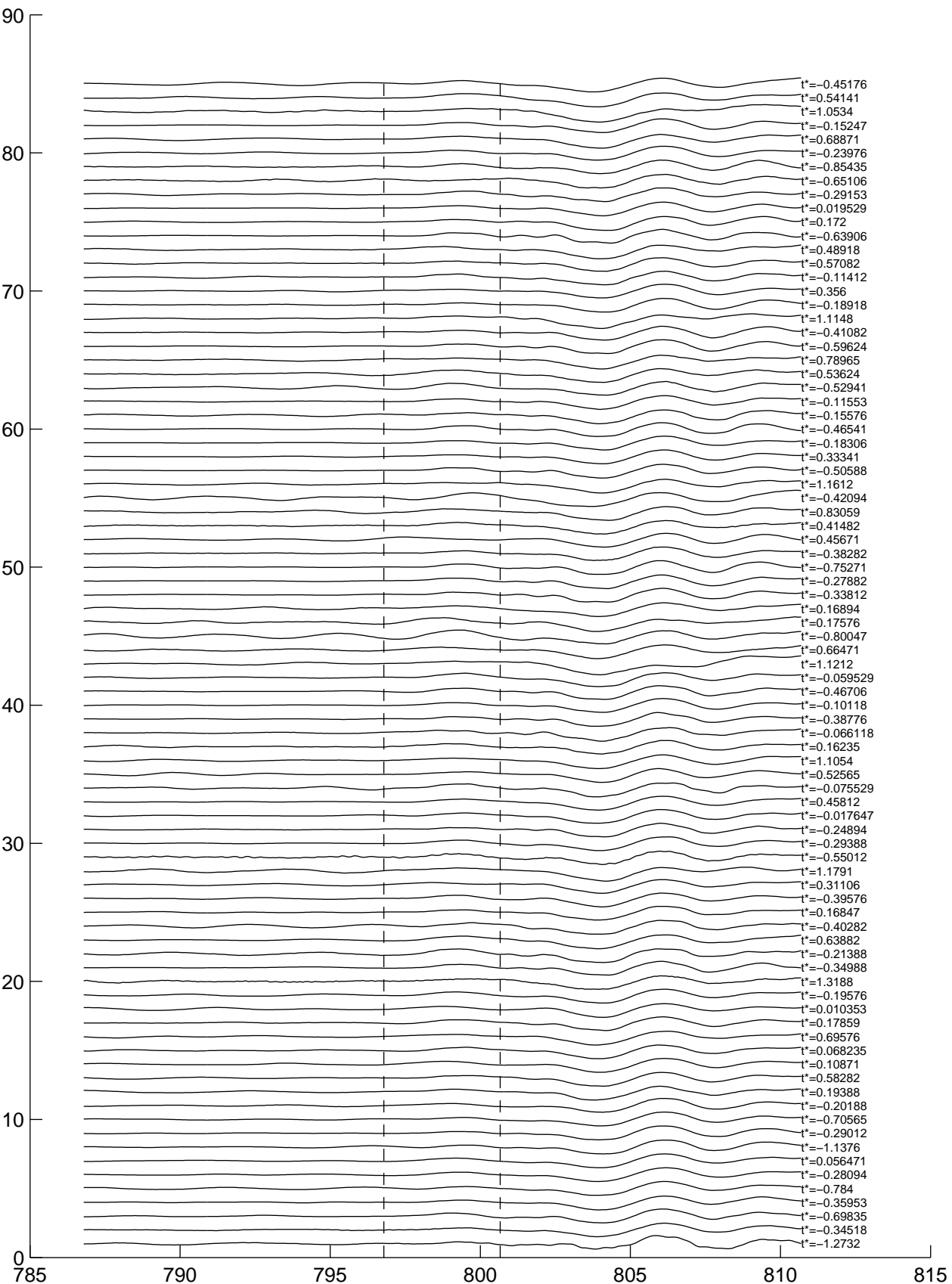
travel time residuals



$t^*$  values

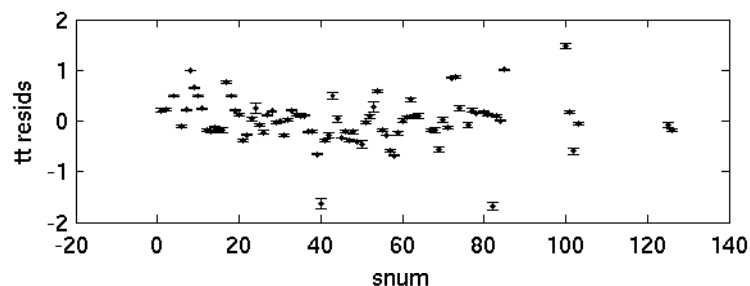
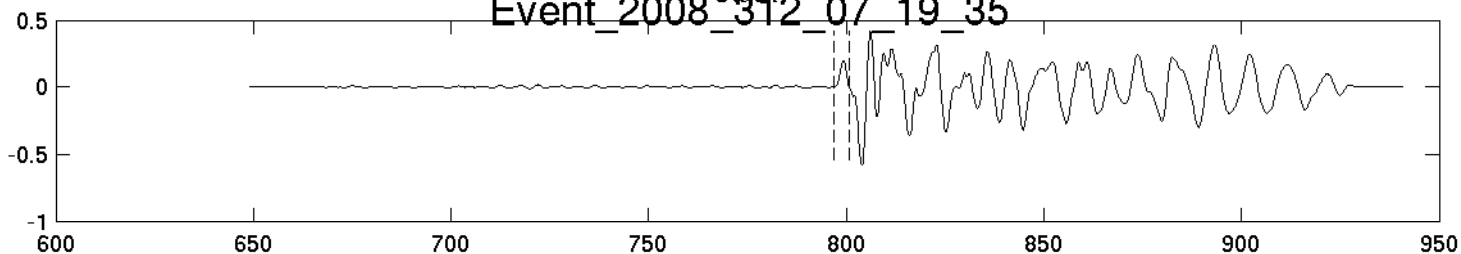


# Event\_2008\_312\_07\_19\_35

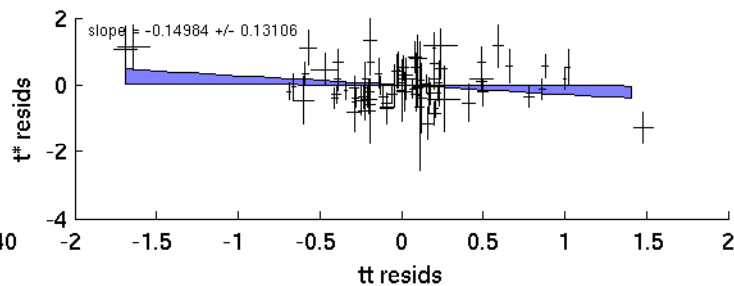
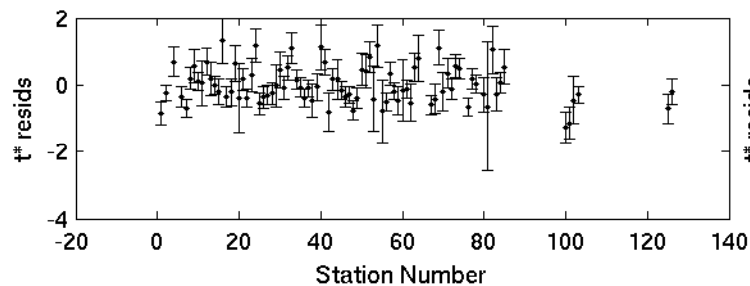




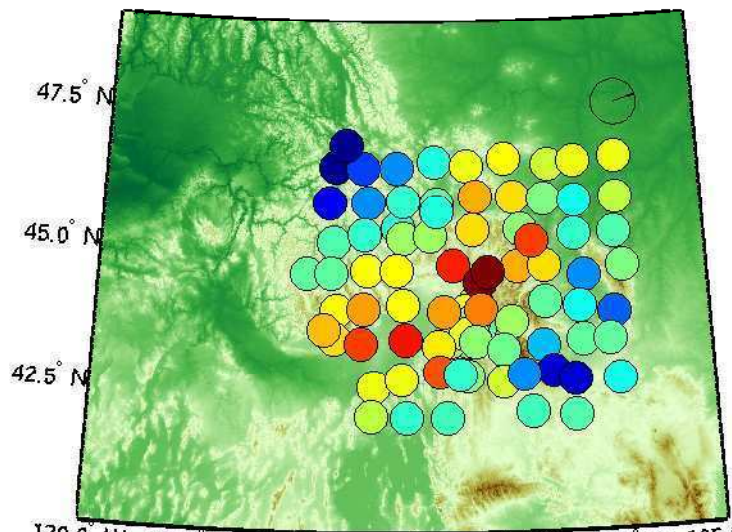
# Event\_2008\_312\_07\_19\_35



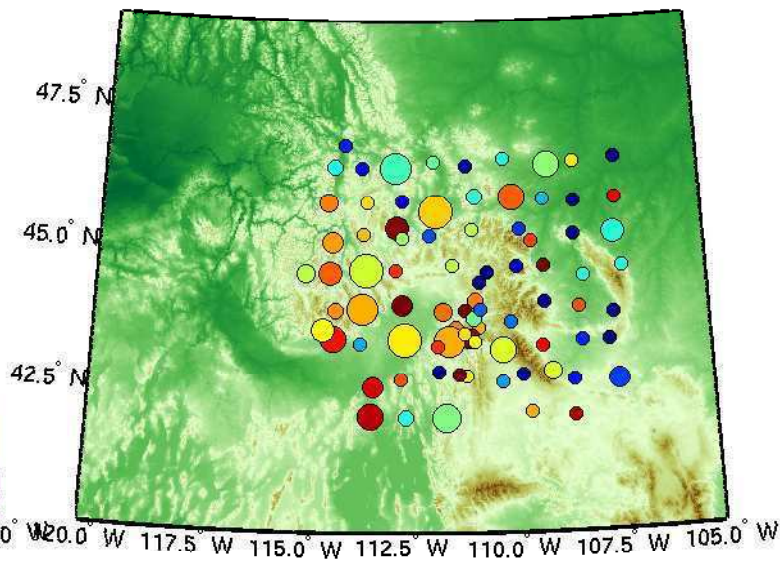
Baz = 253.247  
Mean xcor value = 0.89435  
Range of  $t^*$  values is 2.592  
Median  $t^*$  err is 0.38681



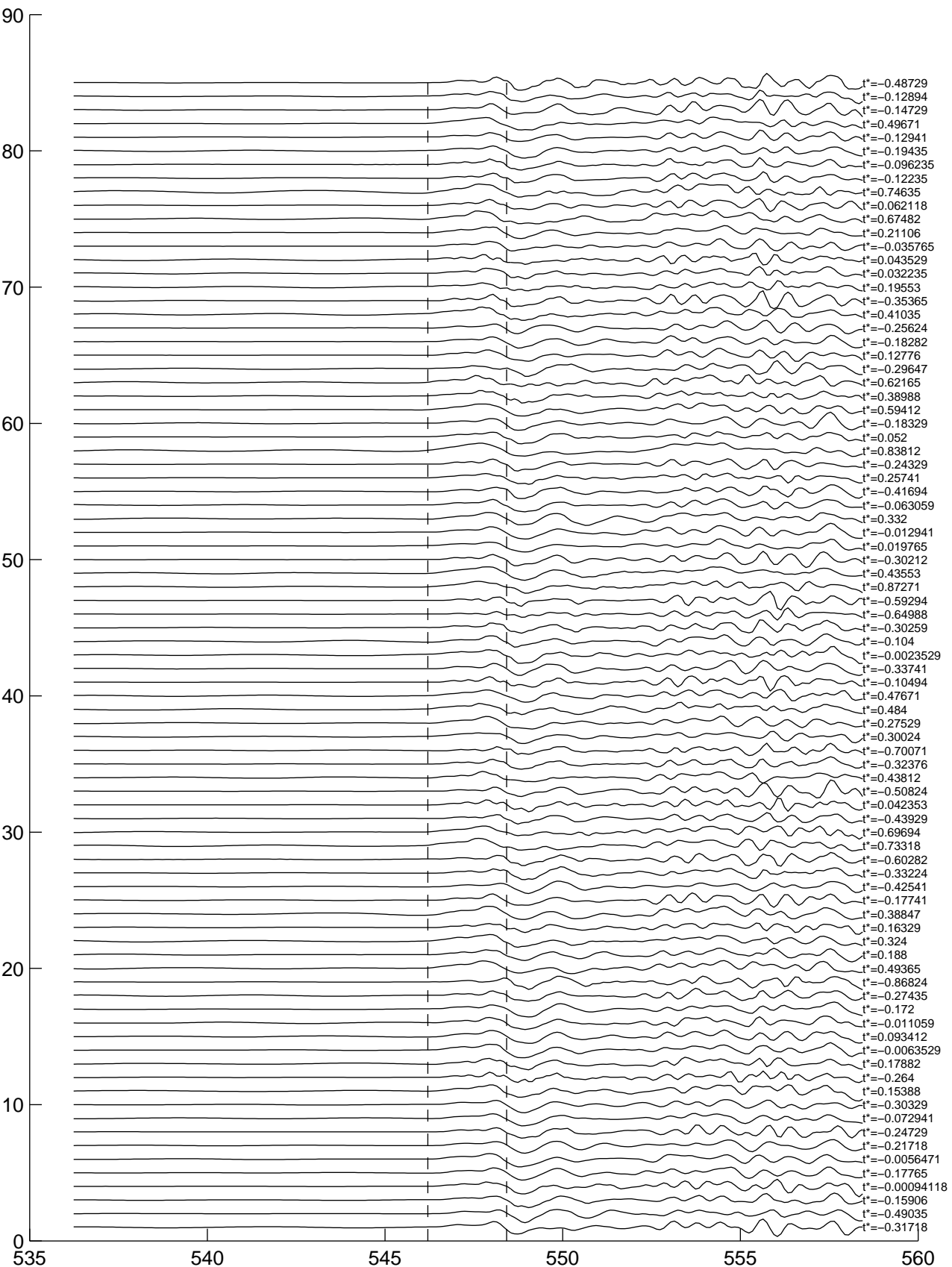
travel time residuals



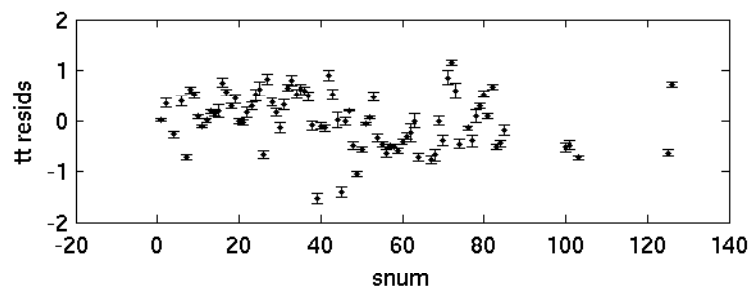
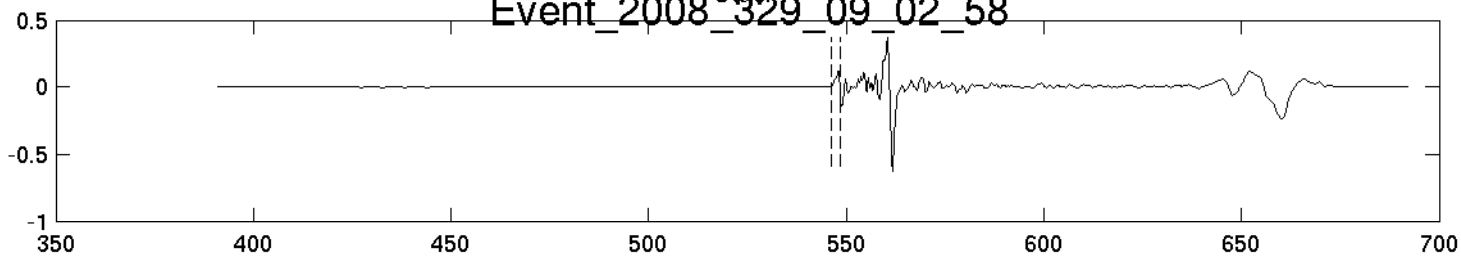
$t^*$  values



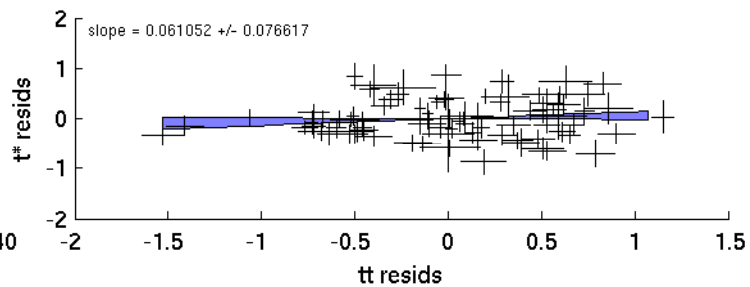
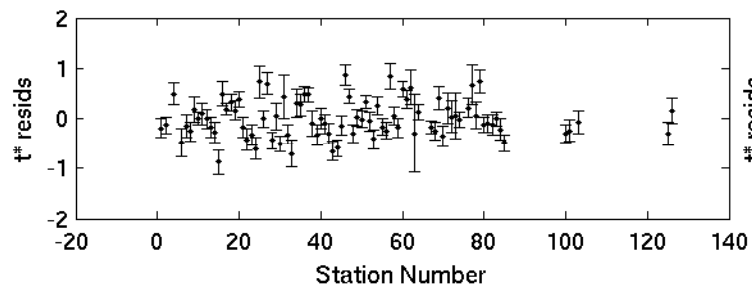
# Event\_2008\_329\_09\_02\_58



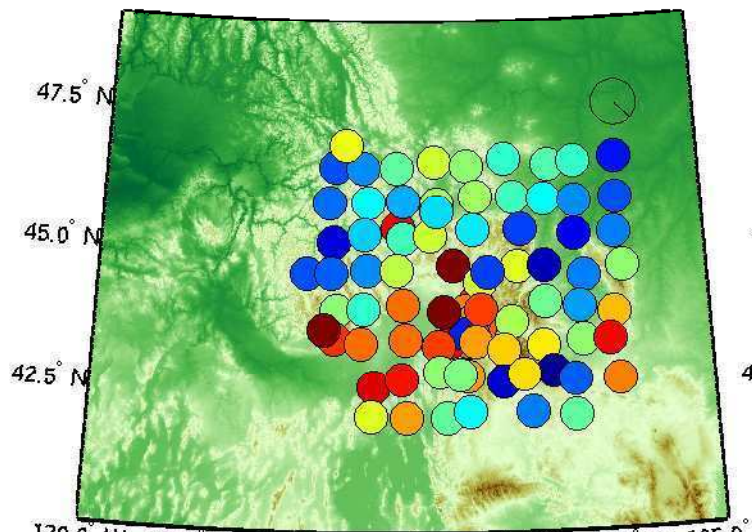
Event\_2008\_329\_09\_02\_58



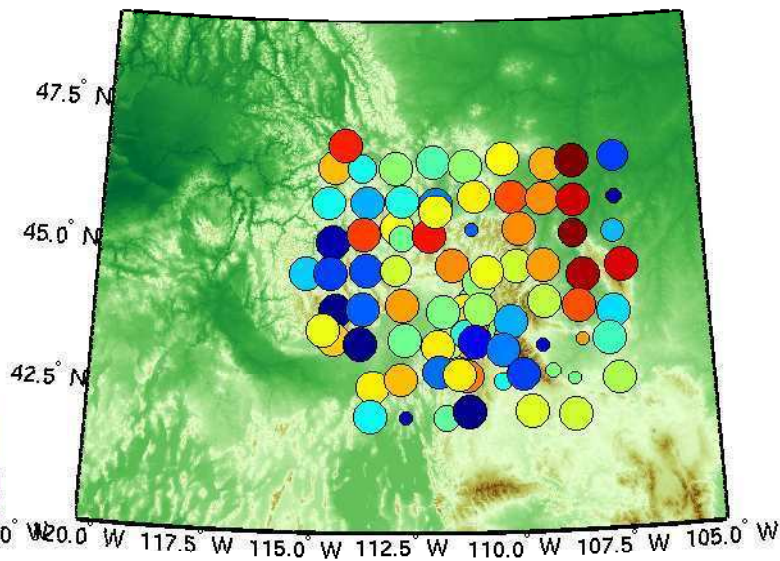
Baz = 316.5243  
Mean xcor value = 0.81541  
Range of  $t^*$  values is 1.7409  
Median  $t^*$  err is 0.19834



travel time residuals

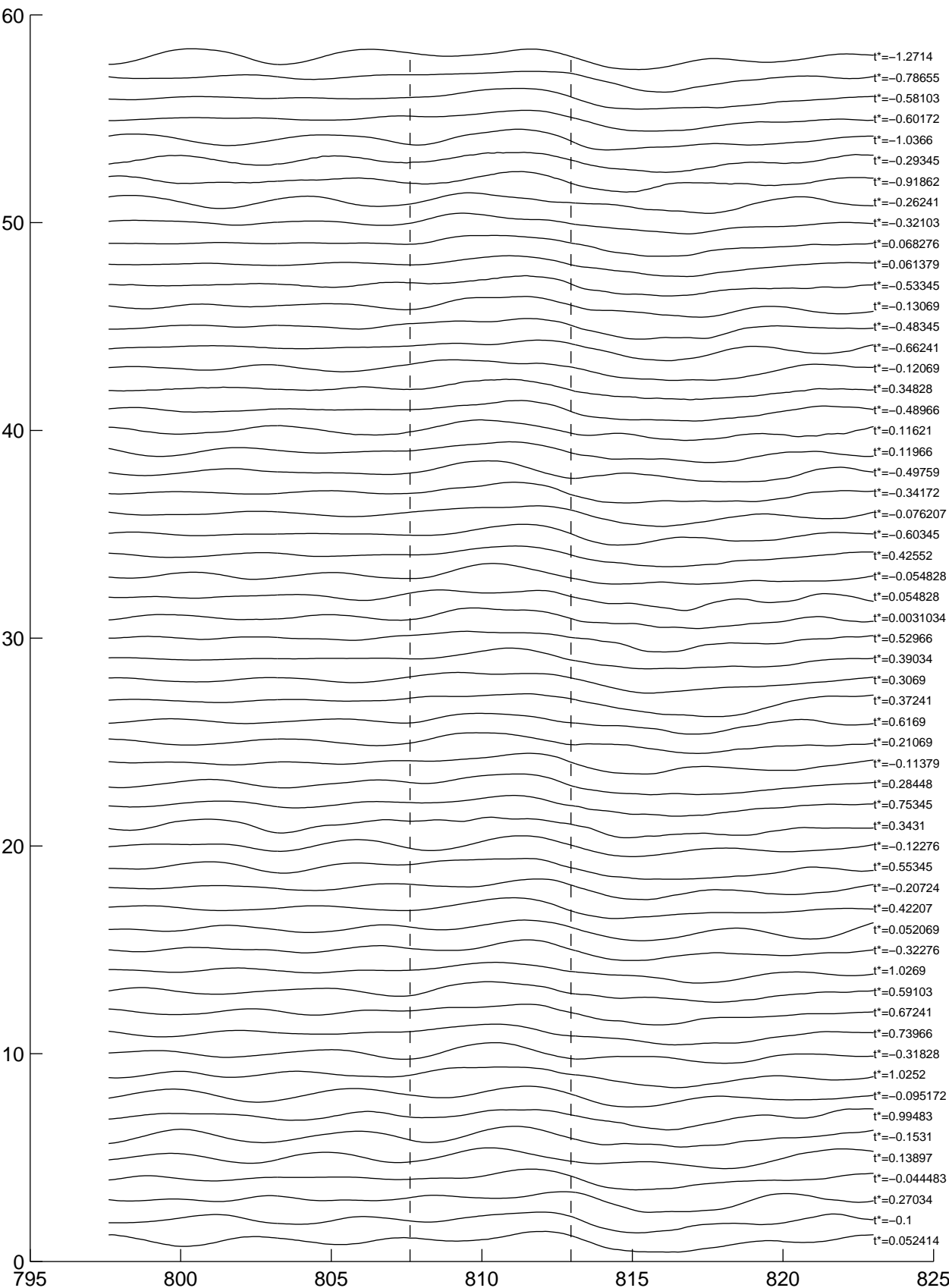


$t^*$  values

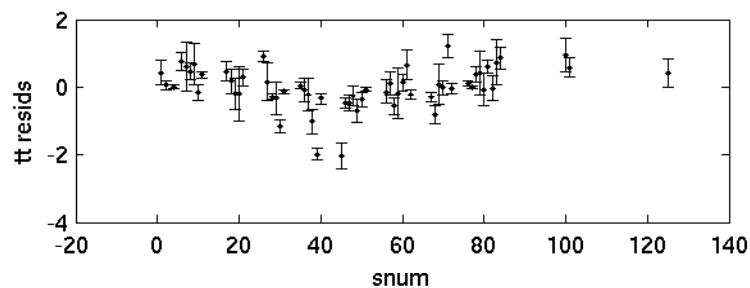
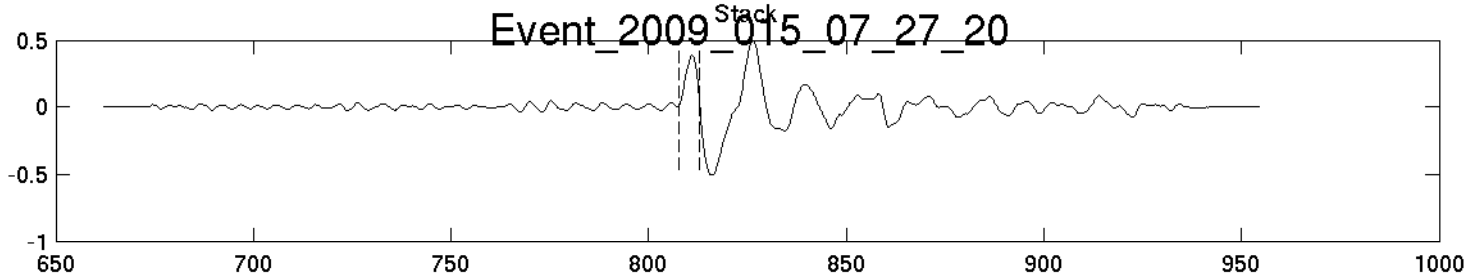




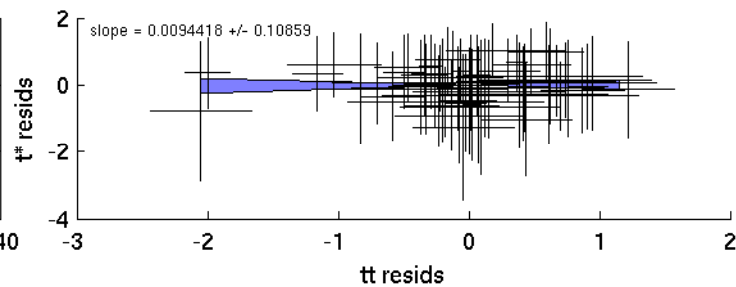
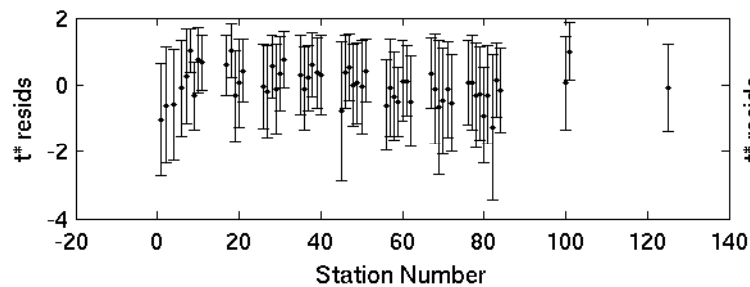
# Event\_2009\_015\_07\_27\_20



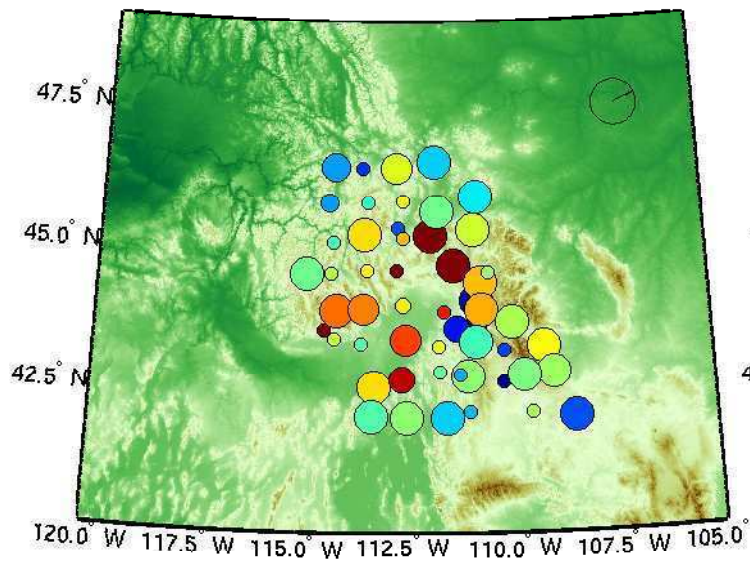
Event\_2009\_015\_07\_27\_20



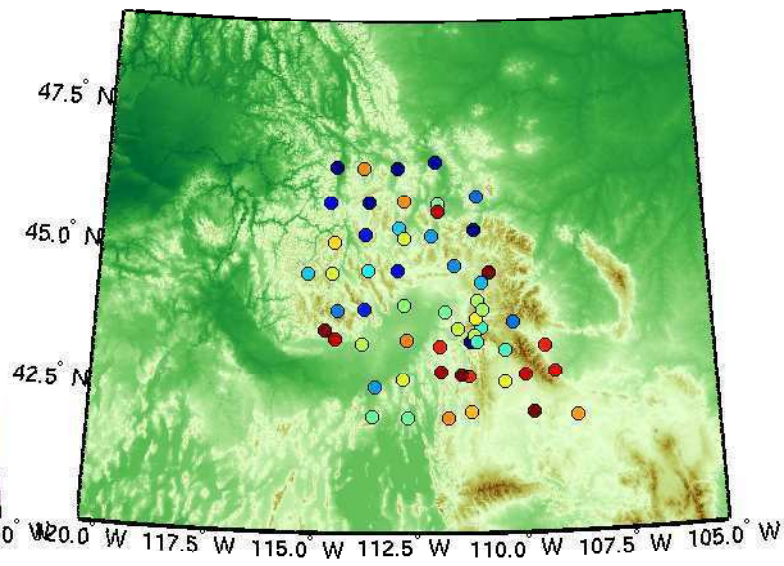
Baz = 245.4589  
Mean xcor value = 0.82466  
Range of  $t^*$  values is 2.2983  
Median  $t^*$  err is 1.2677



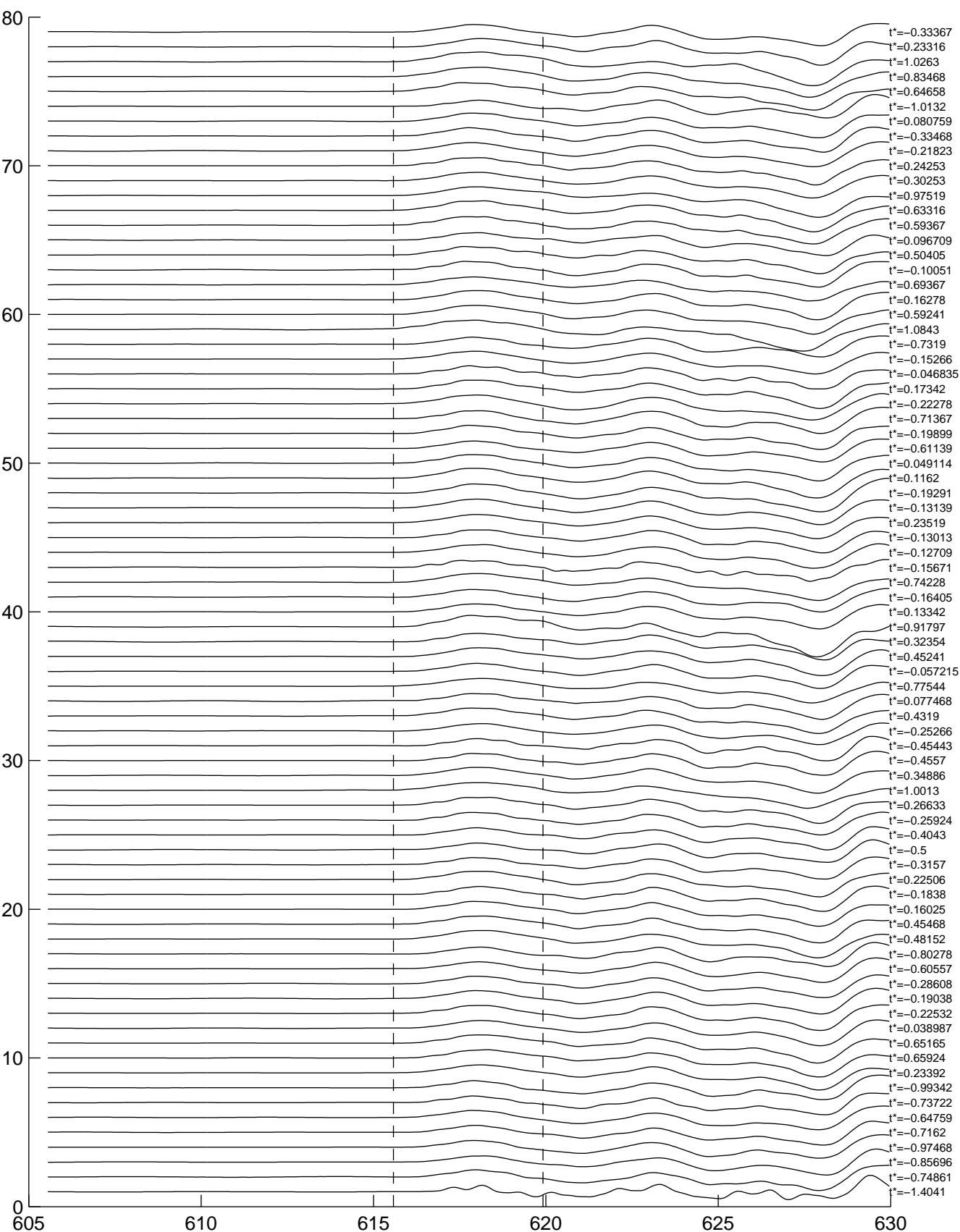
travel time residuals



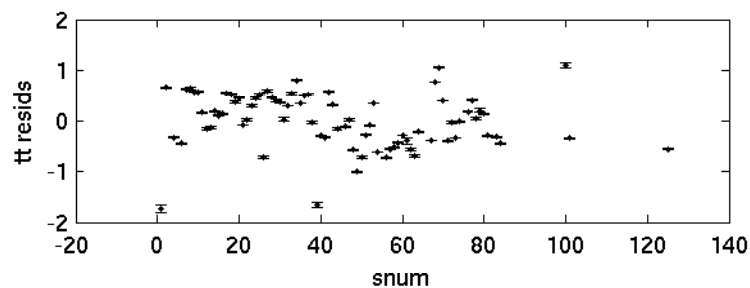
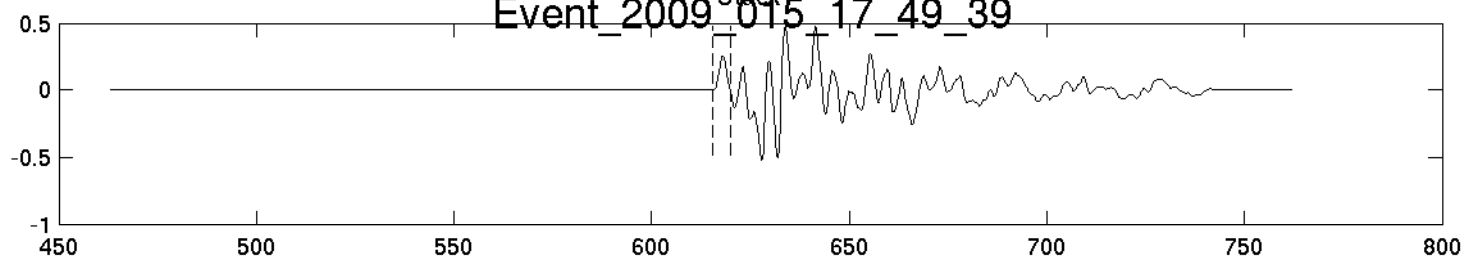
$t^*$  values



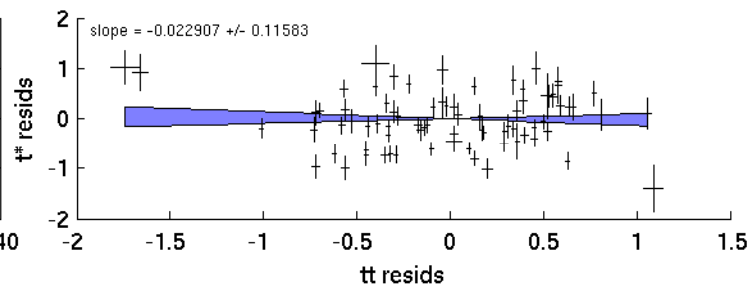
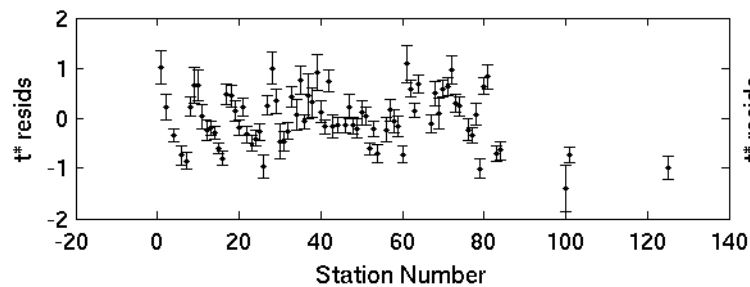
Event\_2009\_015\_17\_49\_39



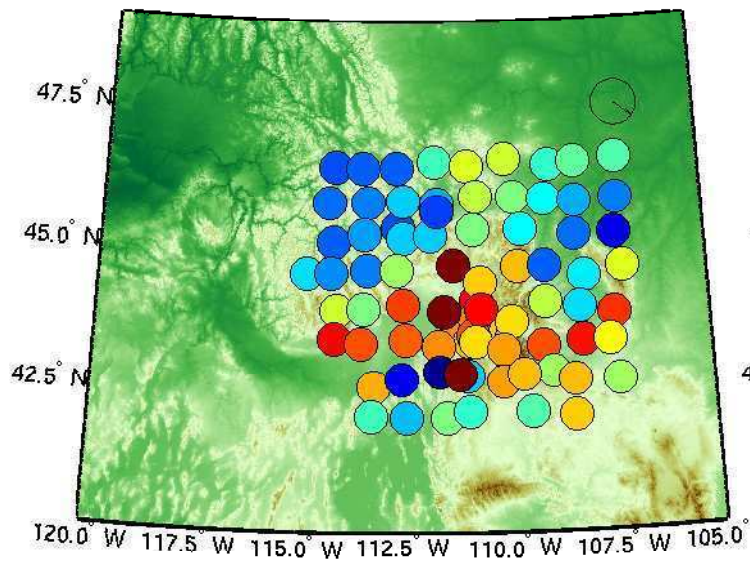
# Event\_2009\_01\_17\_49\_39



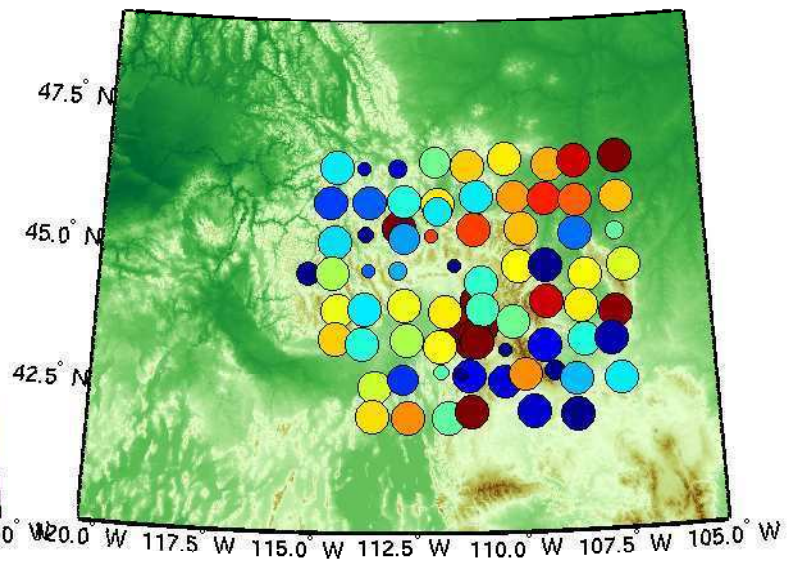
Baz = 309.1396  
 Mean xcor value = 0.89747  
 Range of  $t^*$  values is 2.4884  
 Median  $t^*$  err is 0.19602



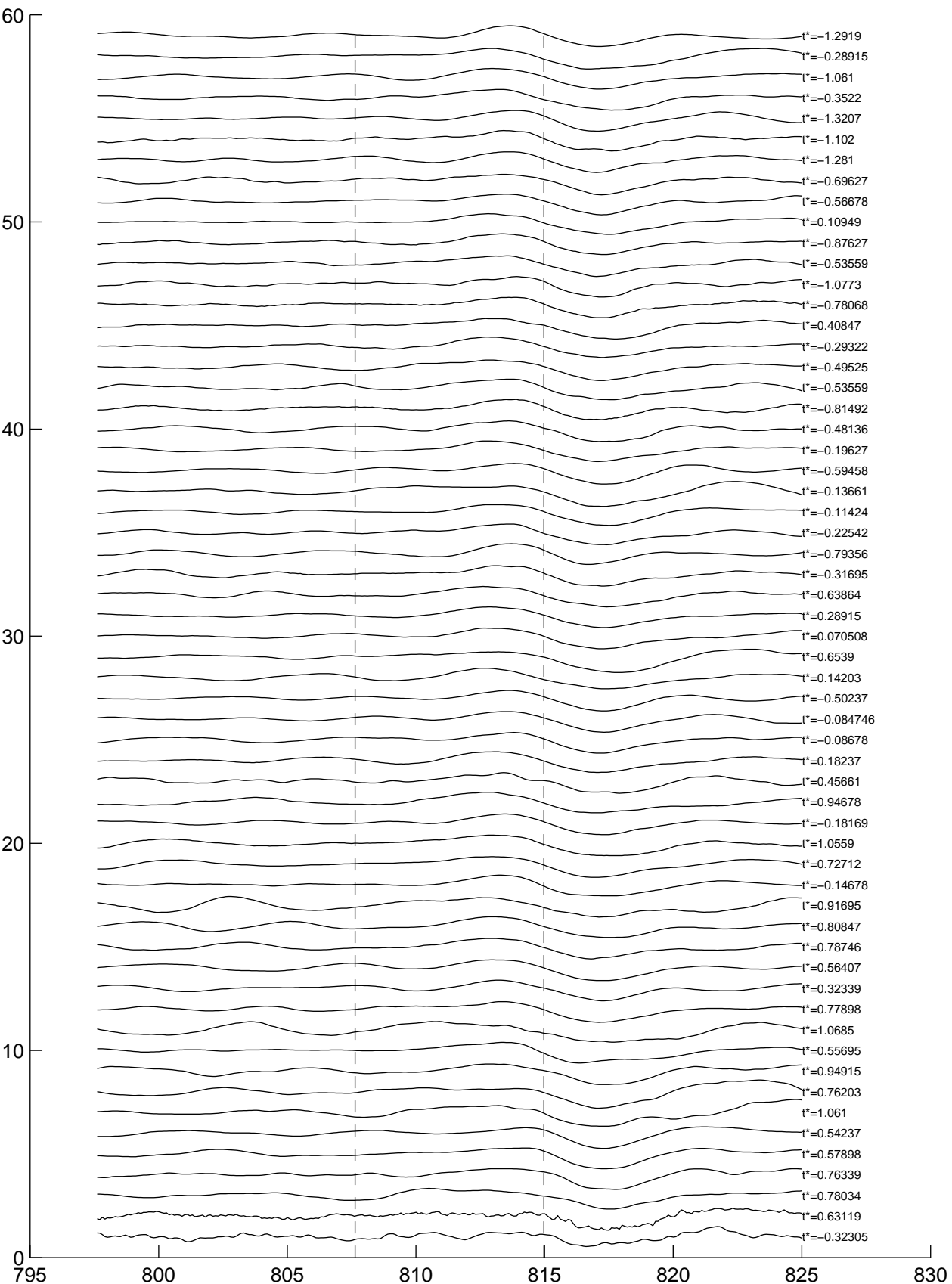
travel time residuals



$t^*$  values

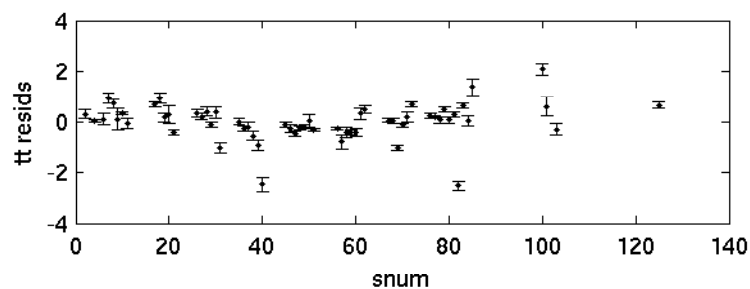
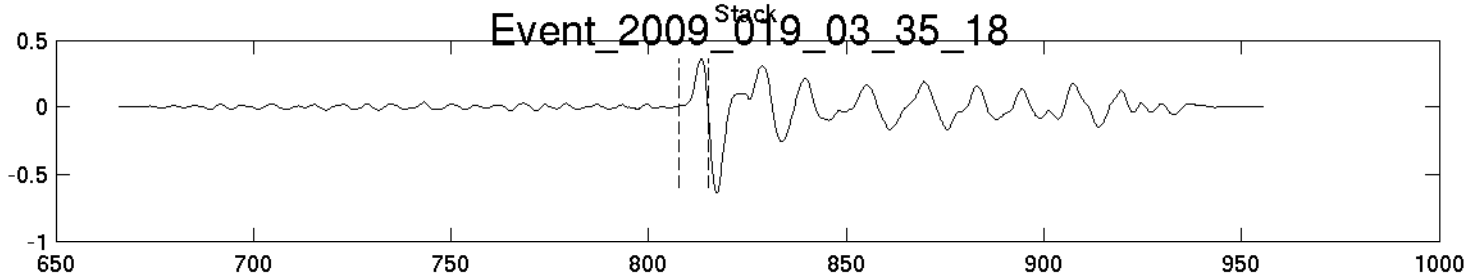


# Event\_2009\_019\_03\_35\_18

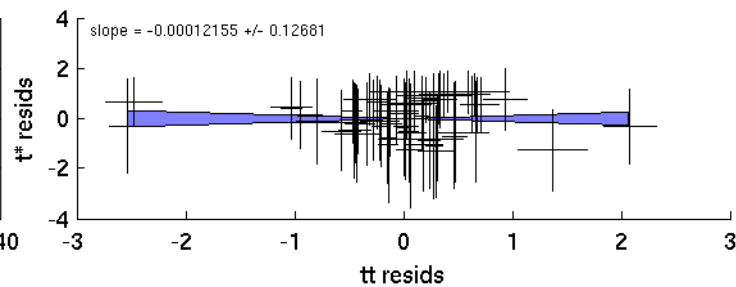
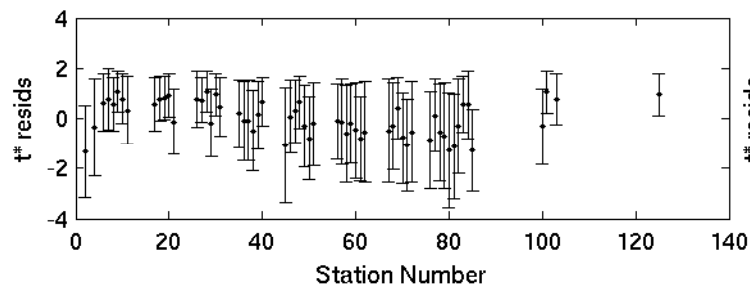




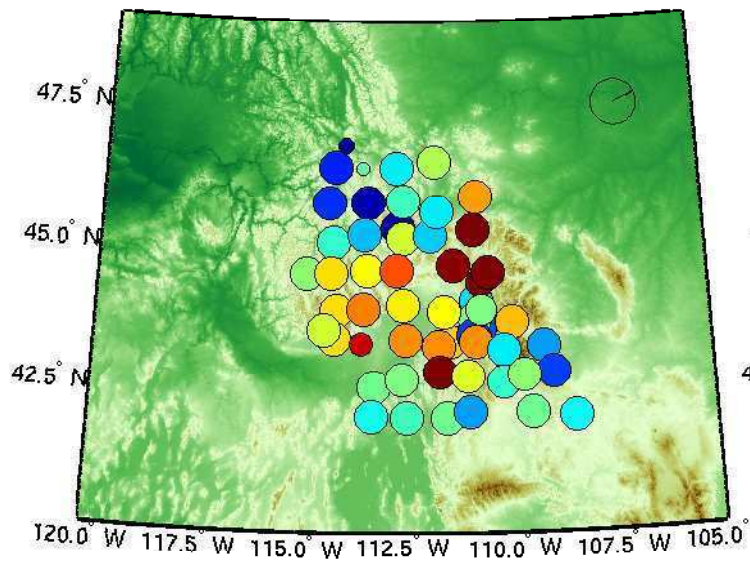
# Event\_2009\_019\_03\_35\_18



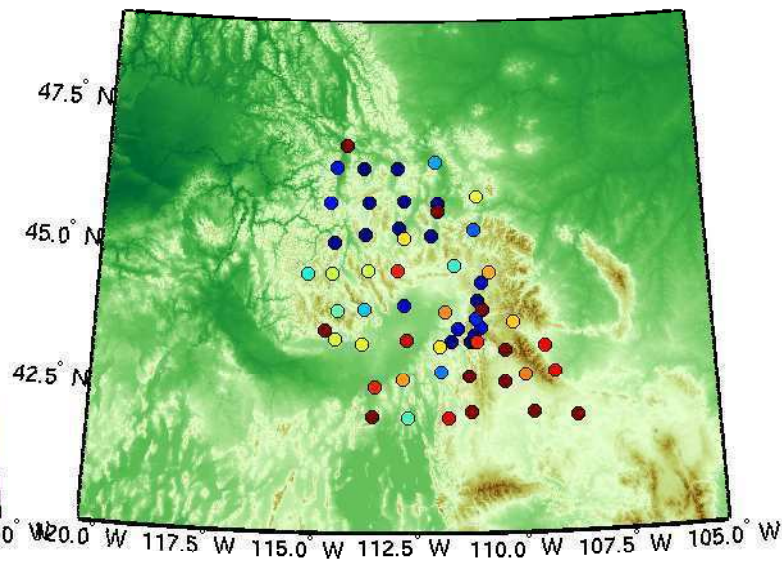
Baz = 245.1022  
 Mean xcor value = 0.83102  
 Range of  $t^*$  values is 2.3892  
 Median  $t^*$  err is 1.4574



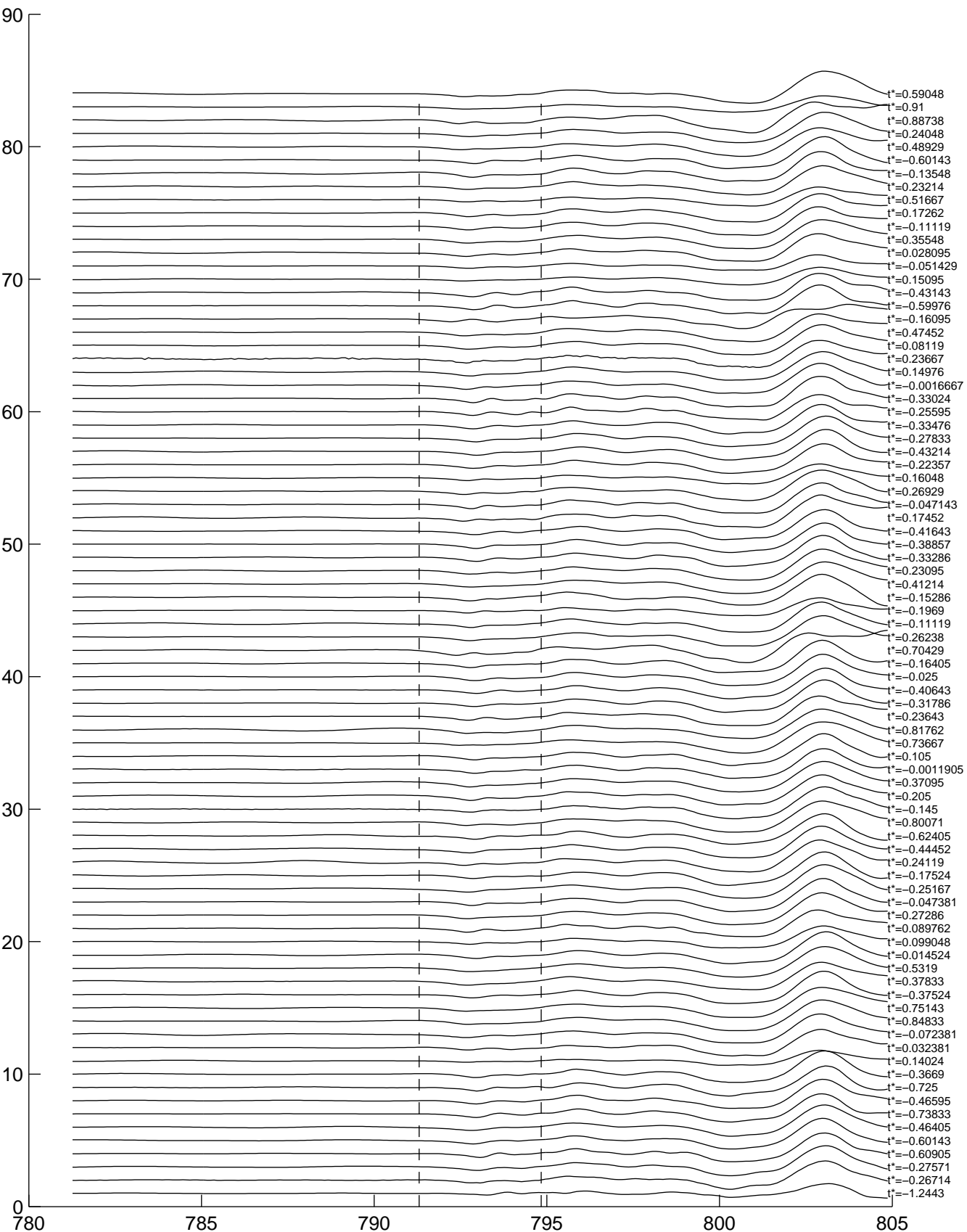
travel time residuals



$t^*$  values

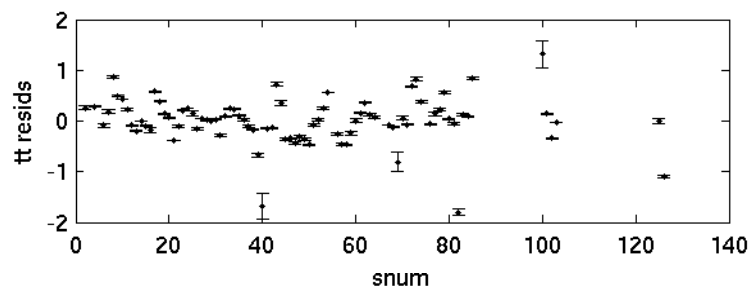
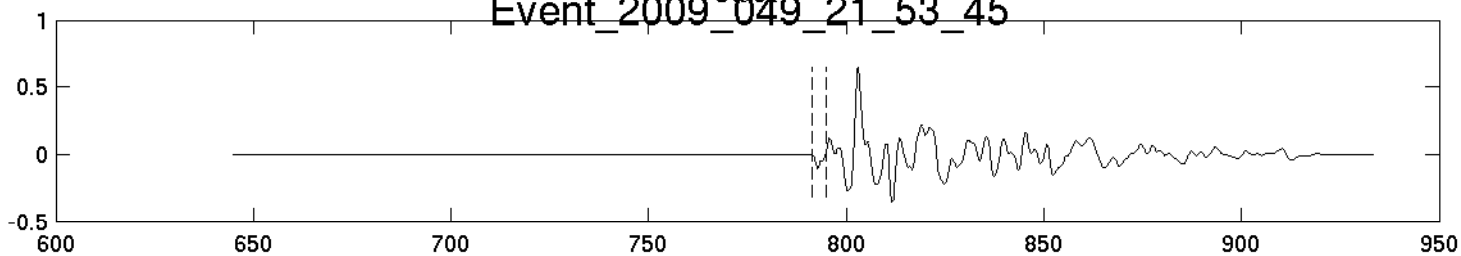


# Event\_2009\_049\_21\_53\_45

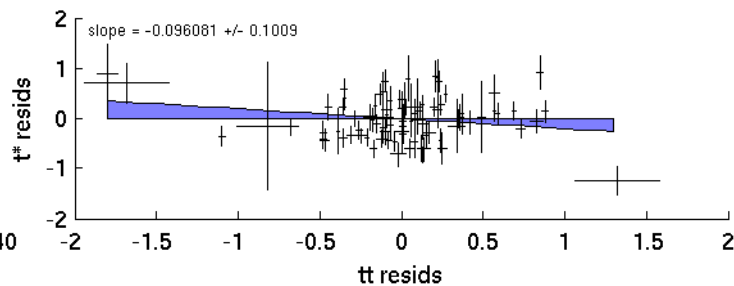
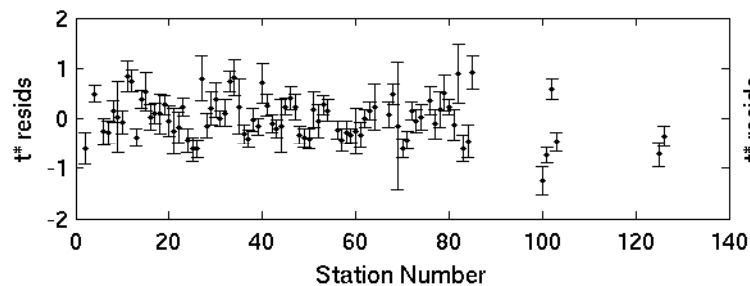




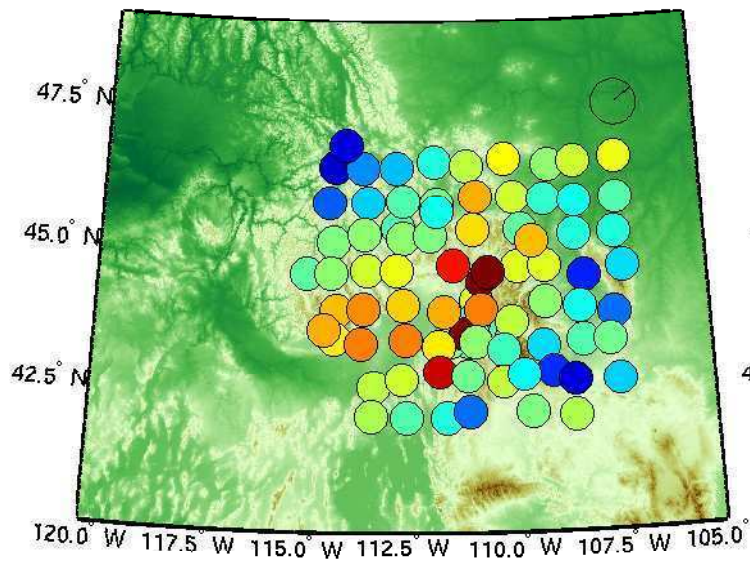
# Event\_2009\_049\_21\_53\_45



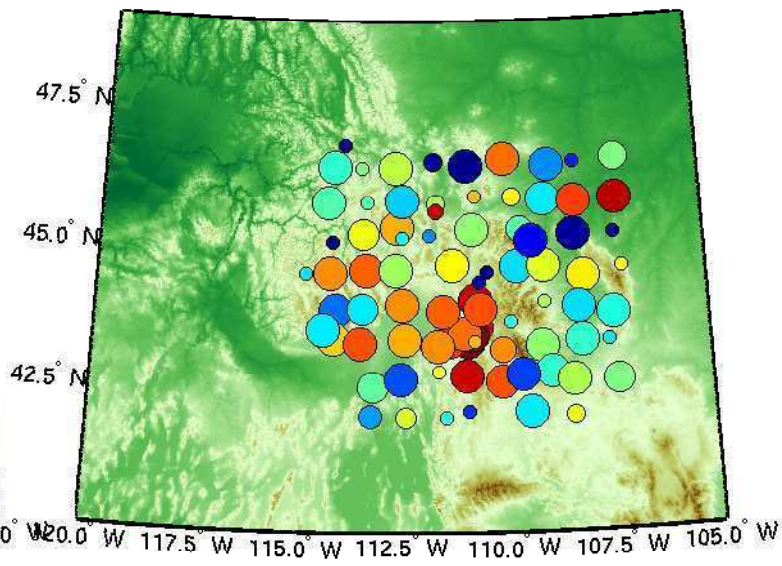
Baz = 233.9882  
 Mean xcor value = 0.91262  
 Range of  $t^*$  values is 2.1543  
 Median  $t^*$  err is 0.23186



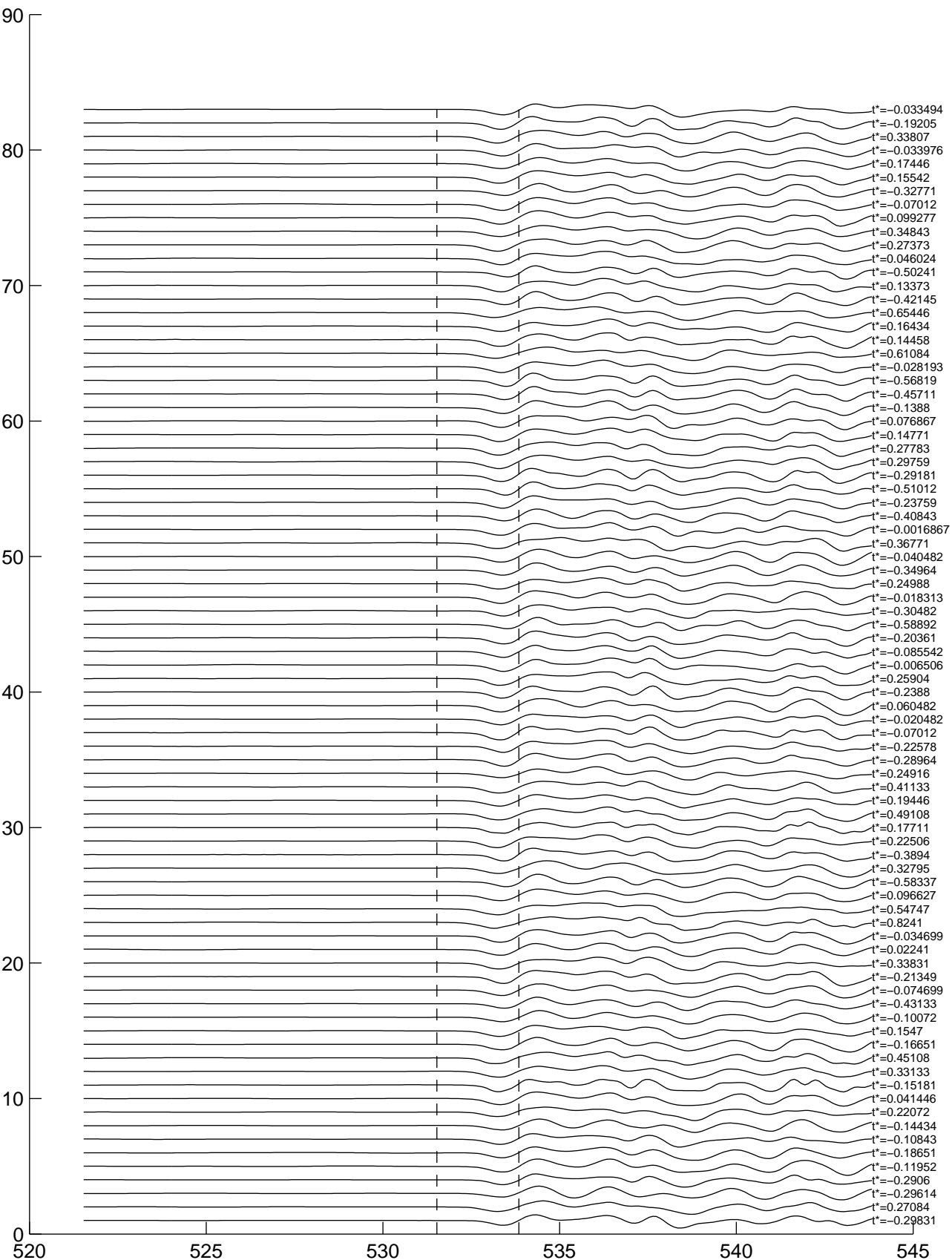
travel time residuals



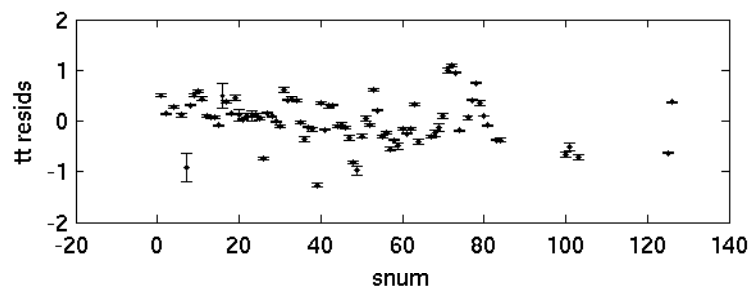
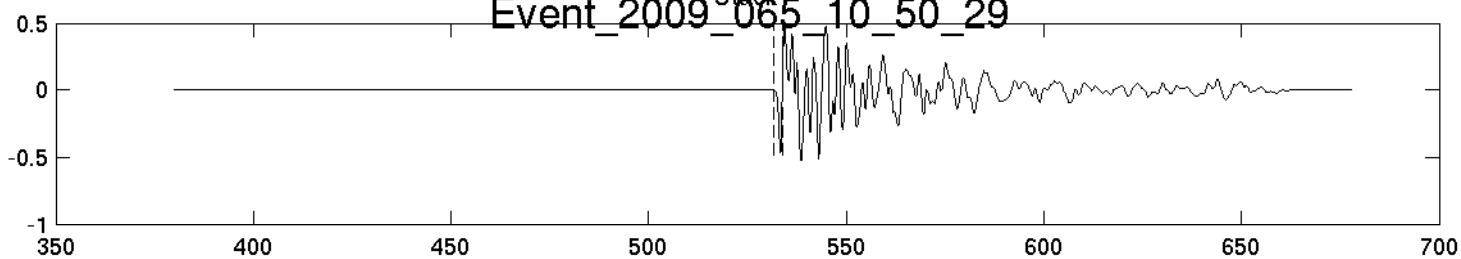
$t^*$  values



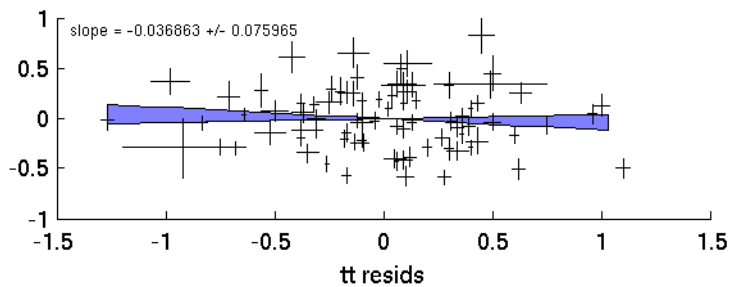
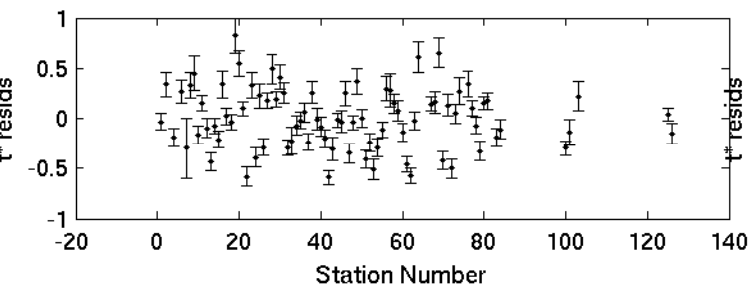
# Event\_2009\_065\_10\_50\_29



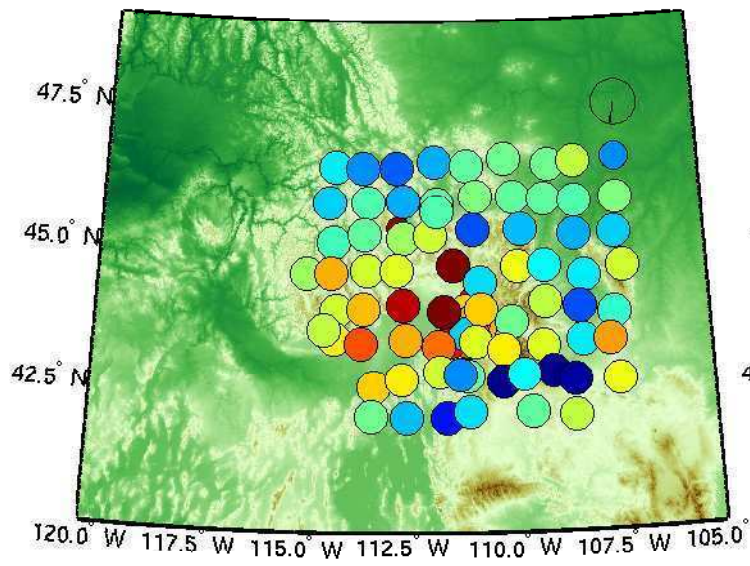
# Event\_2009\_065\_10\_50\_29



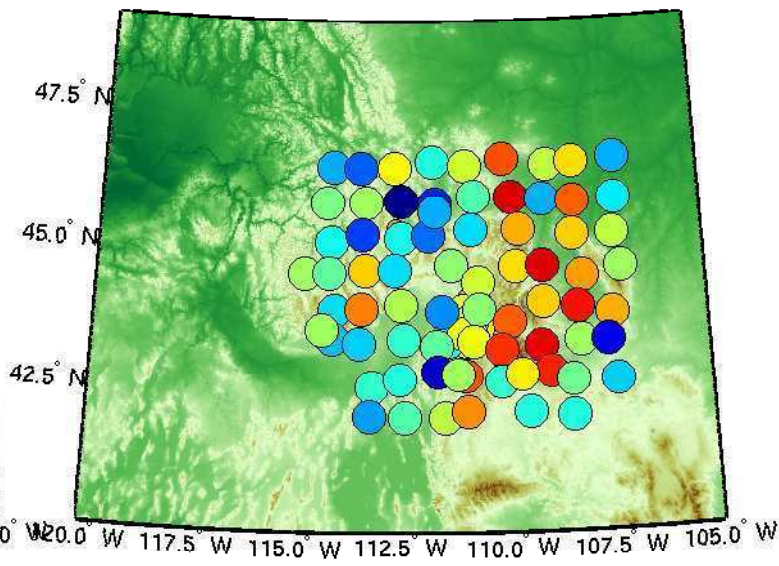
Baz = 12.0615  
 Mean xcor value = 0.80663  
 Range of  $t^*$  values is 1.413  
 Median  $t^*$  err is 0.093719



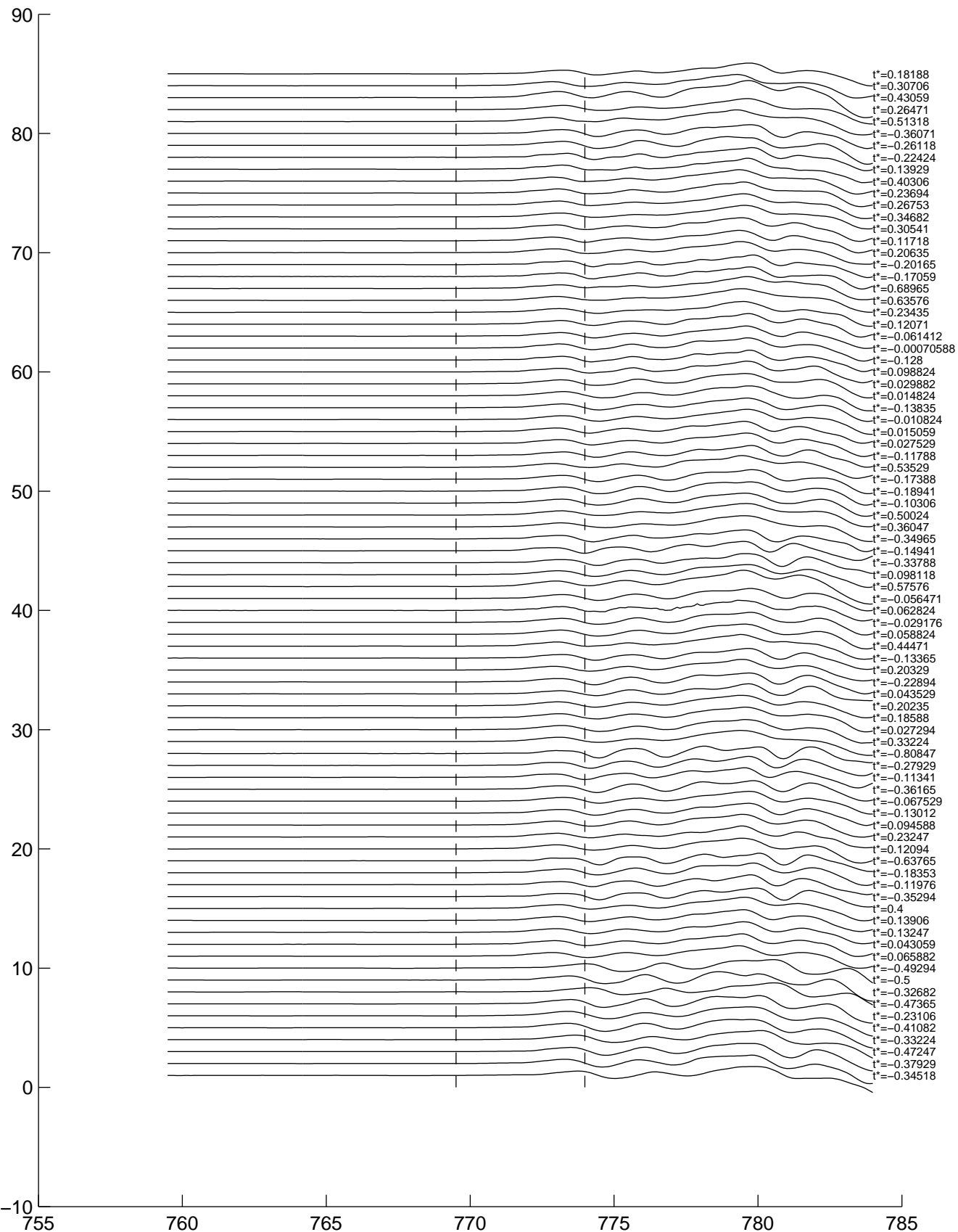
travel time residuals



$t^*$  values

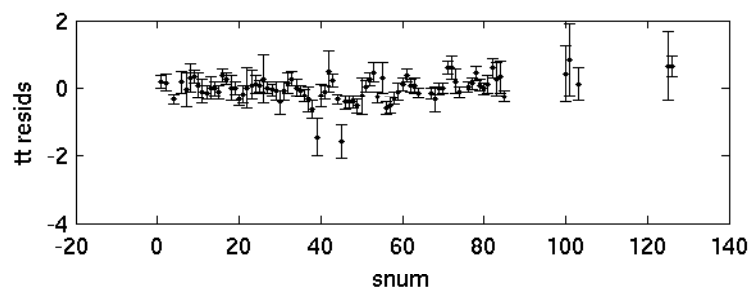
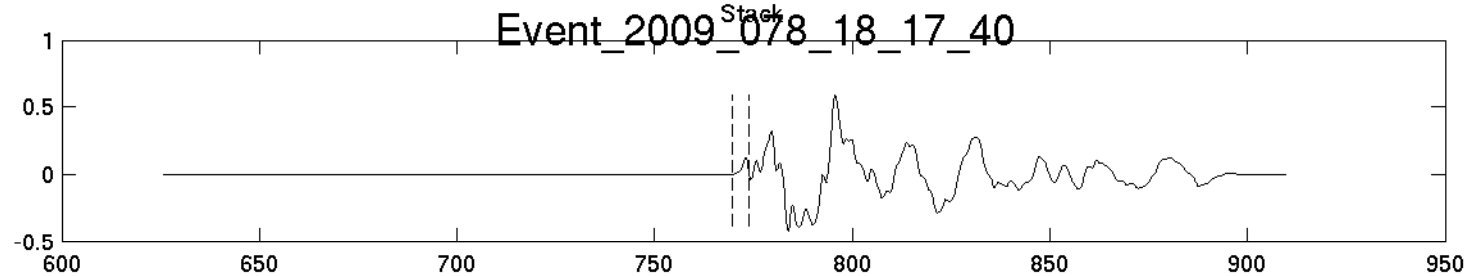


# Event\_2009\_078\_18\_17\_40

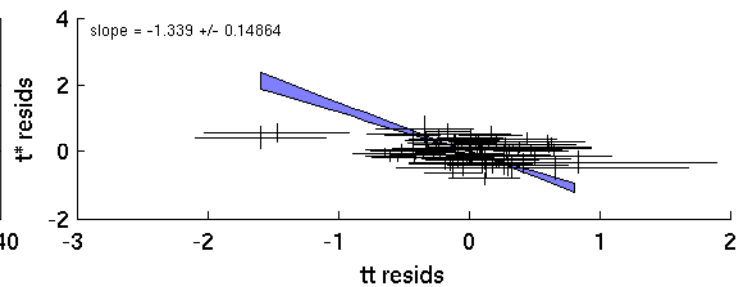
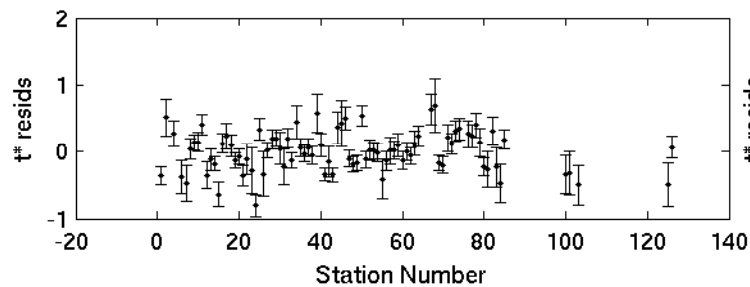




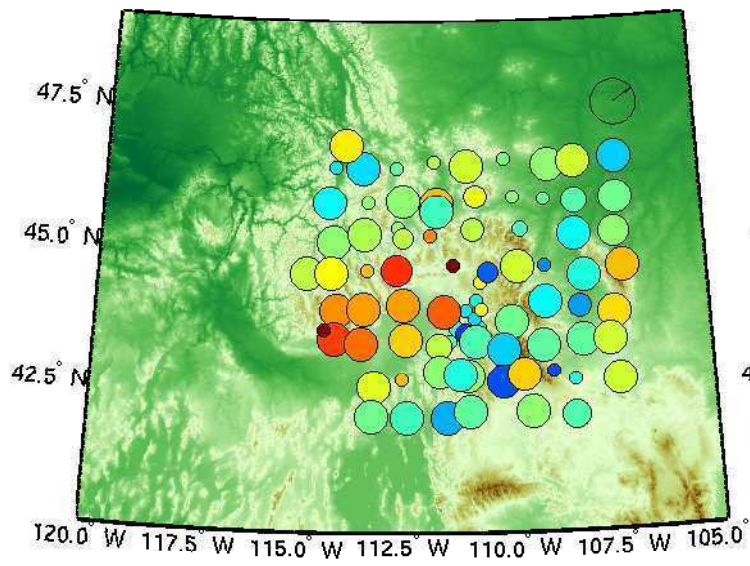
# Event\_2009\_078\_18\_17\_40



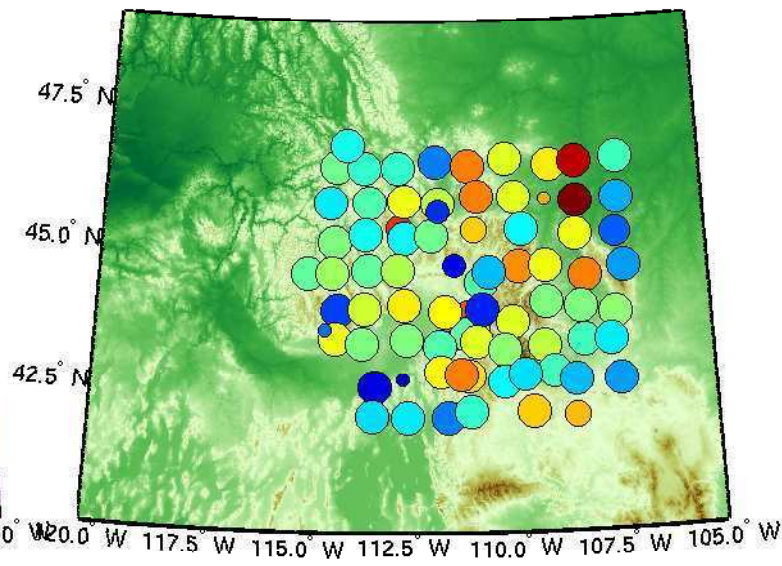
Baz = 235.6648  
 Mean xcor value = 0.91024  
 Range of  $t^*$  values is 1.4981  
 Median  $t^*$  err is 0.1624



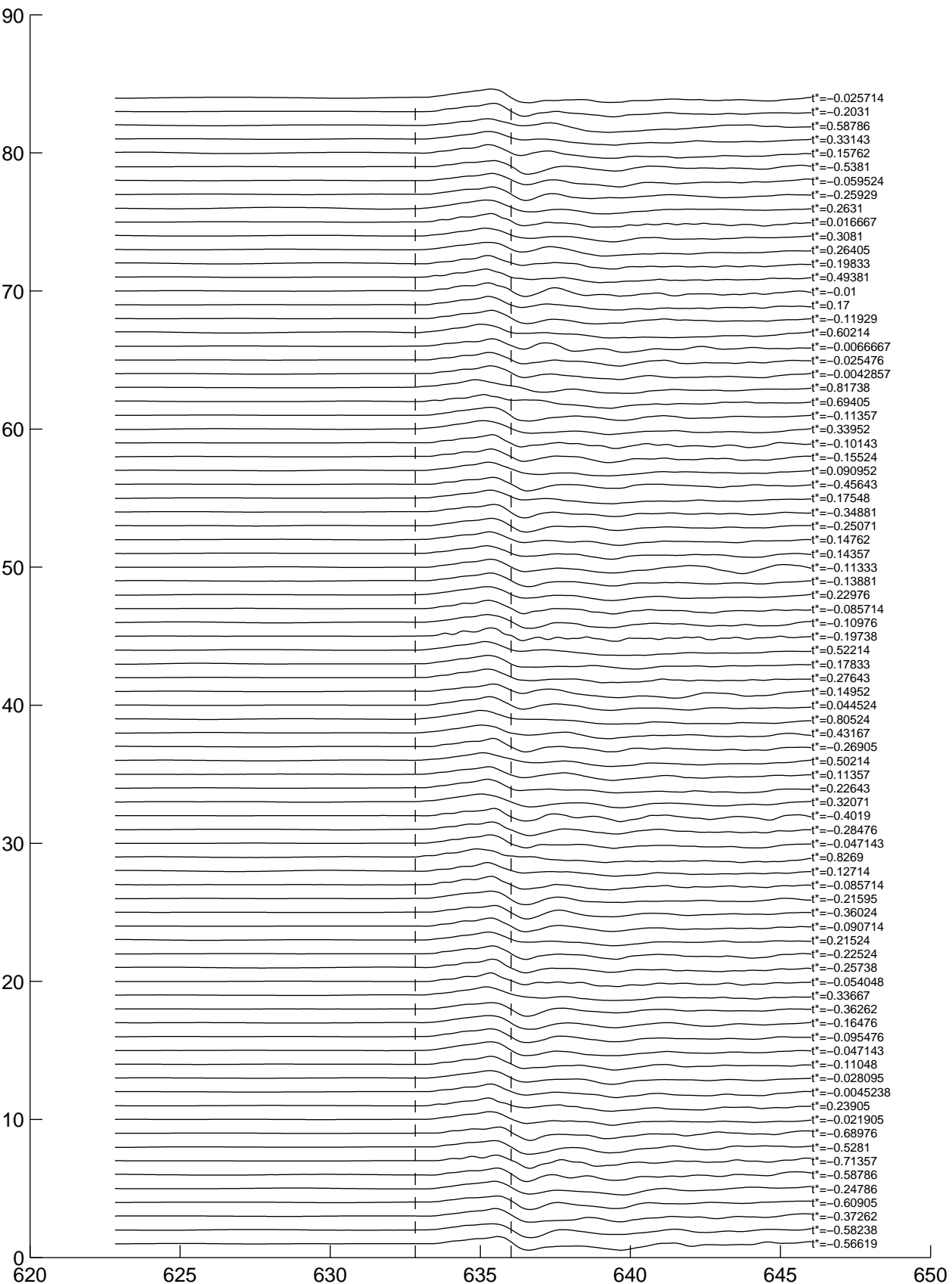
travel time residuals



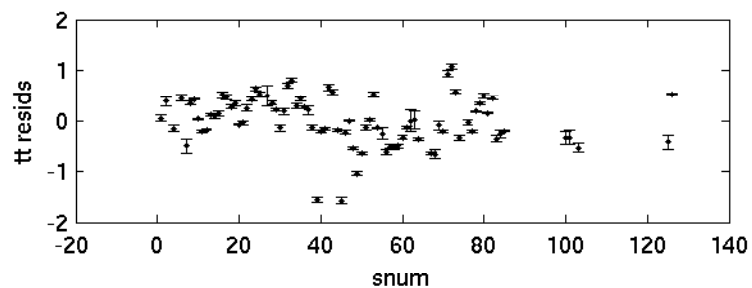
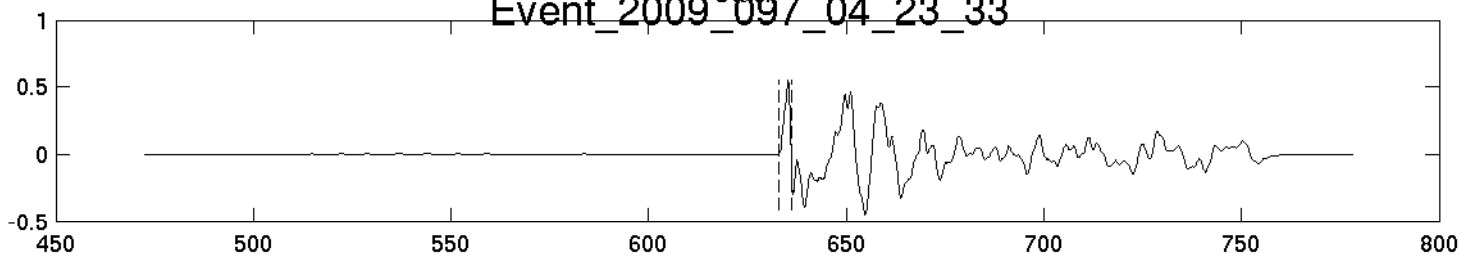
$t^*$  values



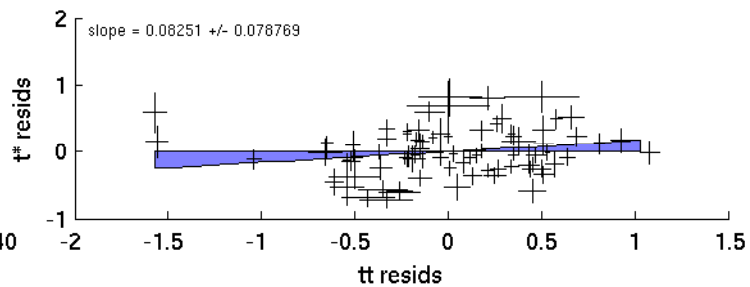
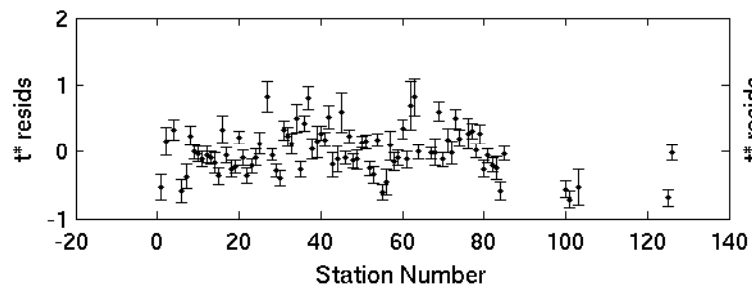
# Event\_2009\_097\_04\_23\_33



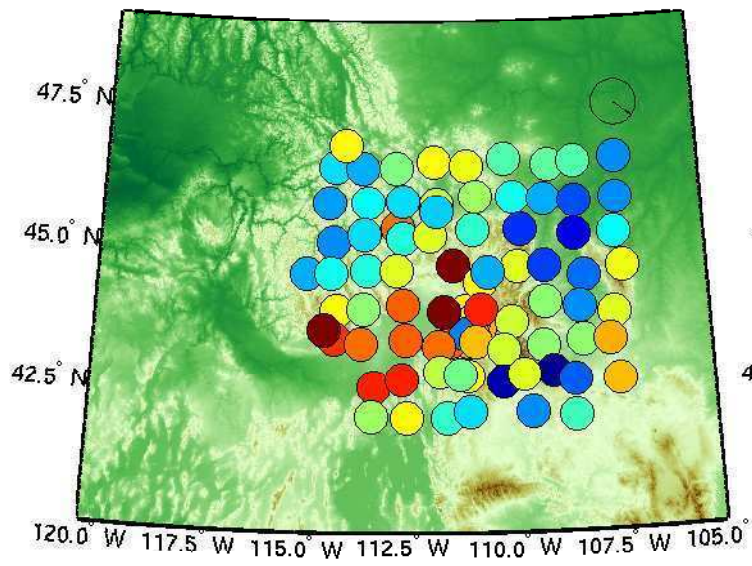
# Event\_2009\_097\_04\_23\_33



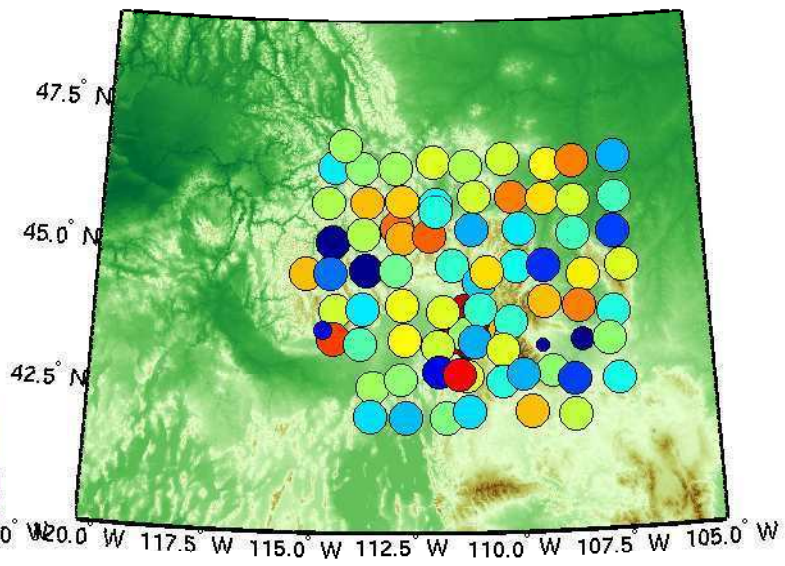
Baz = 310.0933  
 Mean xcor value = 0.90381  
 Range of  $t^*$  values is 1.5405  
 Median  $t^*$  err is 0.12535



travel time residuals

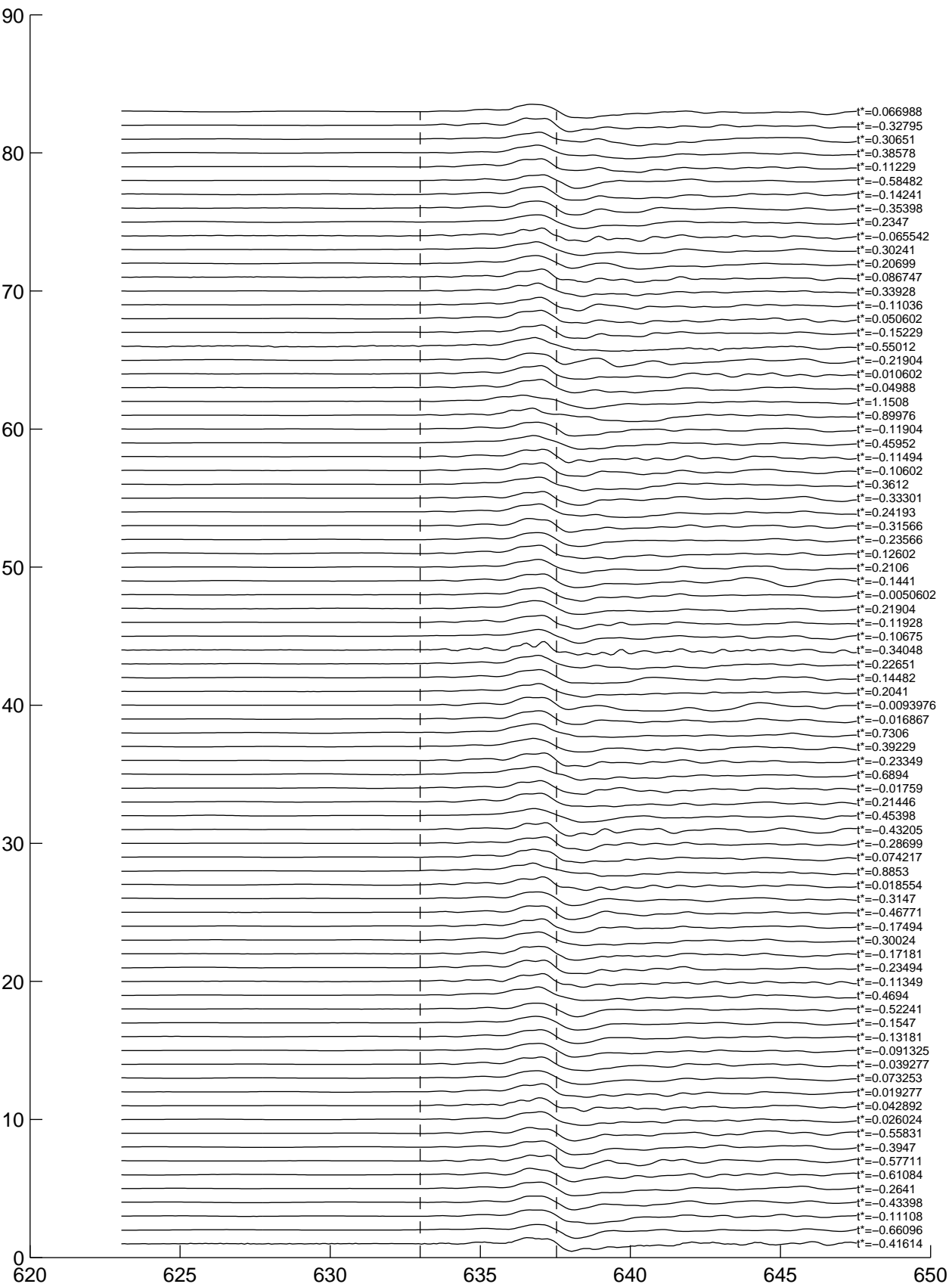


$t^*$  values

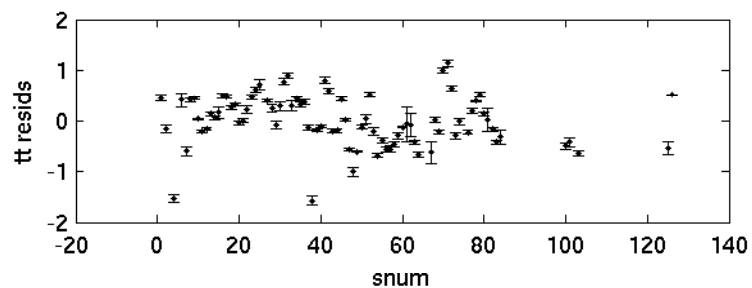
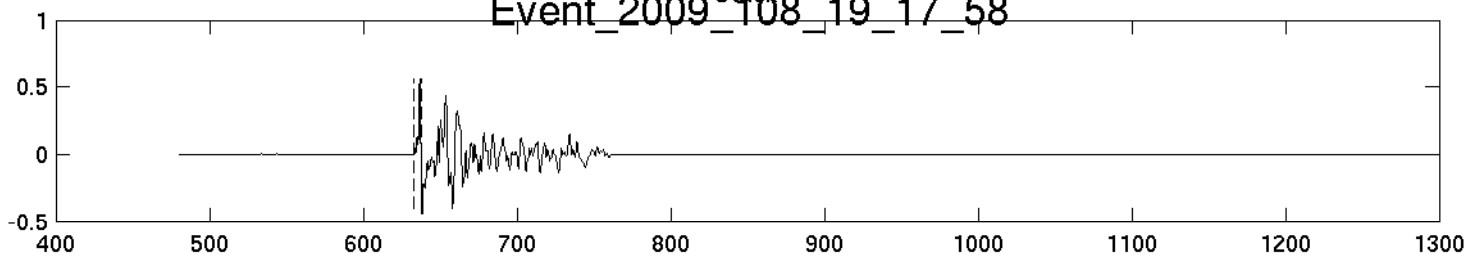




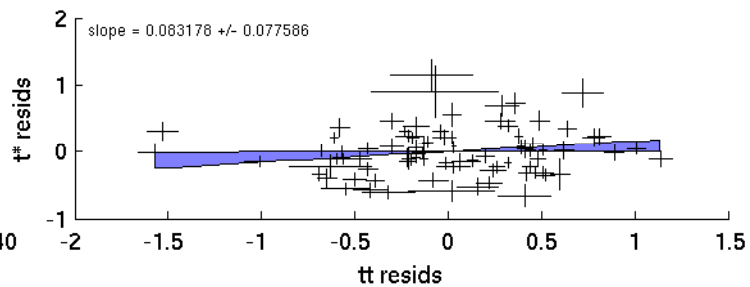
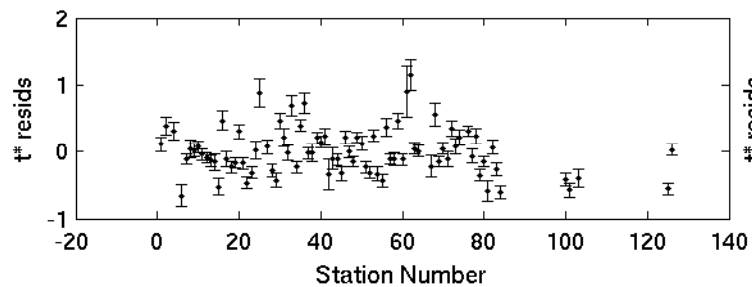
# Event\_2009\_108\_19\_17\_58



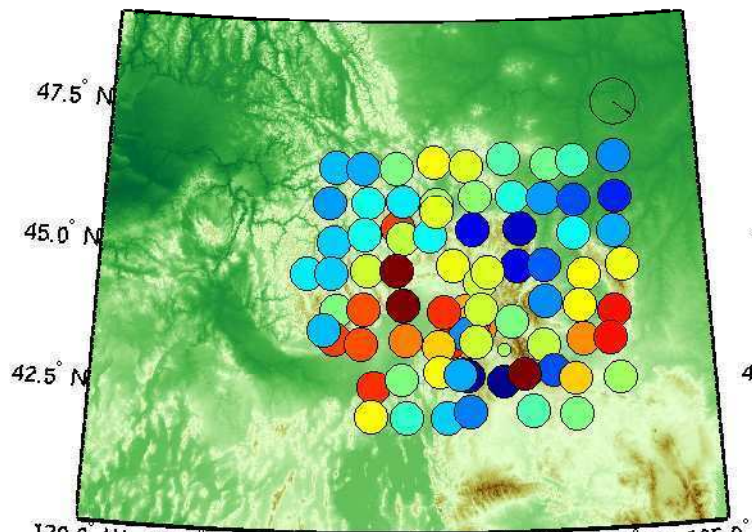
# Event\_2009\_108\_19\_17\_58<sup>Stack</sup>



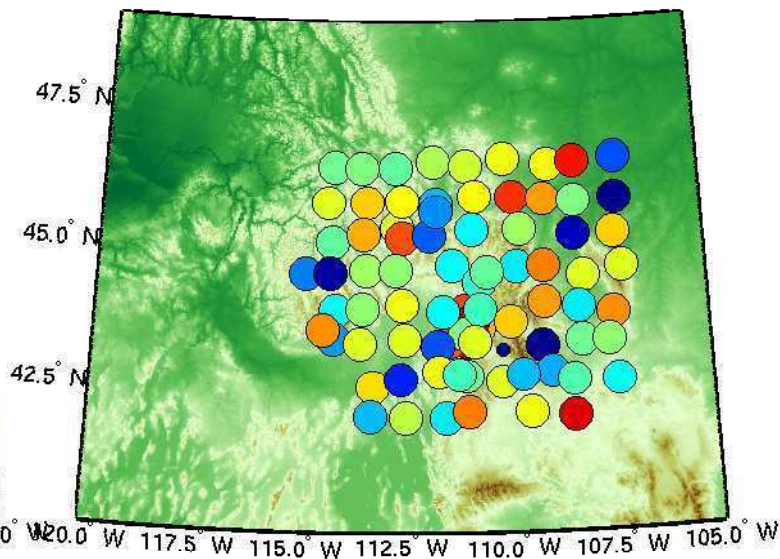
Baz = 310.121  
 Mean xcor value = 0.82976  
 Range of  $t^*$  values is 1.8118  
 Median  $t^*$  err is 0.098774



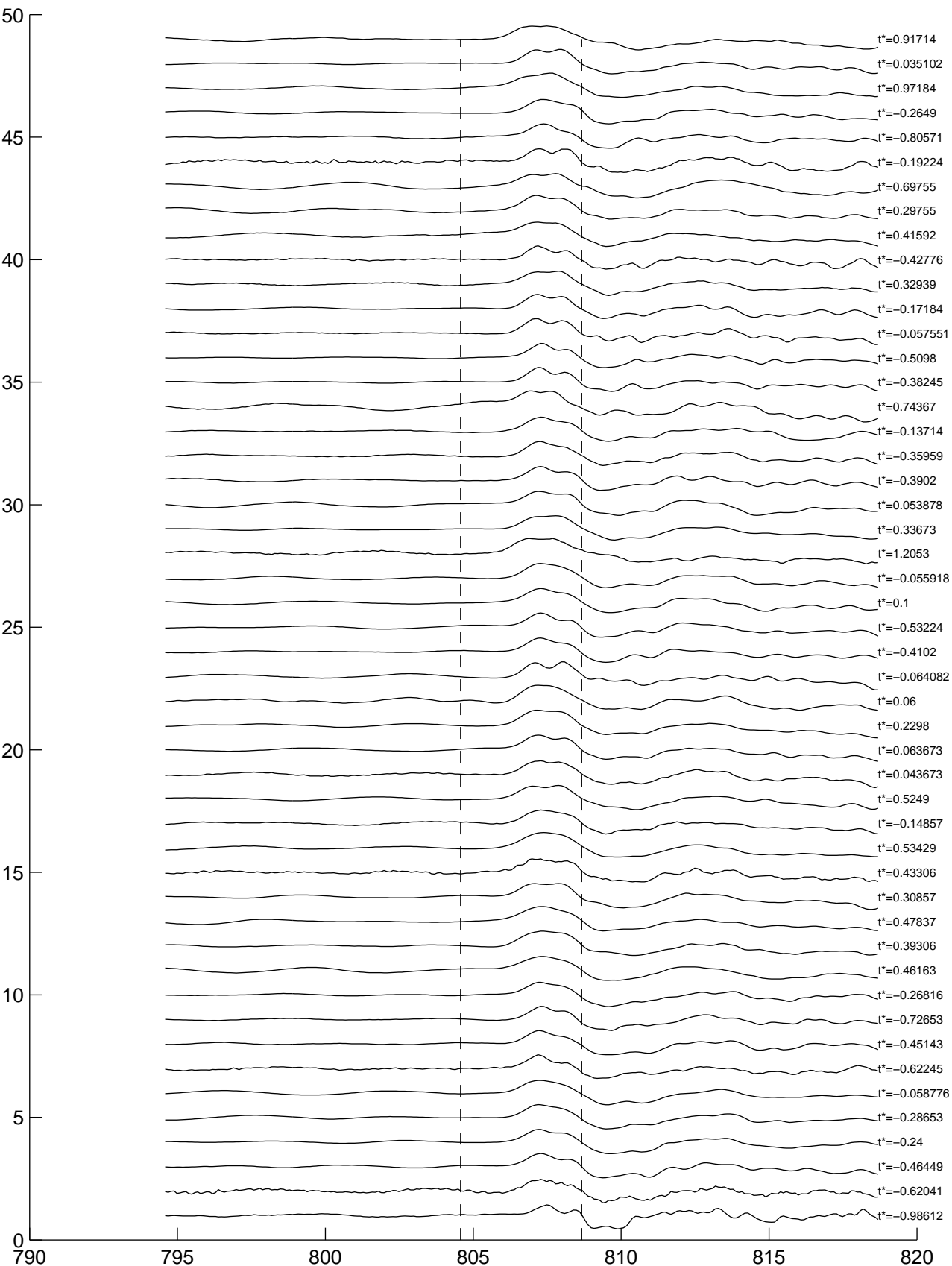
travel time residuals



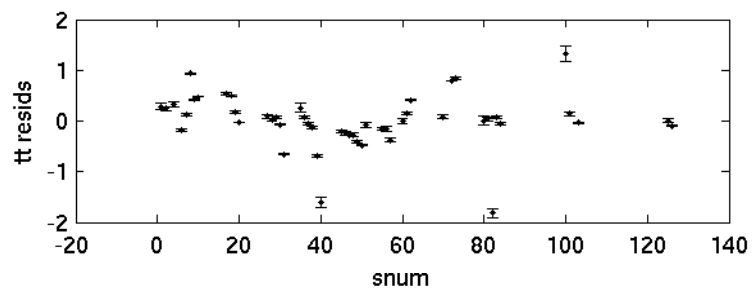
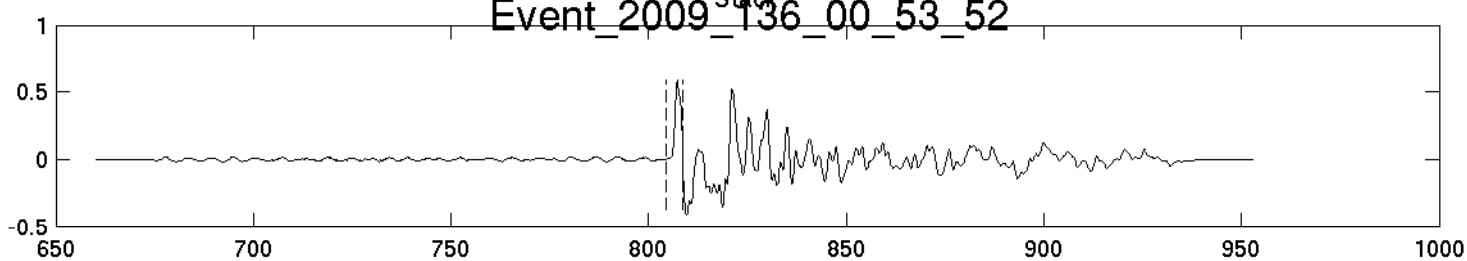
$t^*$  values



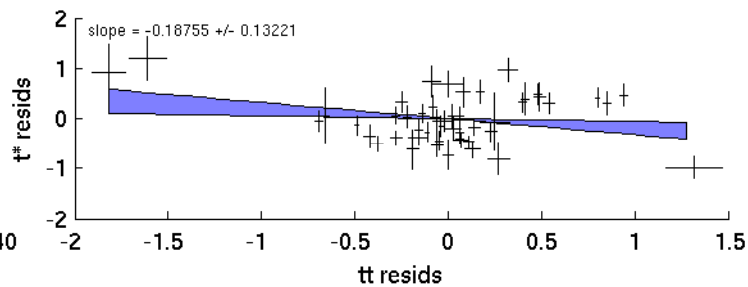
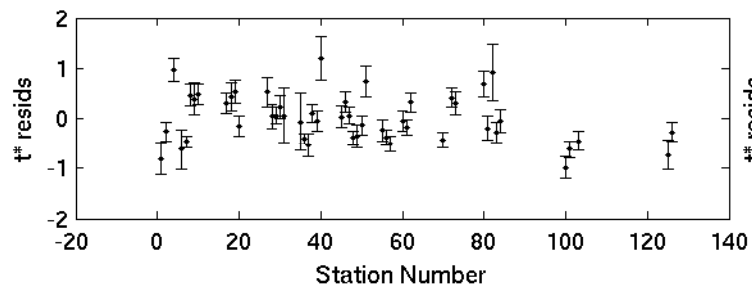
# Event\_2009\_136\_00\_53\_52



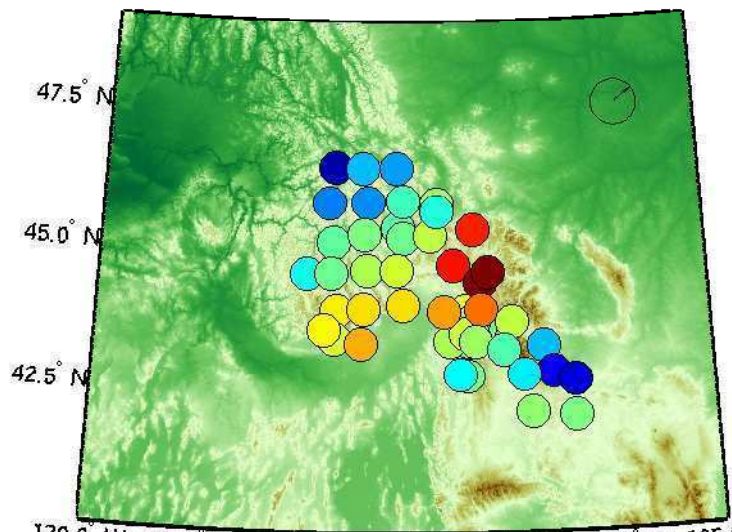
# Event\_2009\_136\_00\_53\_52



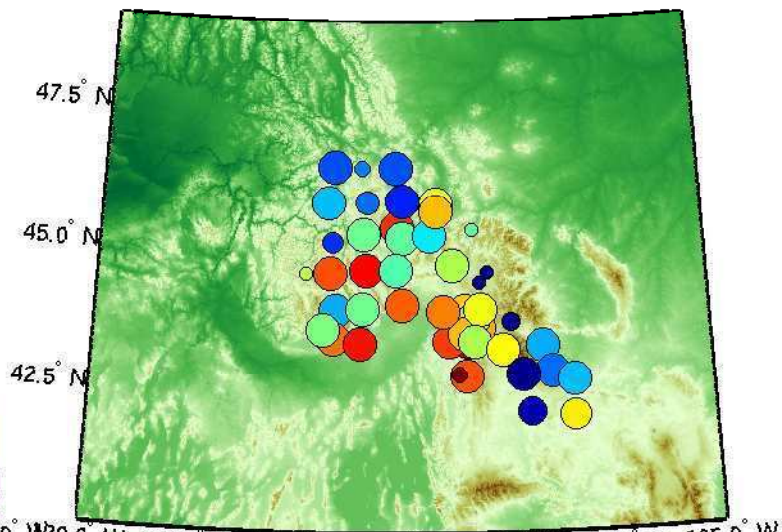
Baz = 232.2934  
 Mean xcor value = 0.84469  
 Range of  $t^*$  values is 2.1914  
 Median  $t^*$  err is 0.21652



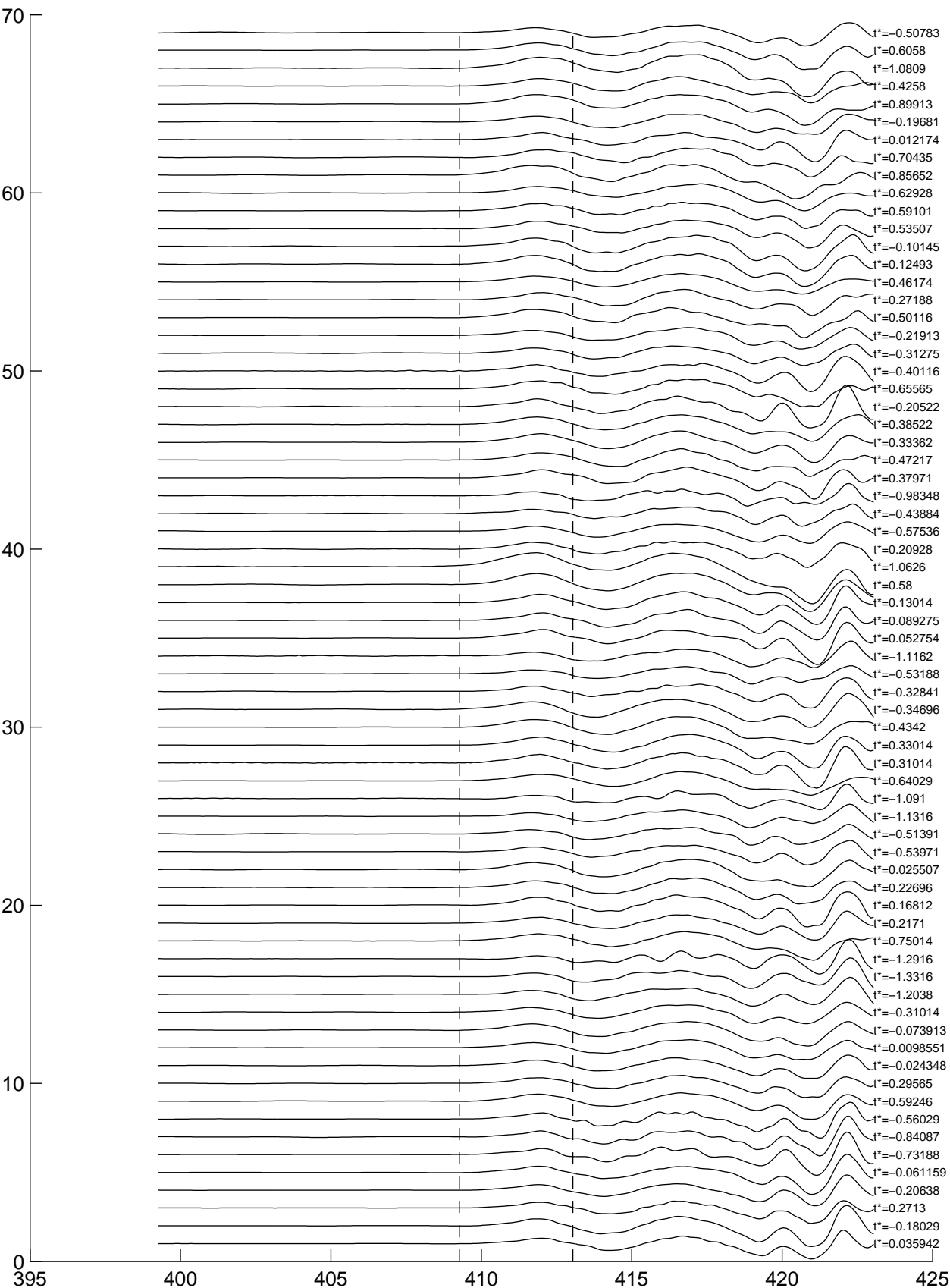
travel time residuals



$t^*$  values

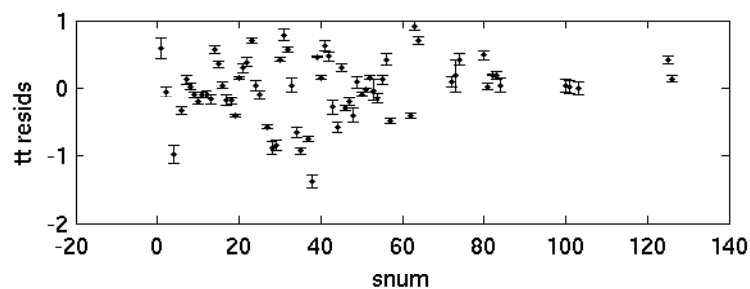
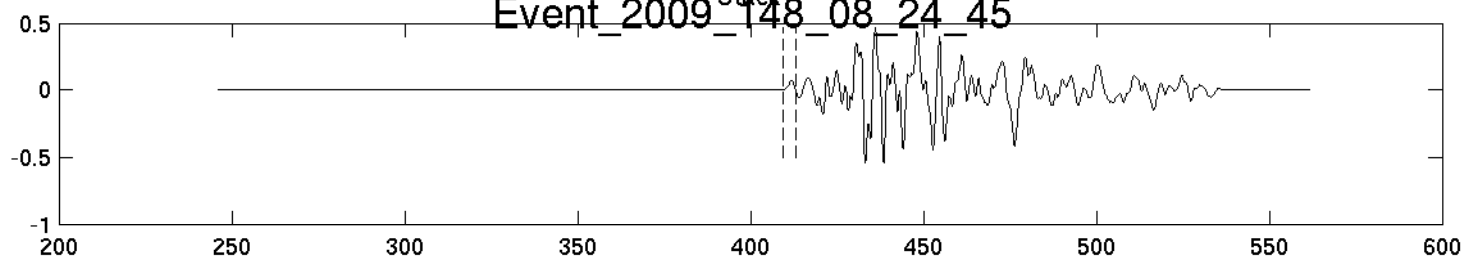


# Event\_2009\_148\_08\_24\_45

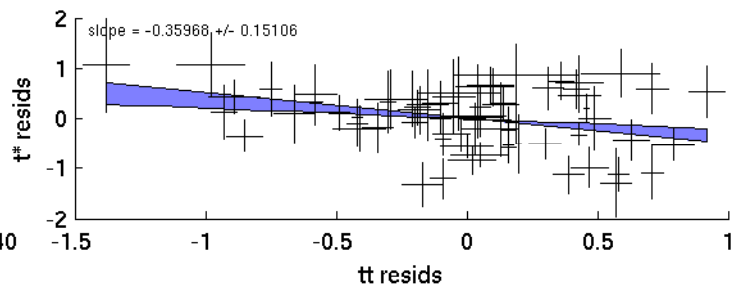
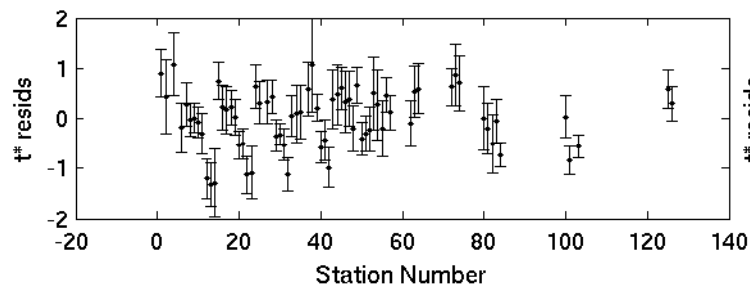




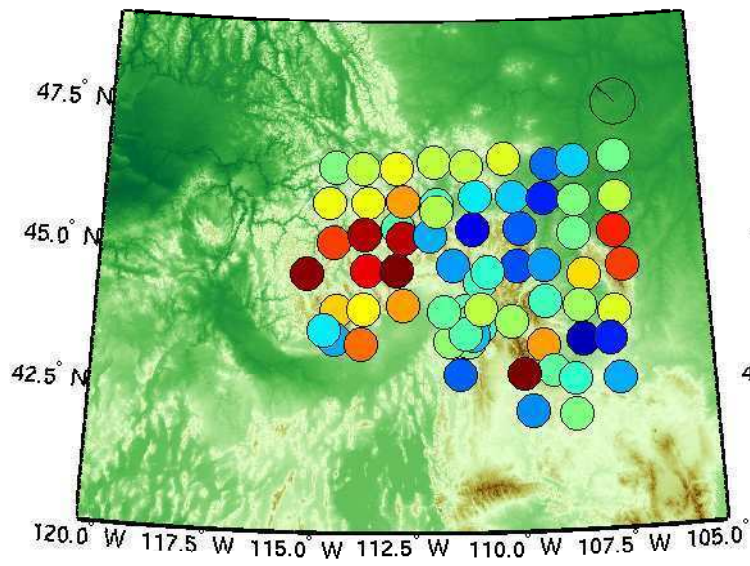
Event\_2009\_148\_08\_24\_45<sup>Stack</sup>



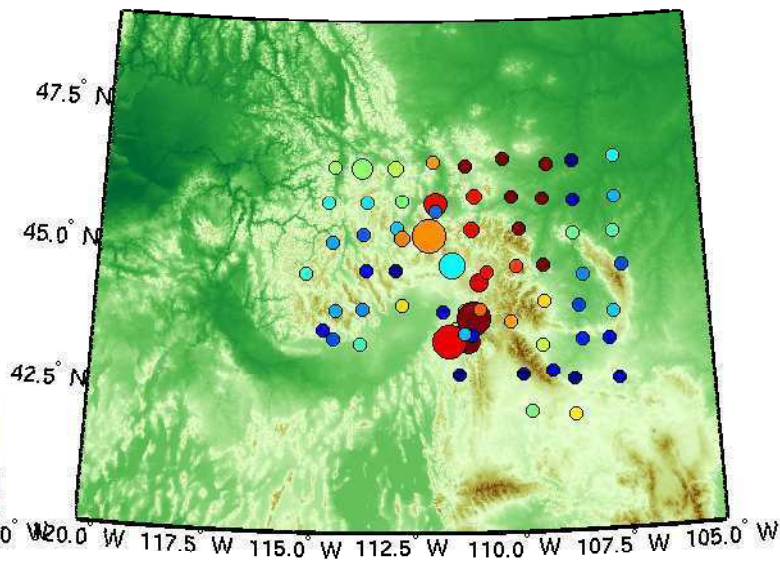
Baz = 135.8256  
Mean xcor value = 0.78913  
Range of  $t^*$  values is 2.4125  
Median  $t^*$  err is 0.42471



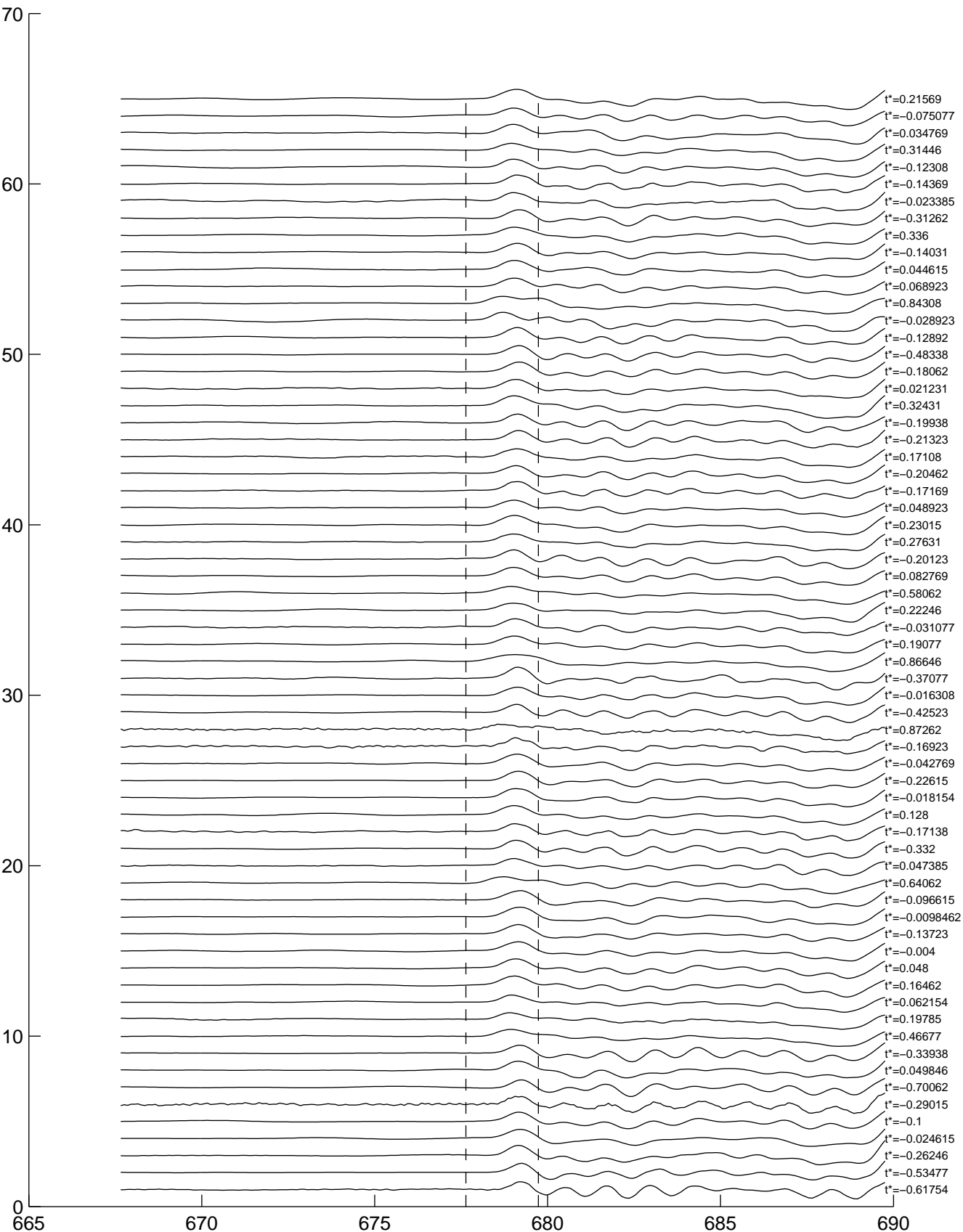
travel time residuals



$t^*$  values

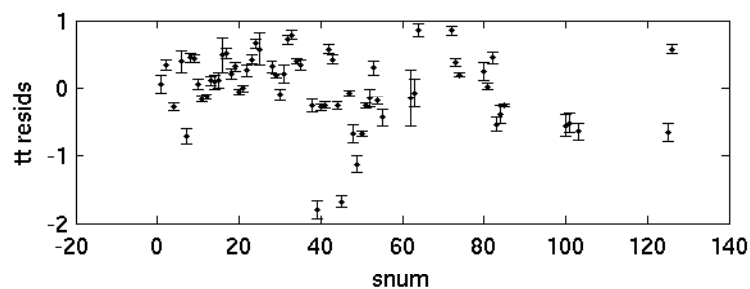
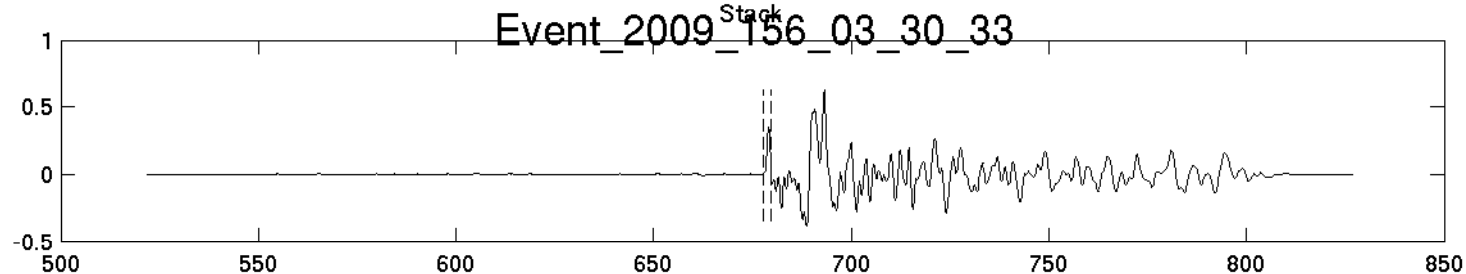


Event\_2009\_156\_03\_30\_33

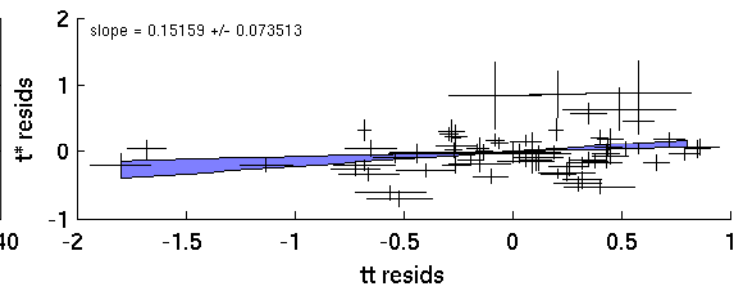
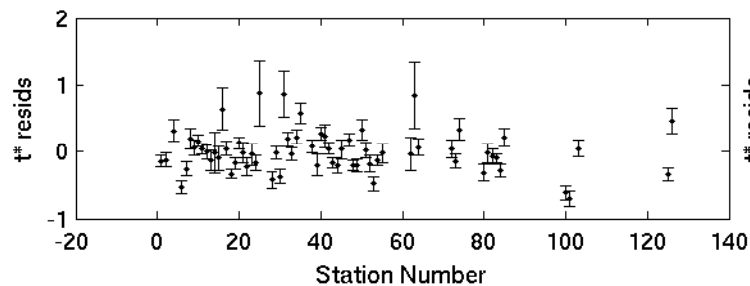




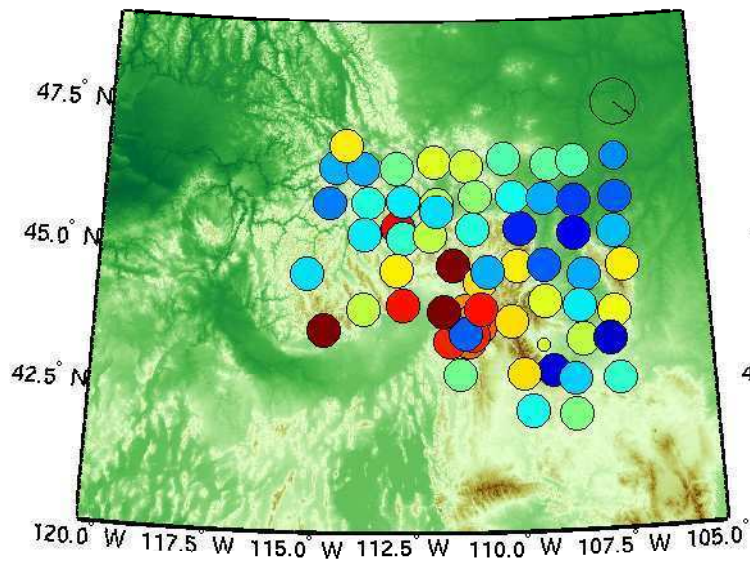
# Event\_2009\_156\_03\_30\_33



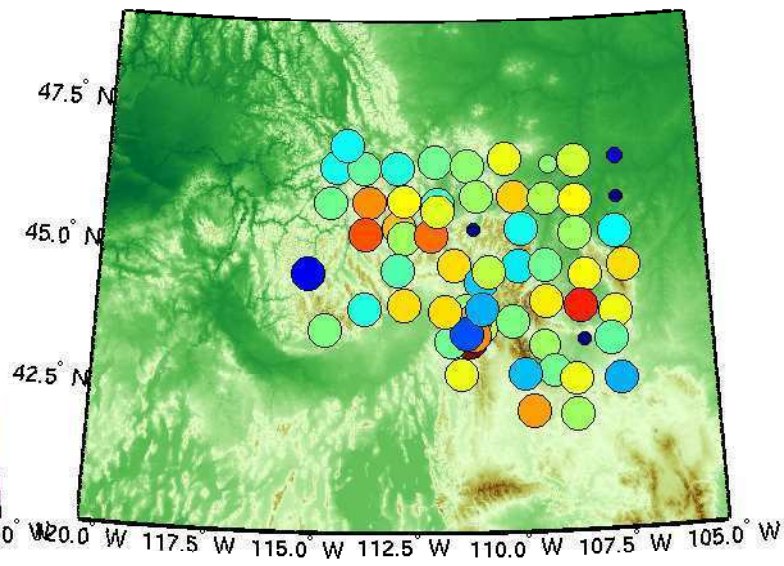
Baz = 310.8841  
 Mean xcor value = 0.86385  
 Range of  $t^*$  values is 1.5732  
 Median  $t^*$  err is 0.11199



travel time residuals



$t^*$  values



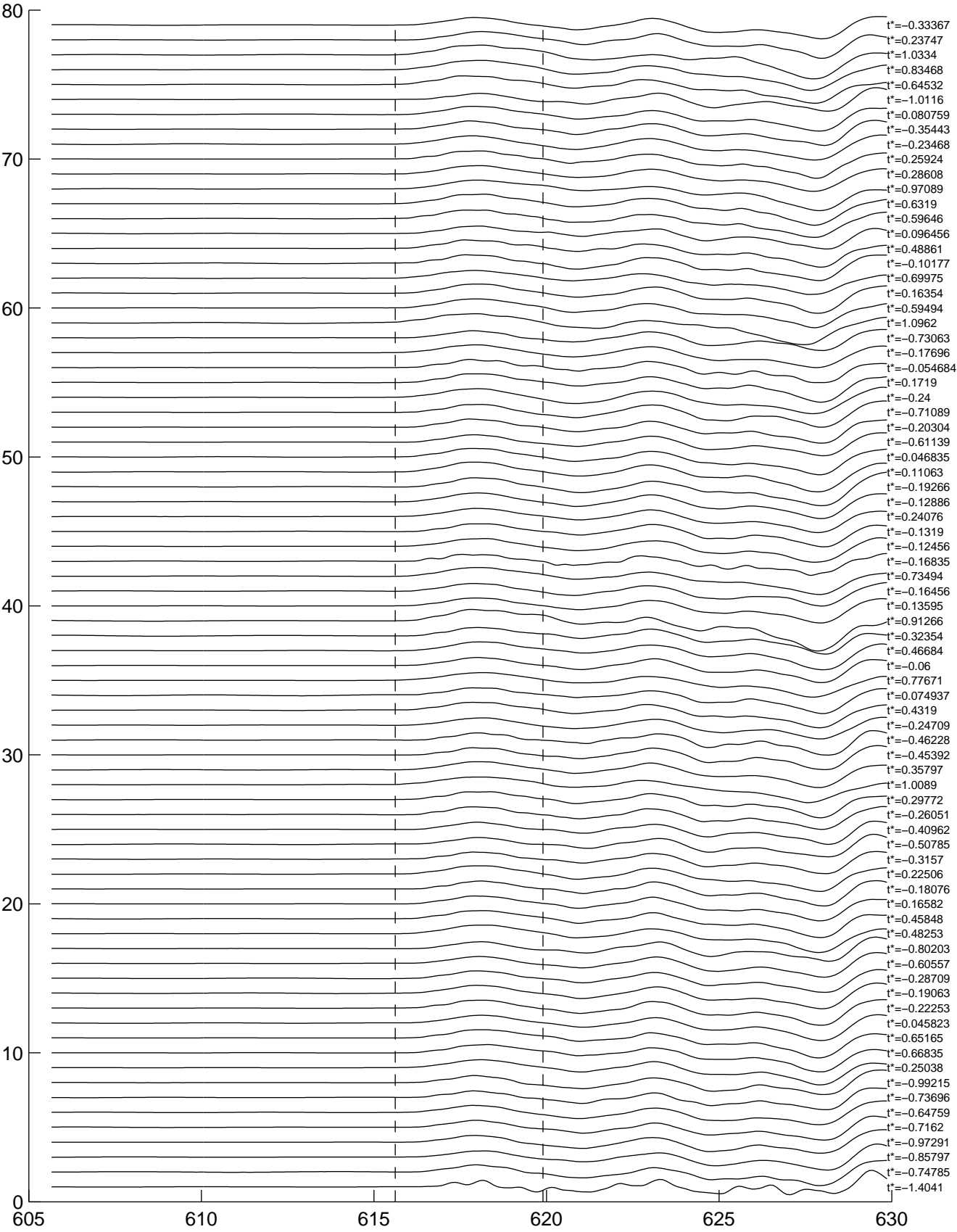
## Appendix V

### TESTING FOR $t^*$ ROBUSTNESS

## CATEGORY 1

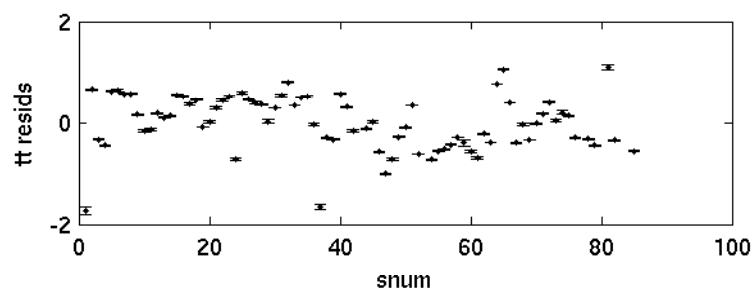
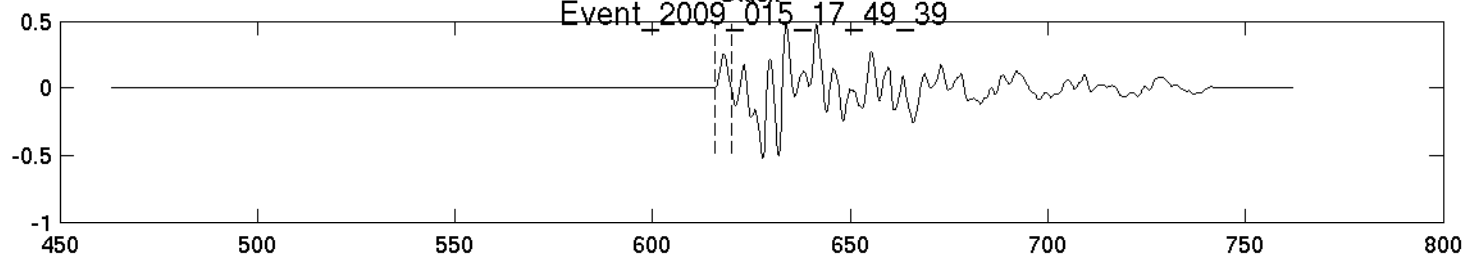
### THE SELECTION OF THE FIRST PULSE

Event\_2009\_015\_17\_49\_39

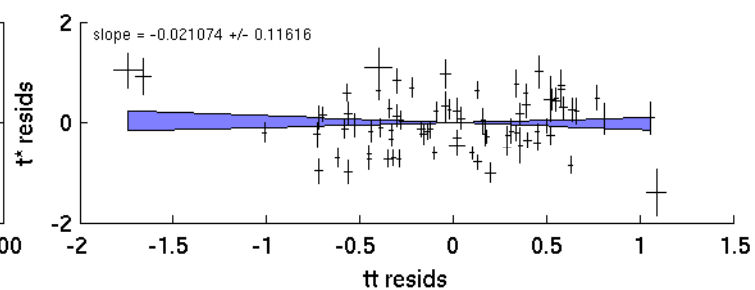
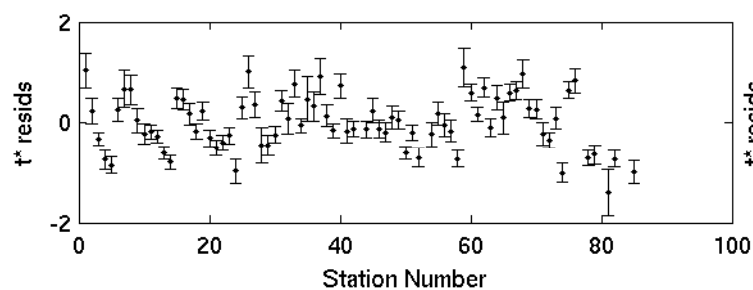


Event 2009\_015\_17\_49\_39

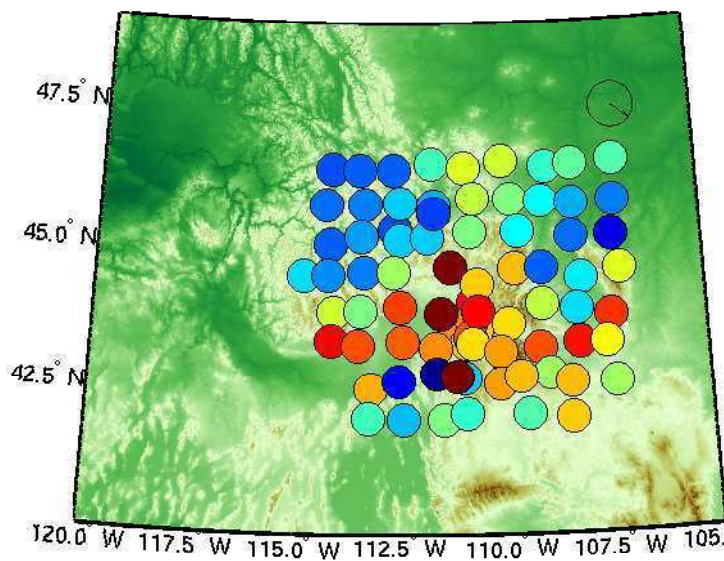
Stack



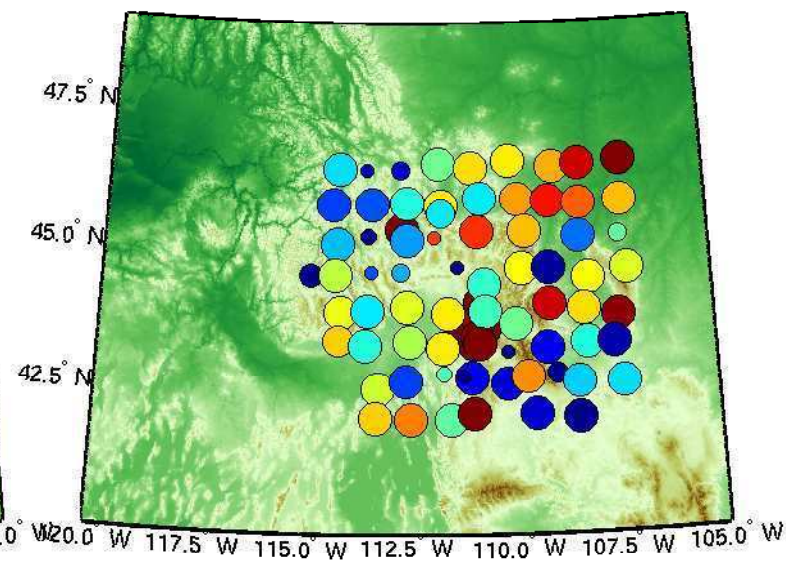
Baz = 309.043  
Mean xcor value = 0.89747  
Range of t\* values is 2.5003  
Median t\* err is 0.19986



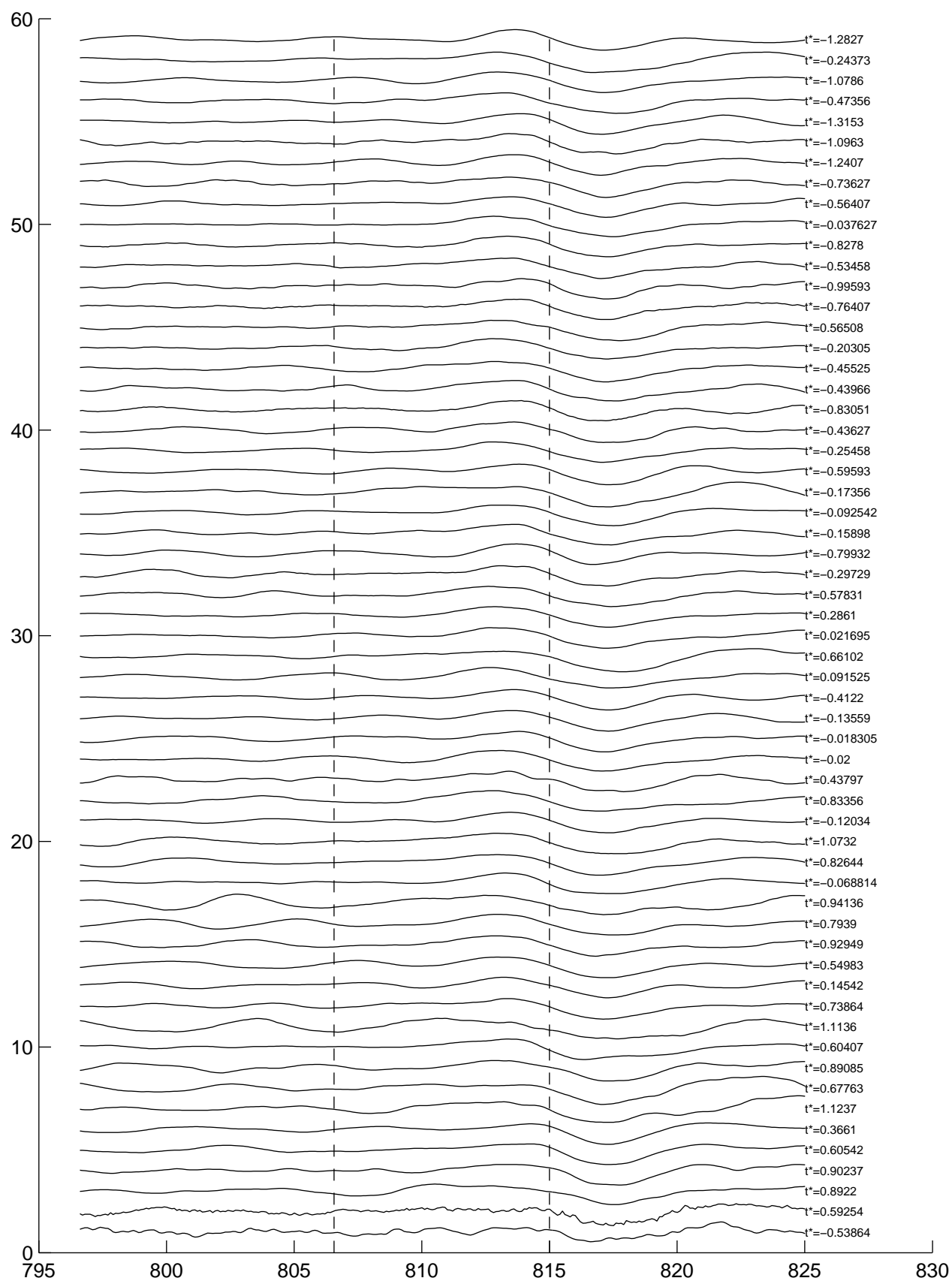
travel time residuals



t\* values



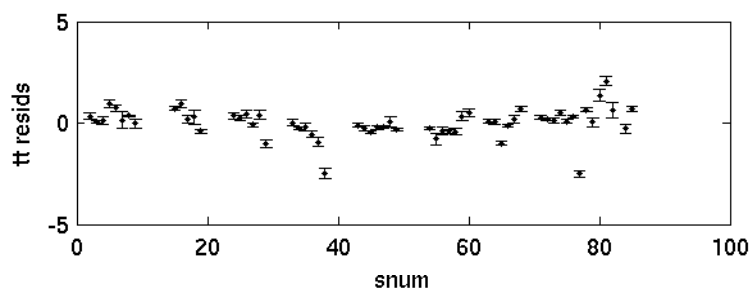
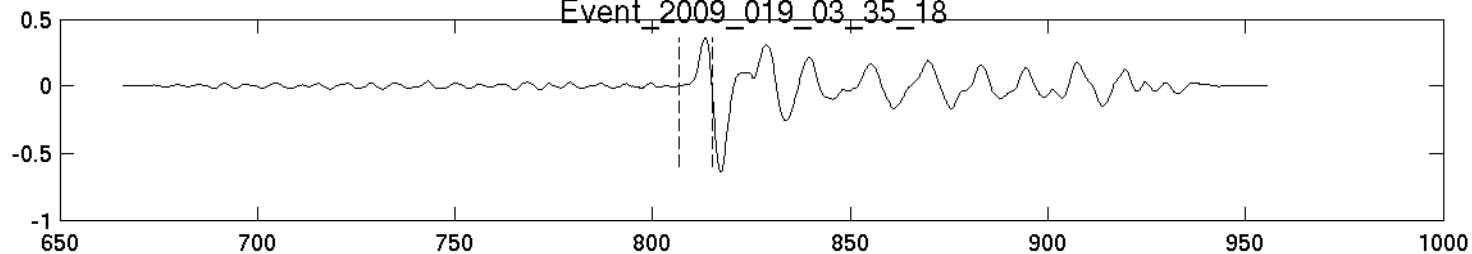
# Event\_2009\_019\_03\_35\_18



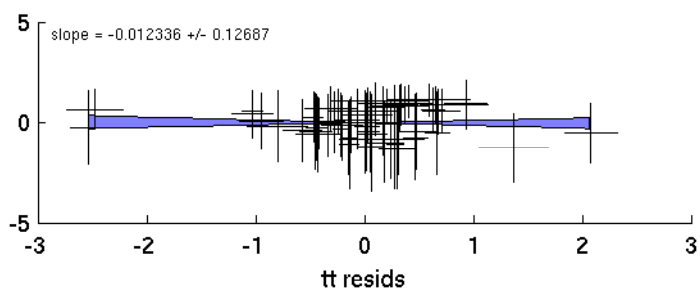
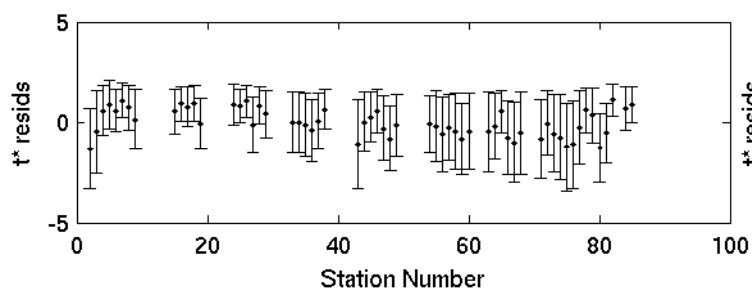


# Event 2009\_019\_03\_35\_18

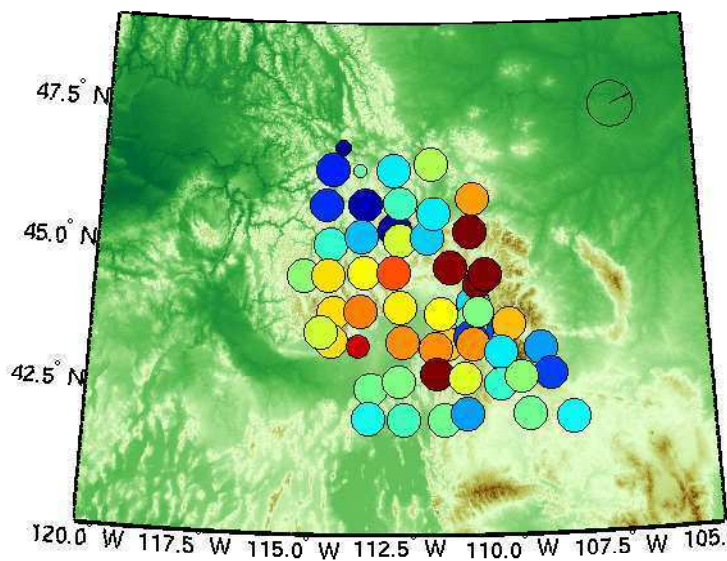
Stack



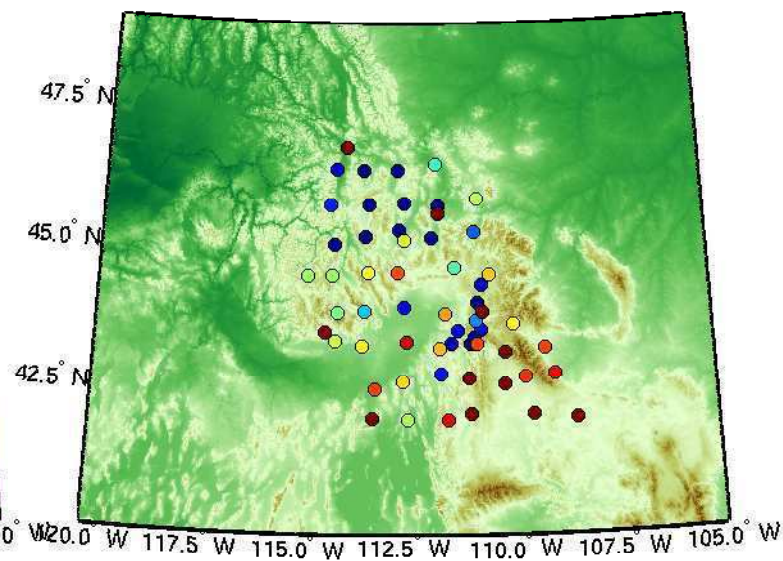
Baz = 245.8635  
Mean xcor value = 0.83102  
Range of t\* values is 2.439  
Median t\* err is 1.5039



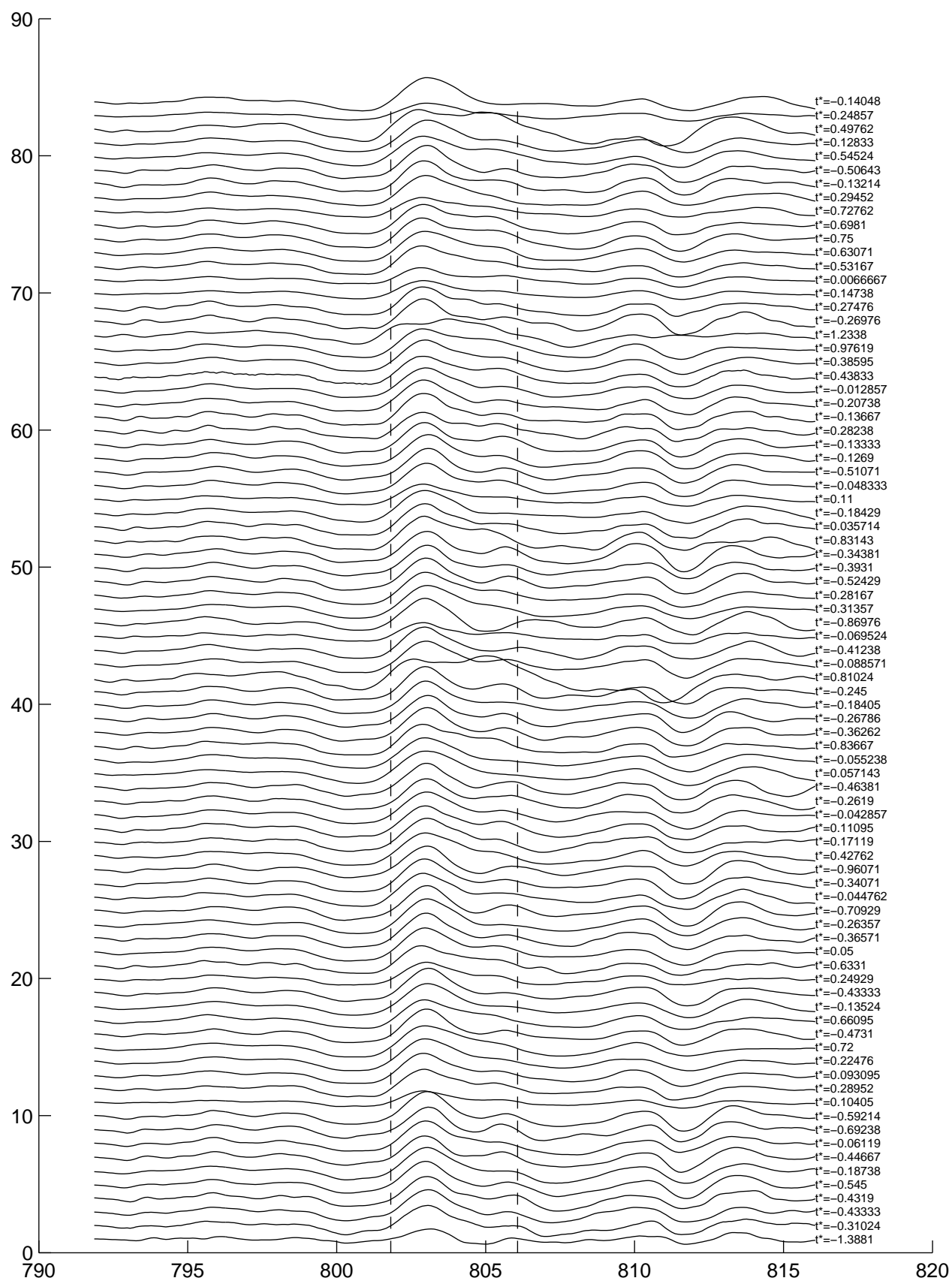
travel time residuals



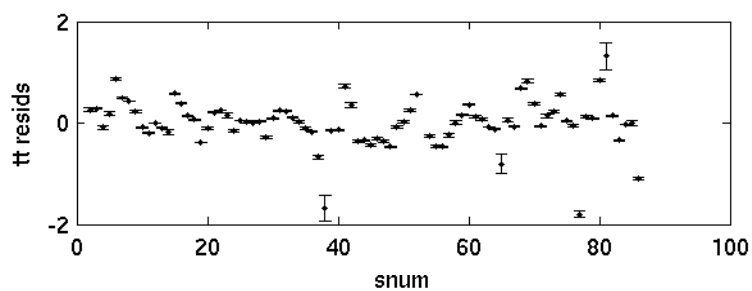
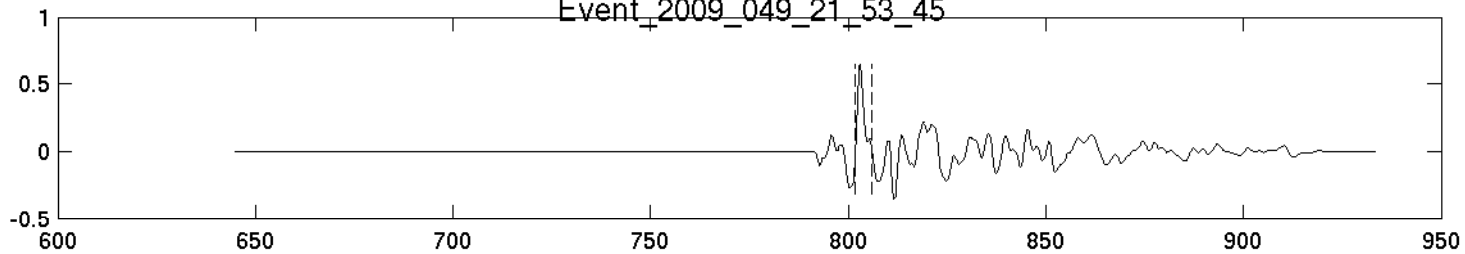
t\* values



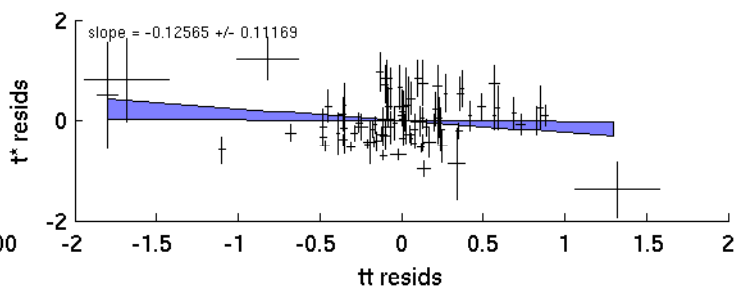
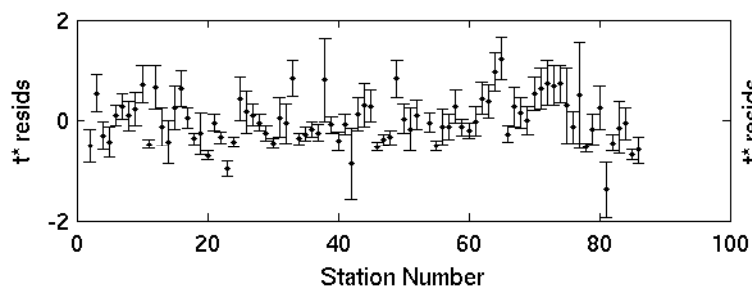
# Event\_2009\_049\_21\_53\_45



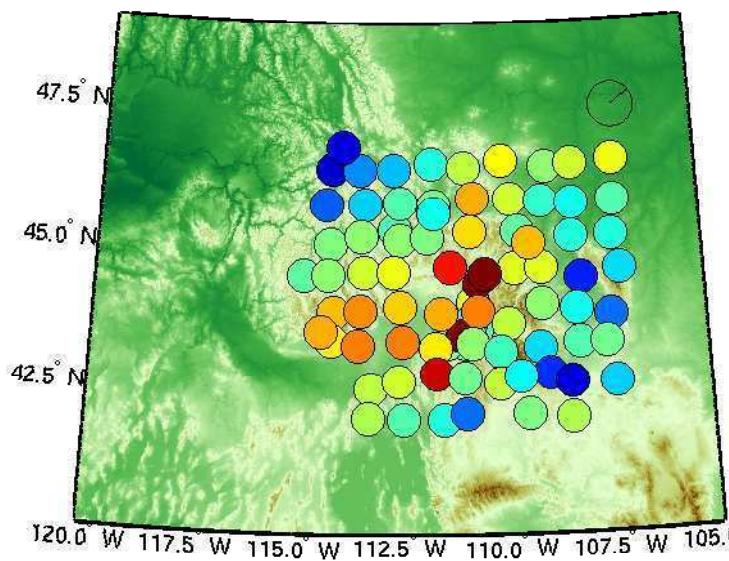
Stack  
Event\_2009\_049\_21\_53\_45



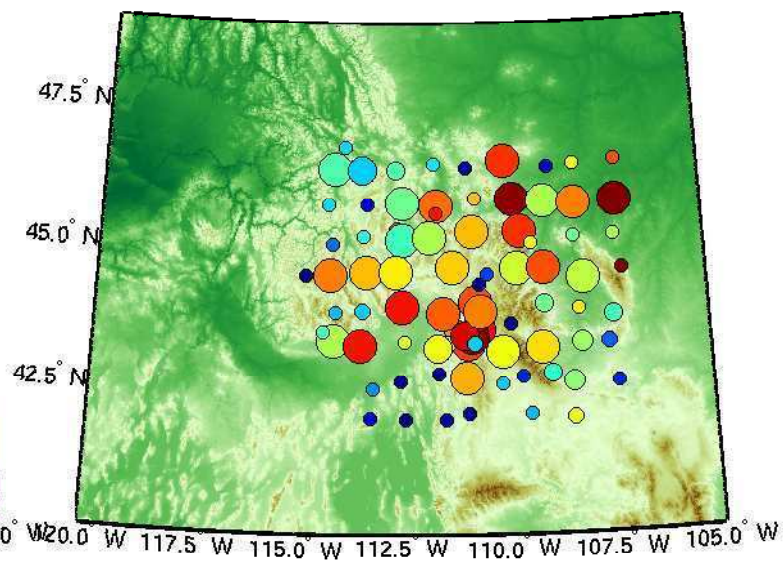
Baz = 234.0821  
Mean xcor value = 0.91262  
Range of  $t^*$  values is 2.6219  
Median  $t^*$  err is 0.30911



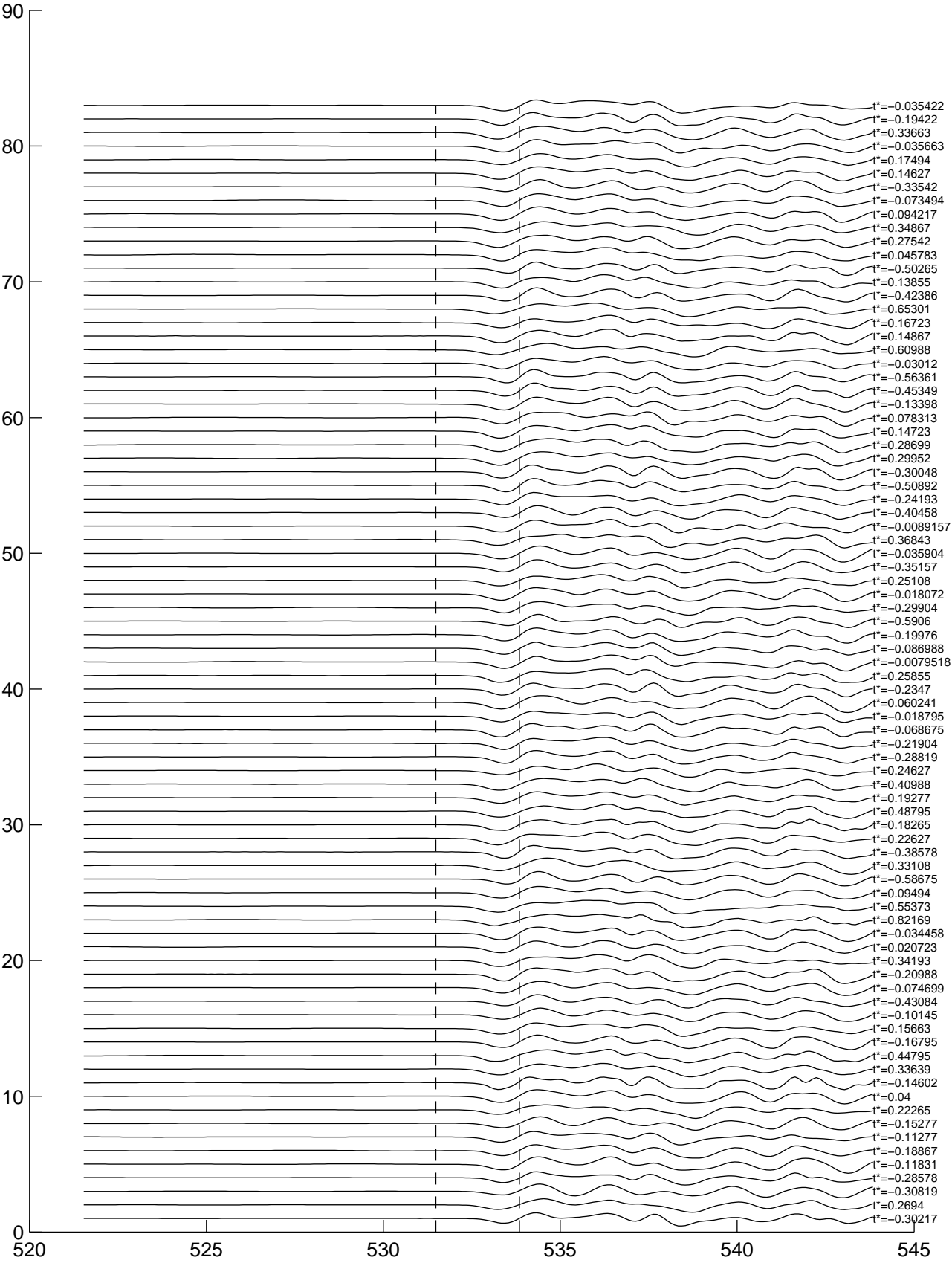
travel time residuals



$t^*$  values



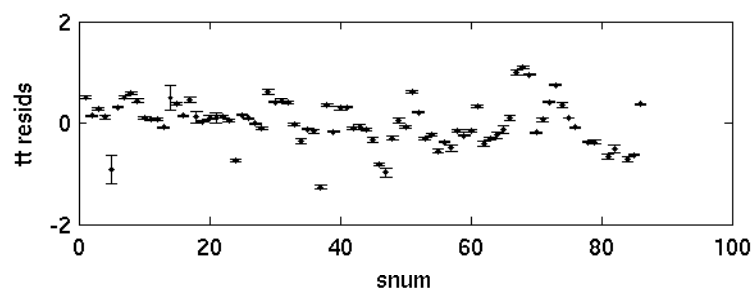
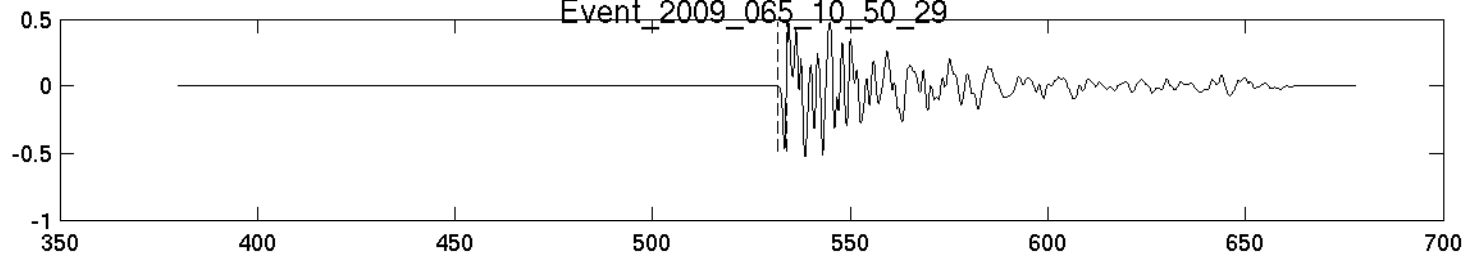
Event\_2009\_065\_10\_50\_29



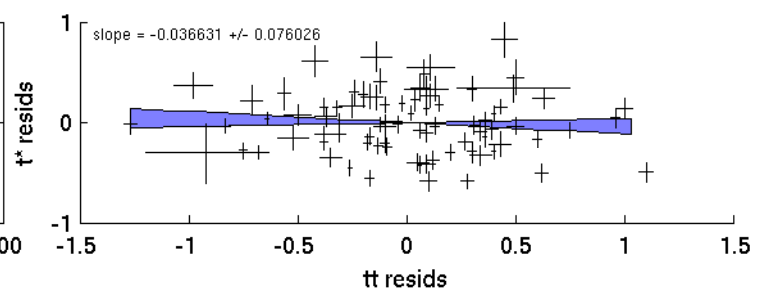
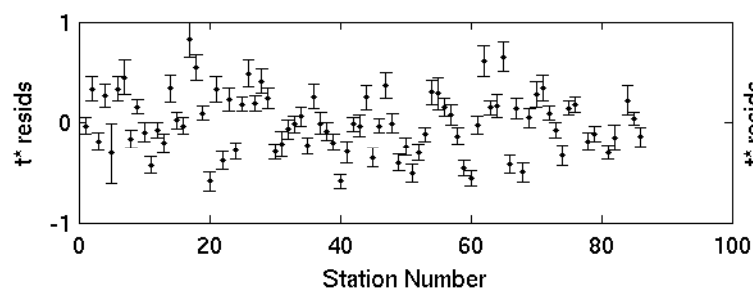


Event\_2009\_065\_10\_50\_29

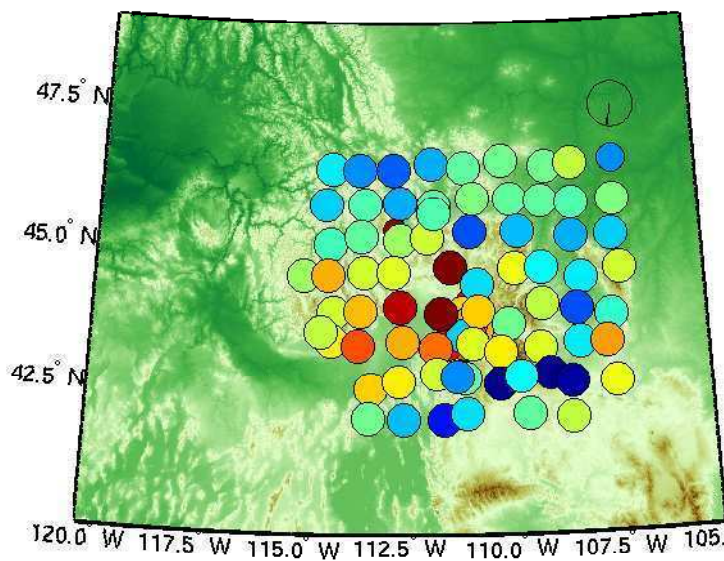
Stack



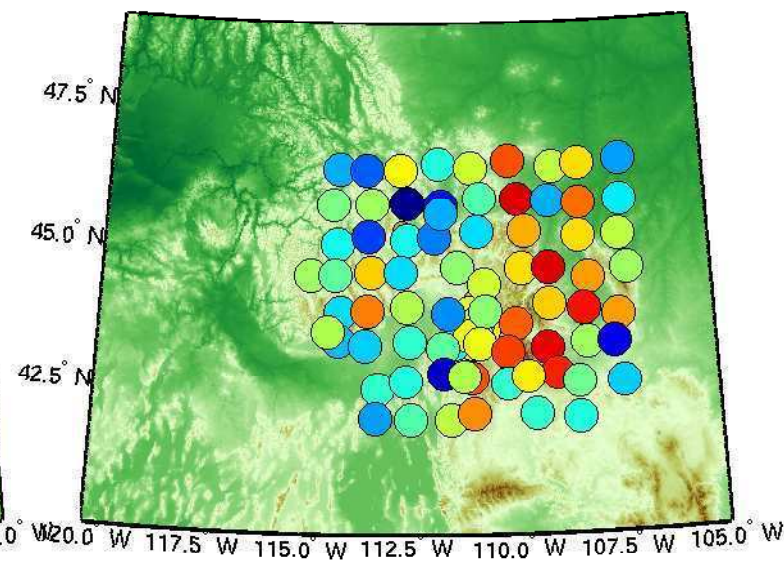
Baz = 12.102  
Mean xcor value = 0.80663  
Range of t\* values is 1.4123  
Median t\* err is 0.091721



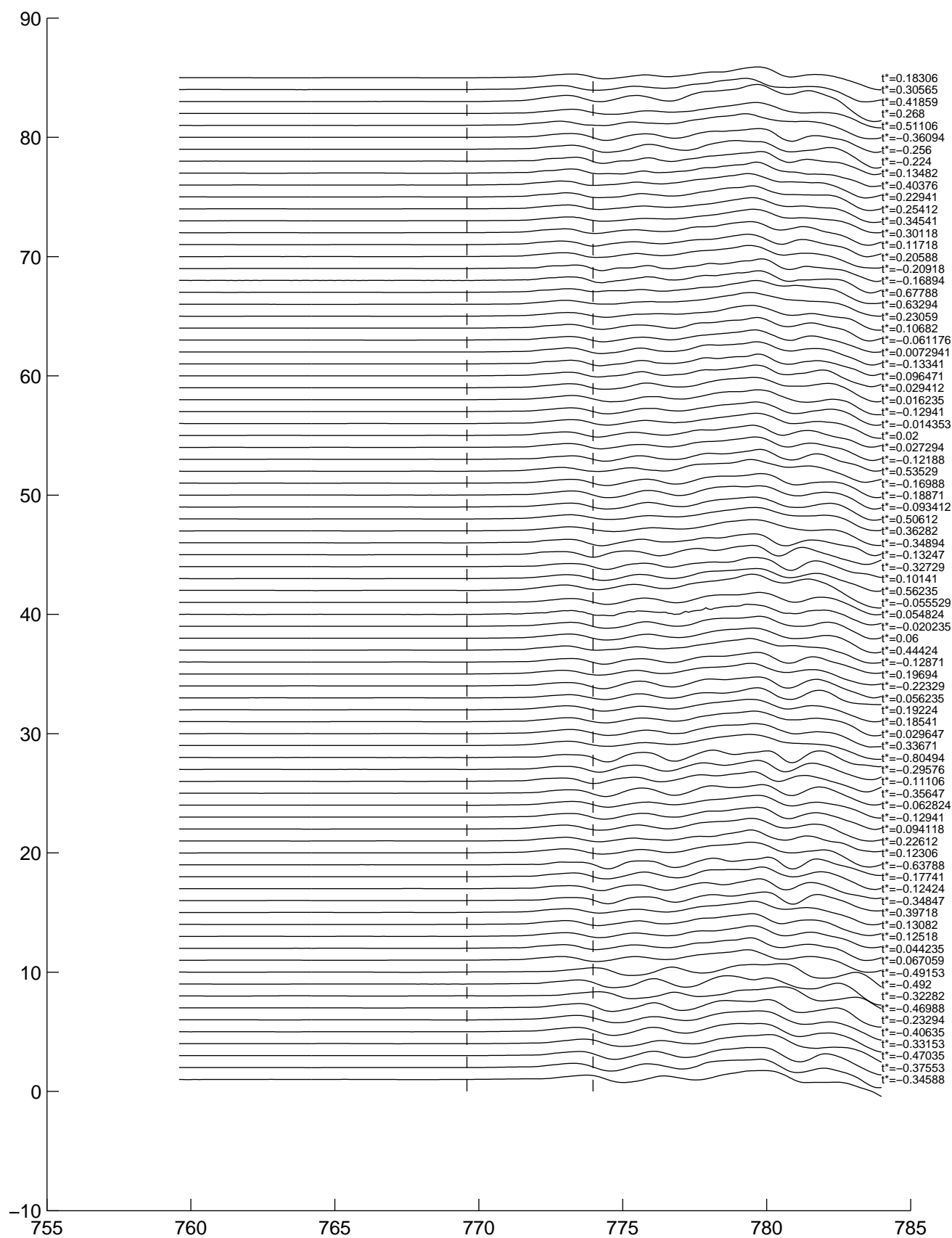
travel time residuals



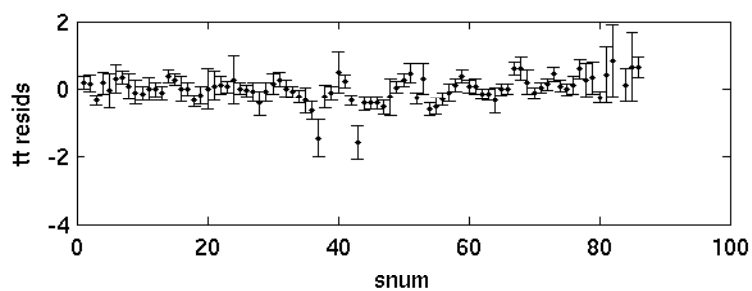
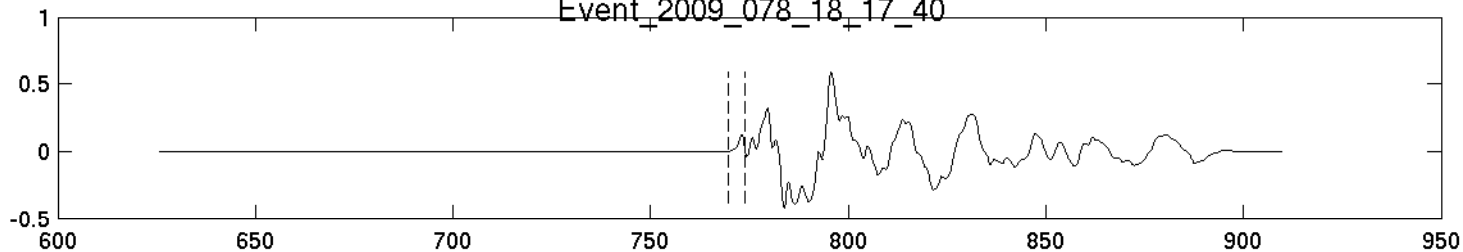
t\* values



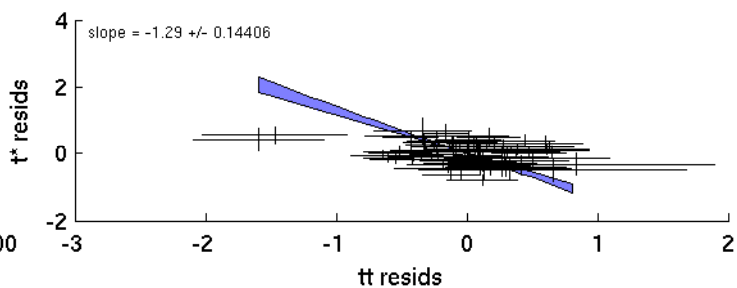
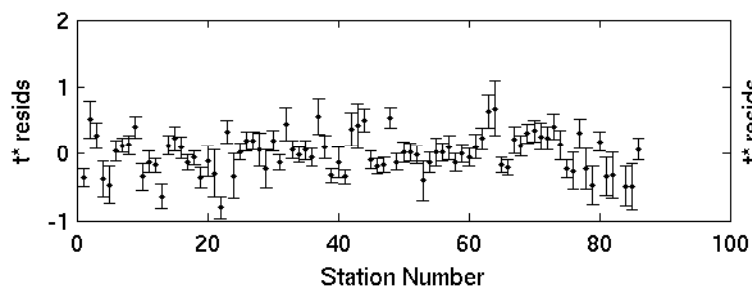
# Event\_2009\_078\_18\_17\_40



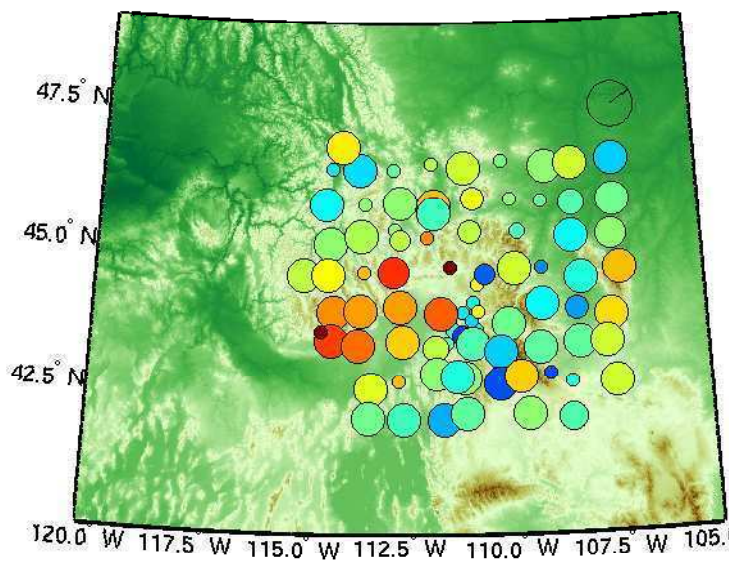
Stack  
Event\_2009\_078\_18\_17\_40



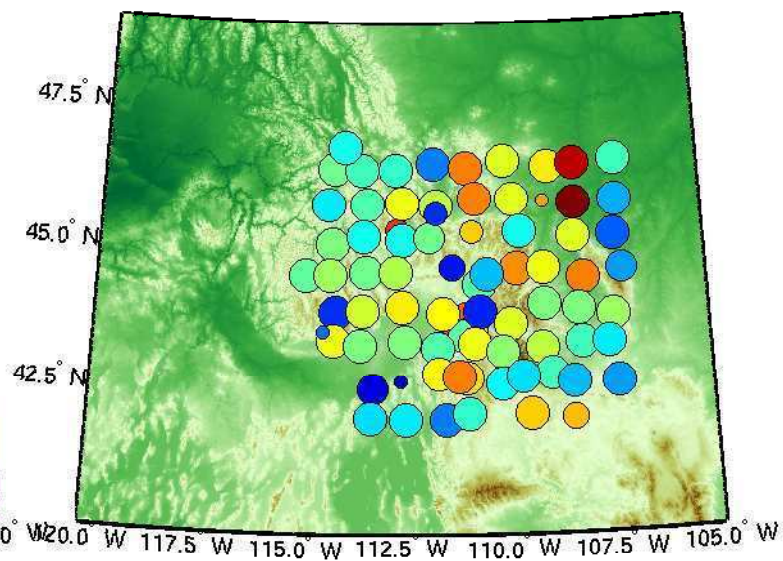
Baz = 235.7568  
Mean xcor value = 0.91024  
Range of  $t^*$  values is 1.4628  
Median  $t^*$  err is 0.1617



travel time residuals

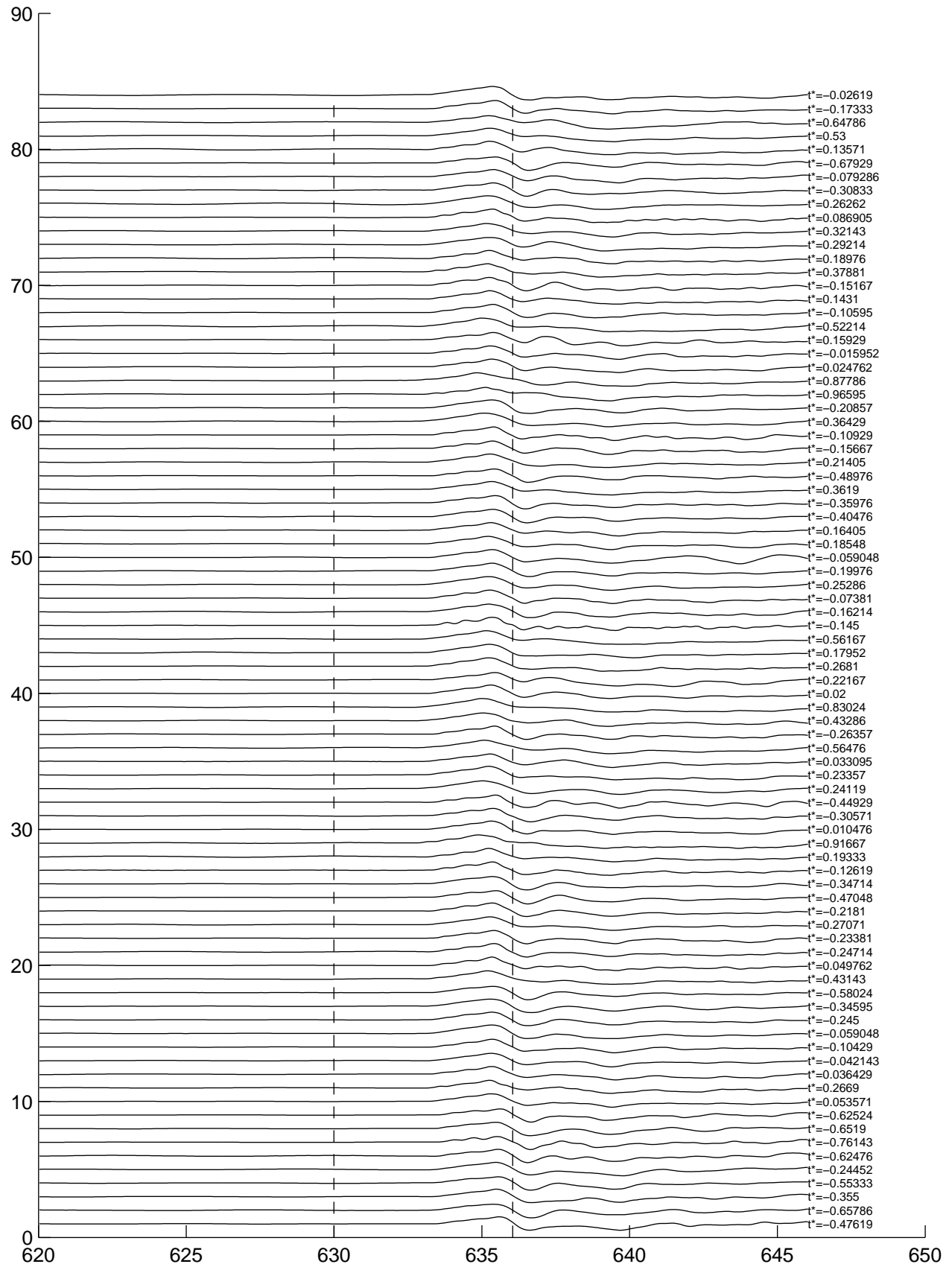


$t^*$  values

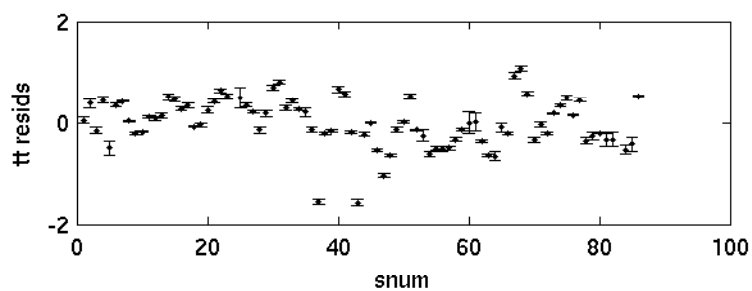
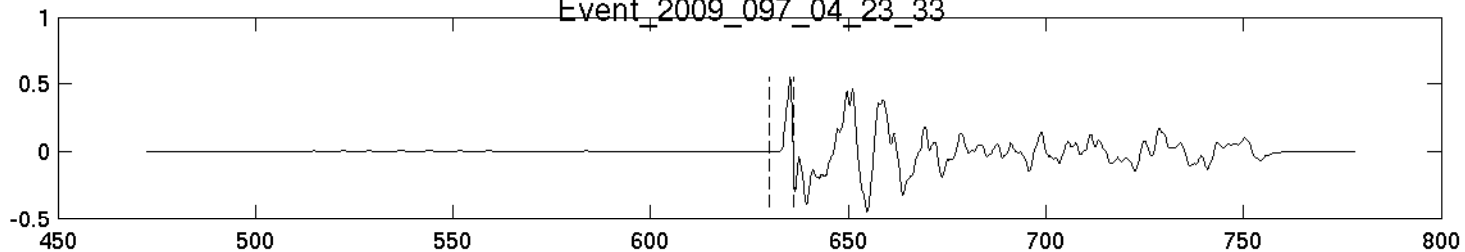




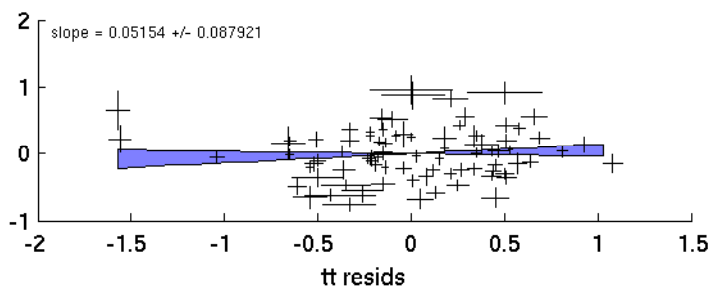
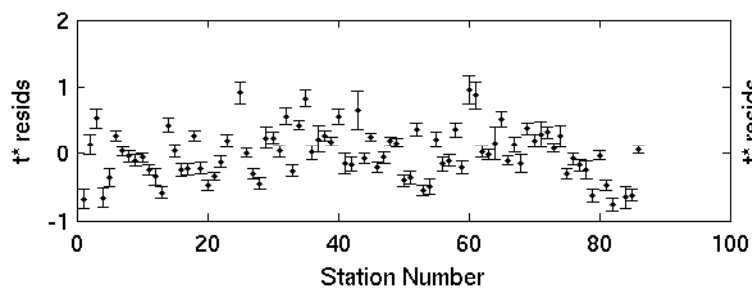
# Event\_2009\_097\_04\_23\_33



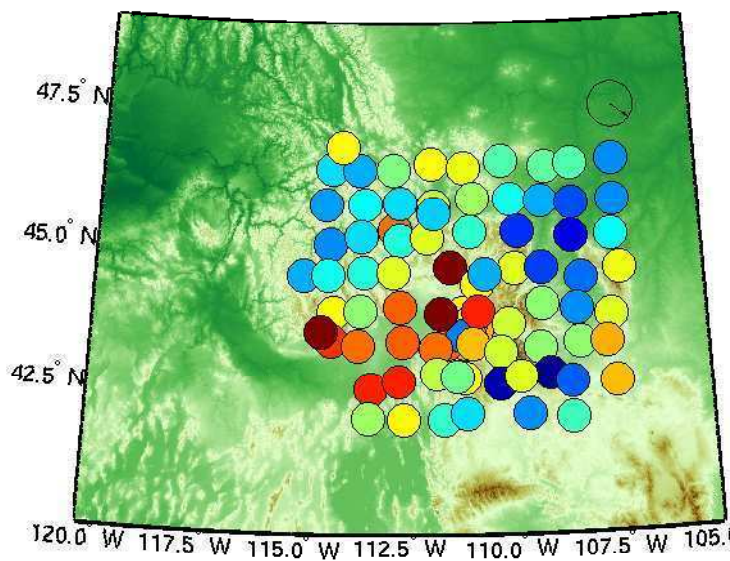
# Stack Event\_2009\_097\_04\_23\_33



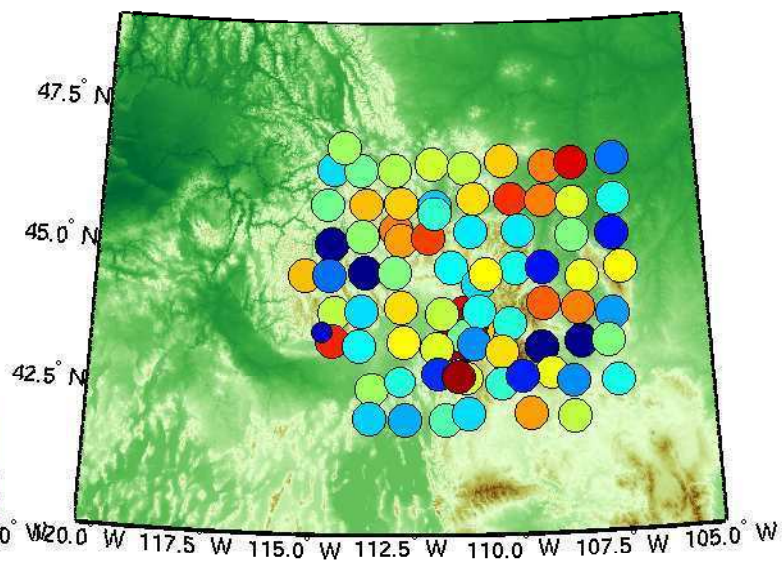
Baz = 309.996  
Mean xcor value = 0.90381  
Range of t\* values is 1.7274  
Median t\* err is 0.088882



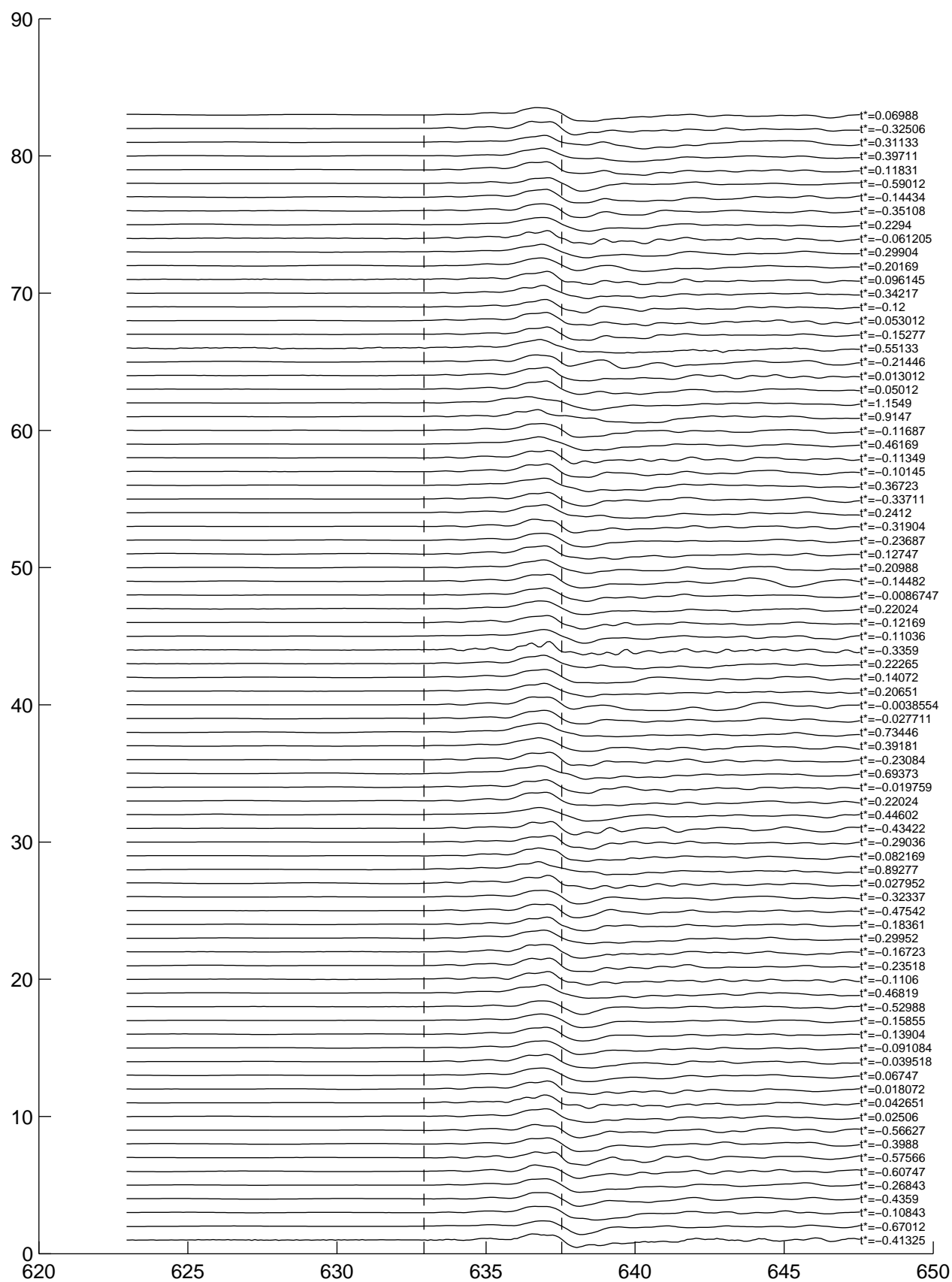
travel time residuals



t\* values

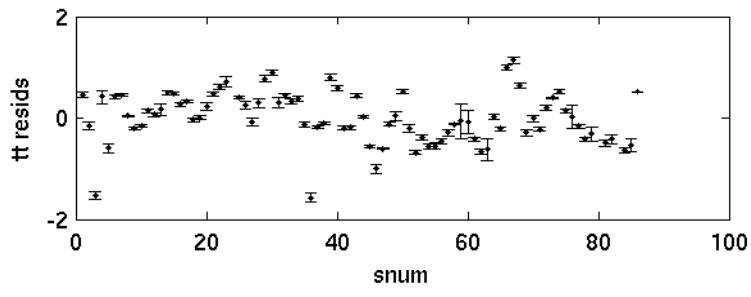
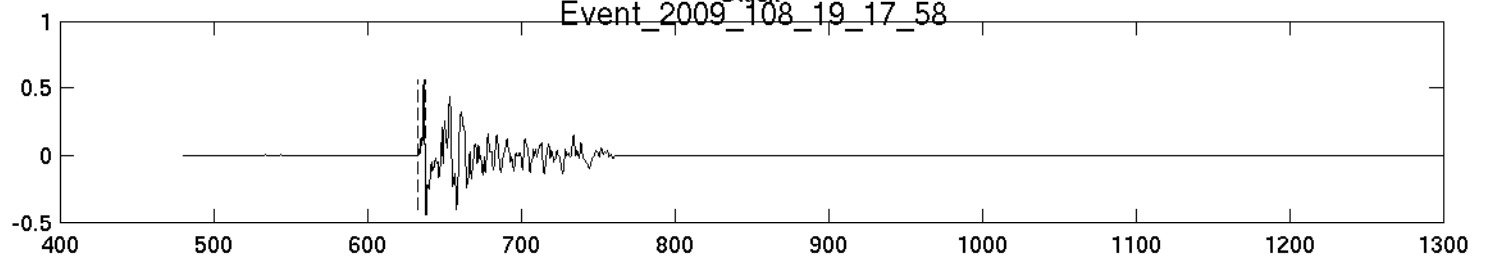


# Event\_2009\_108\_19\_17\_58

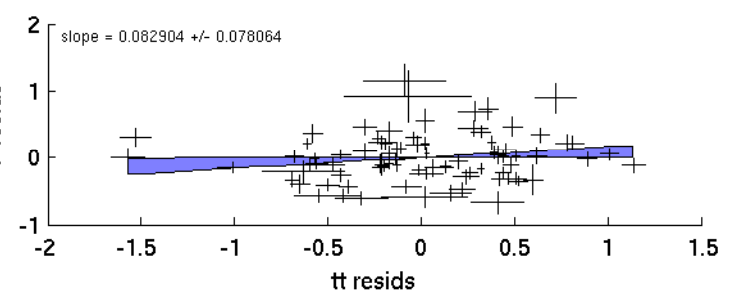
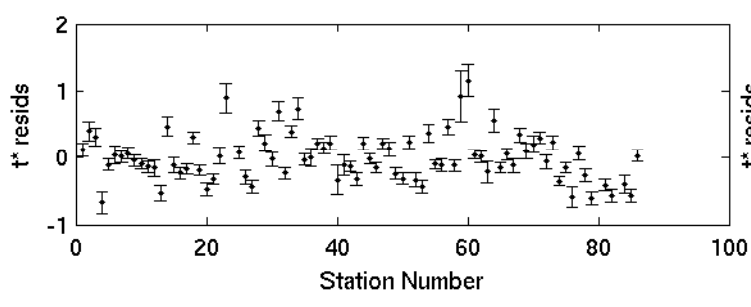


Stack

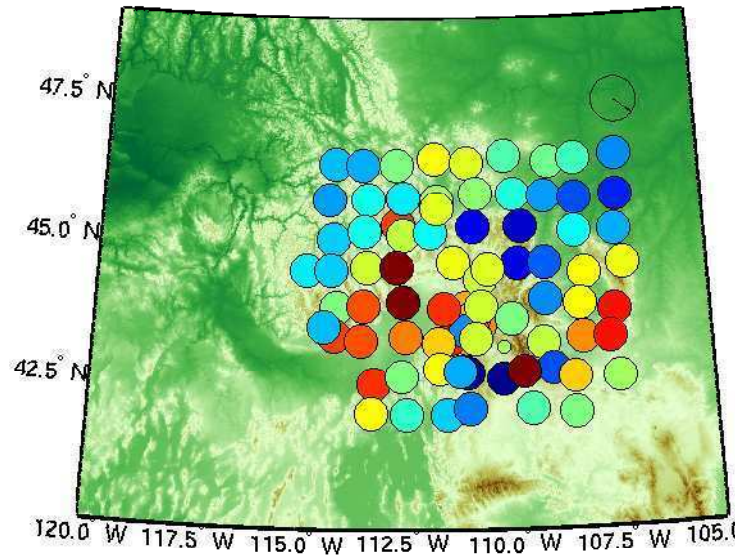
Event\_2009\_108\_19\_17\_58



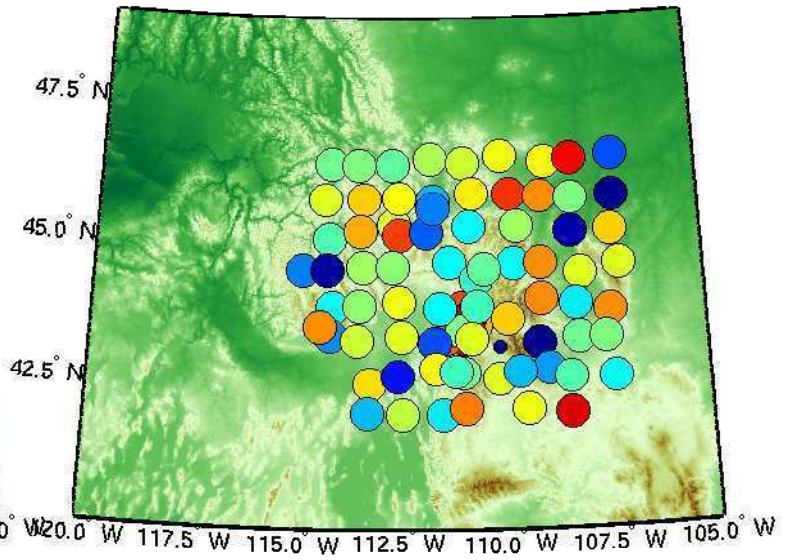
Baz = 310.0237  
Mean xcor value = 0.82976  
Range of t\* values is 1.6251  
Median t\* err is 0.097432



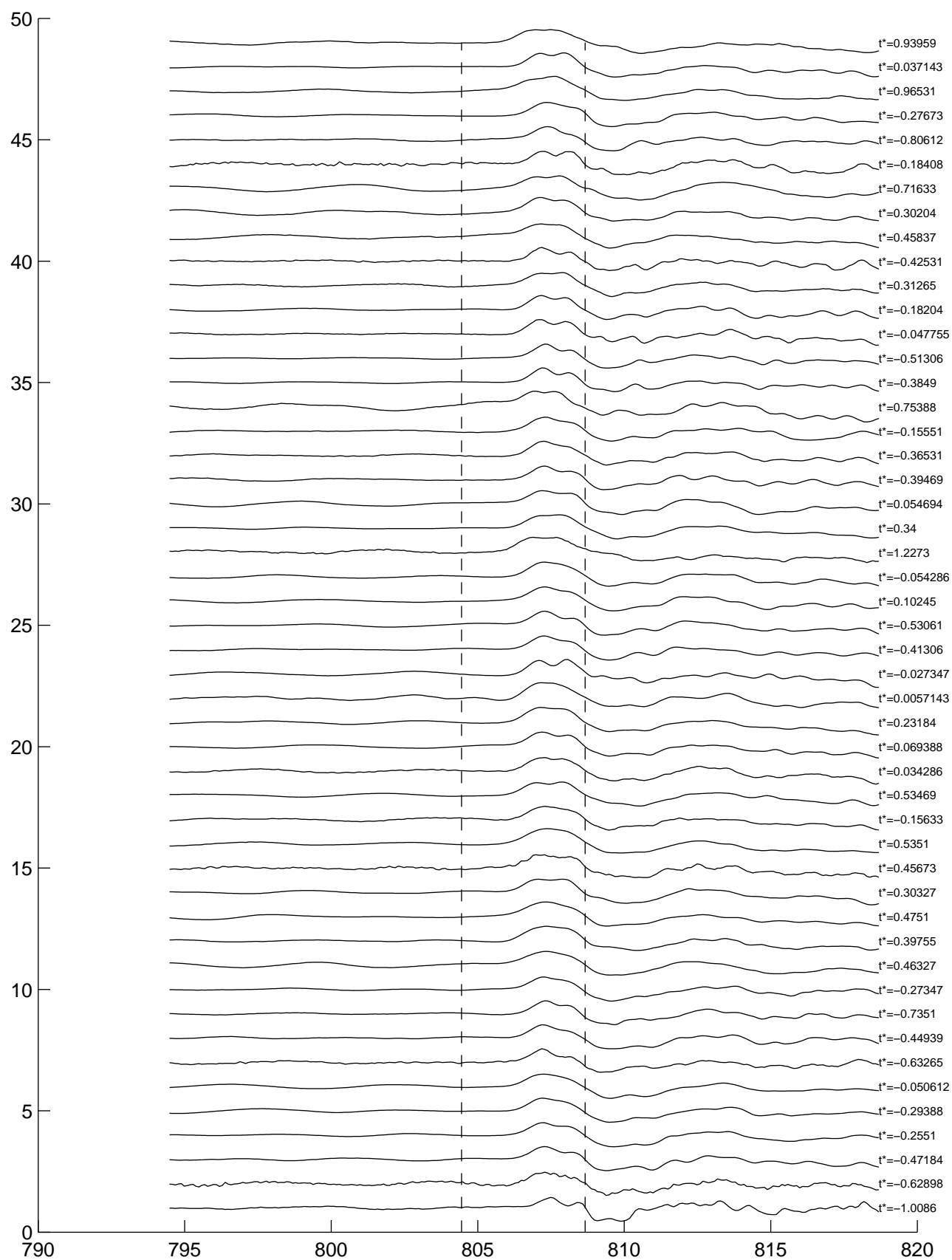
travel time residuals



$t^*$  values



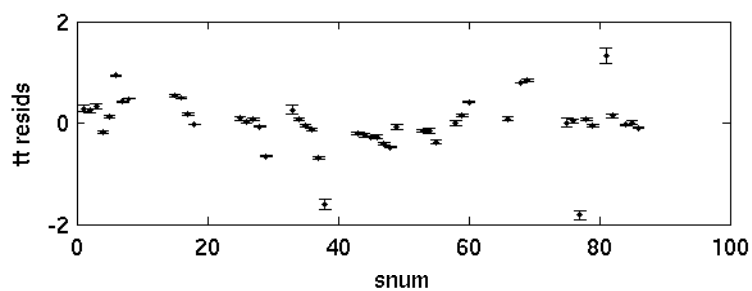
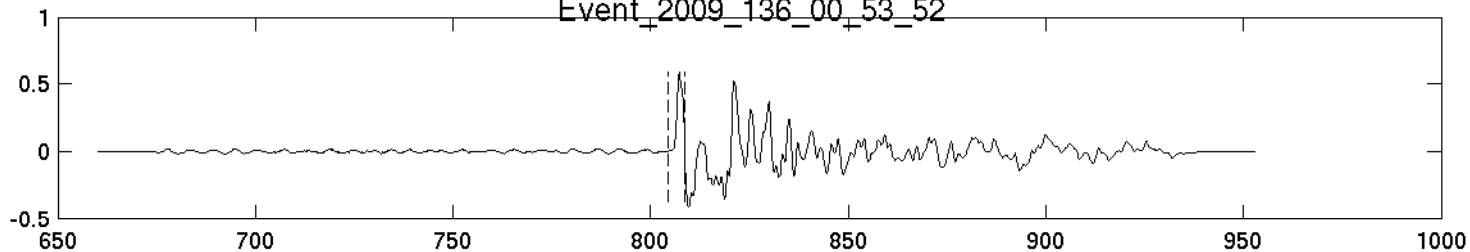
# Event\_2009\_136\_00\_53\_52



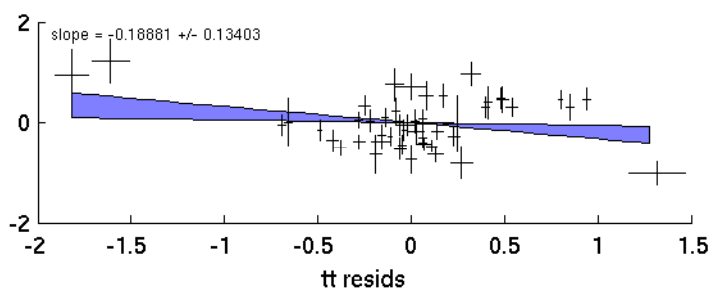
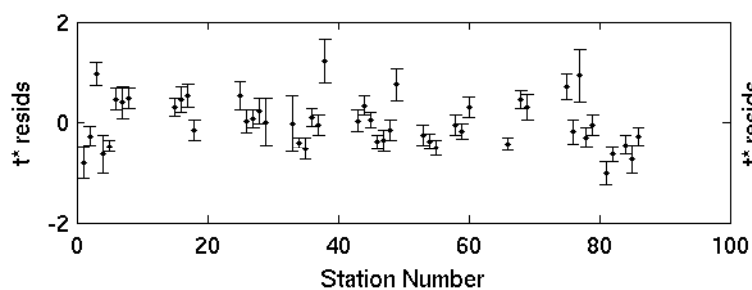


# Event 2009\_136\_00\_53\_52

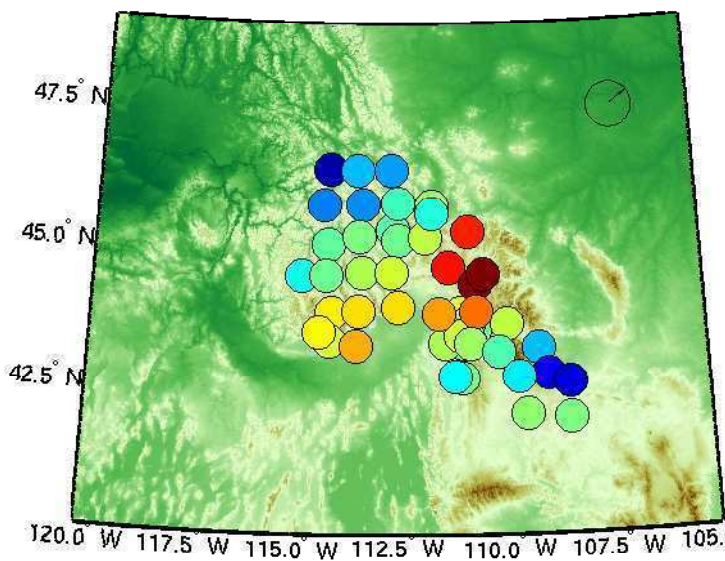
Stack



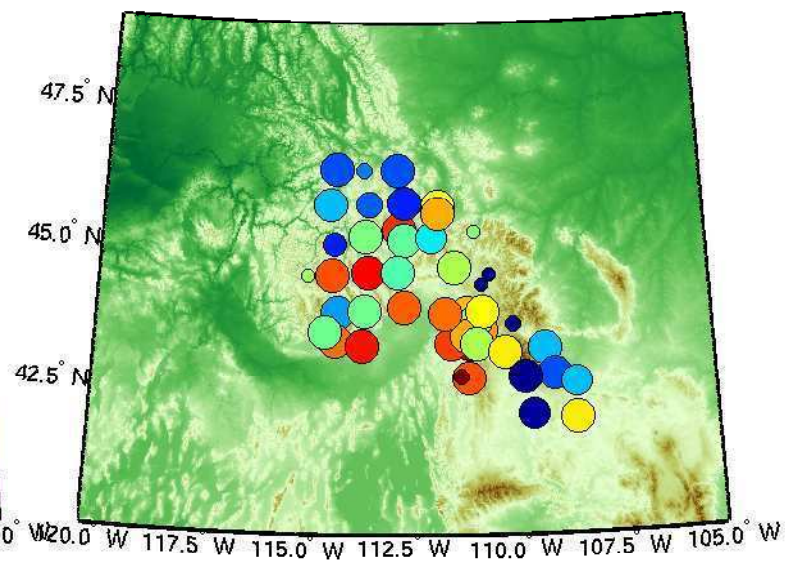
Baz = 233.09  
Mean xcor value = 0.84469  
Range of t\* values is 2.2359  
Median t\* err is 0.20738



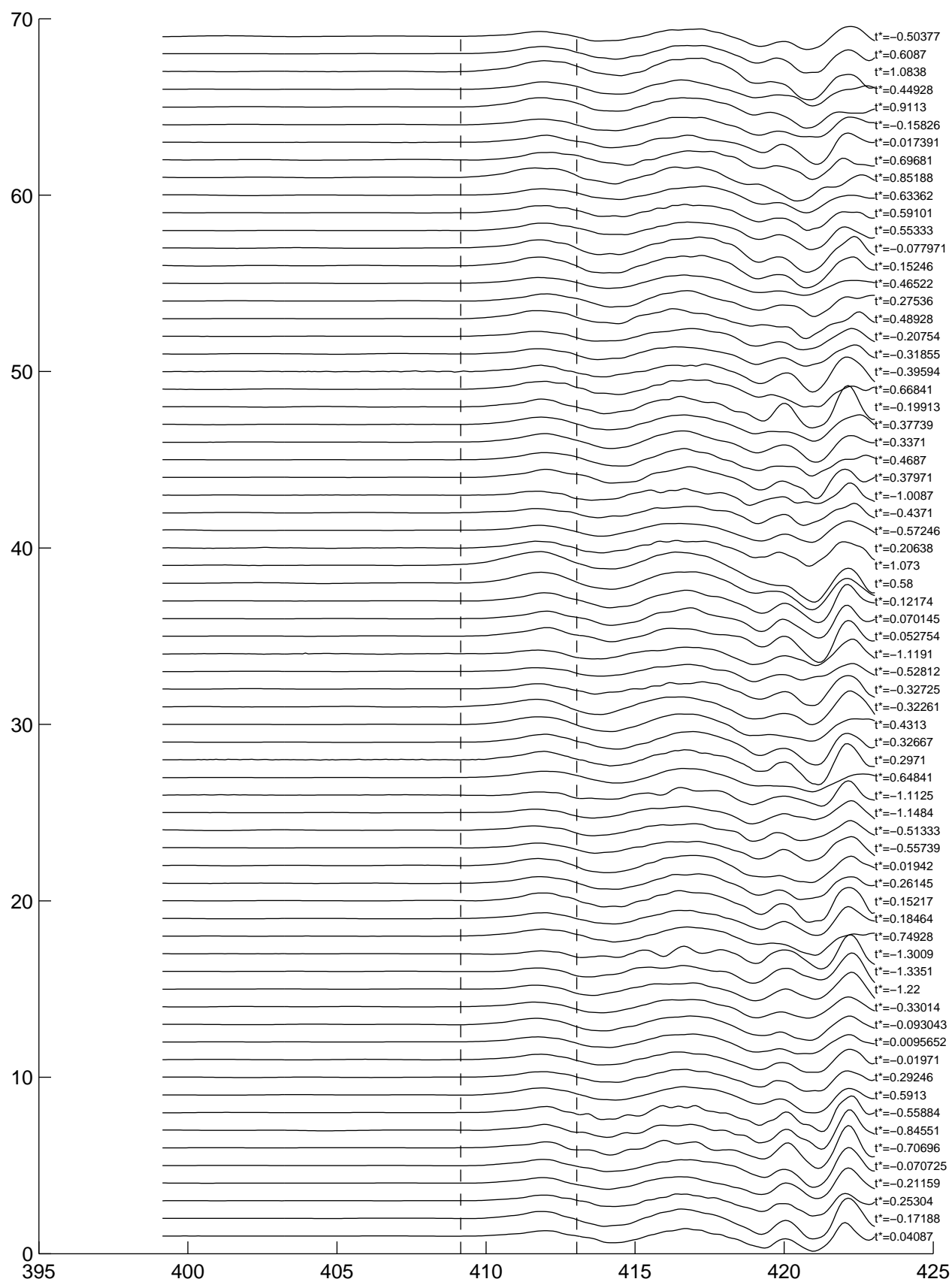
travel time residuals



t\* values



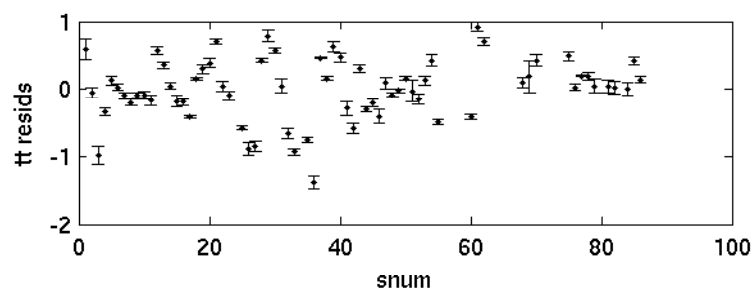
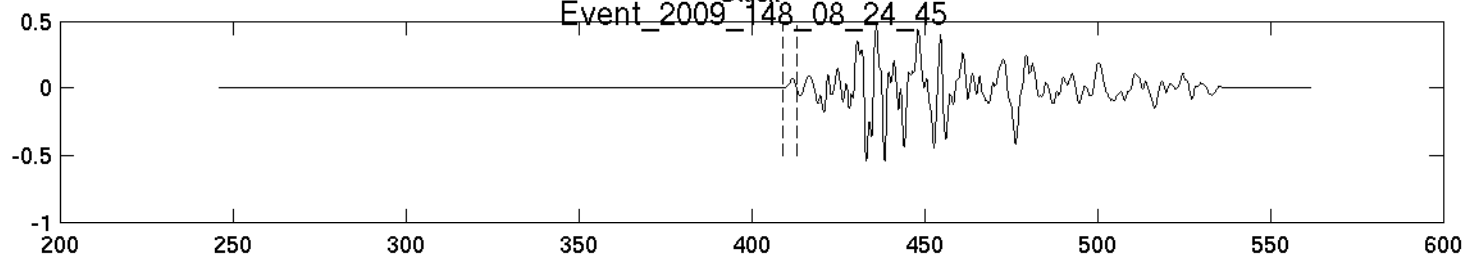
# Event\_2009\_148\_08\_24\_45



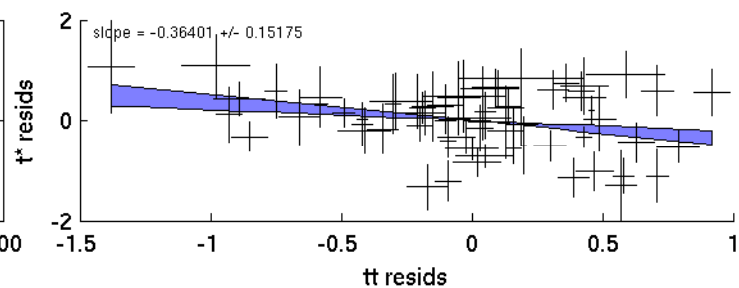
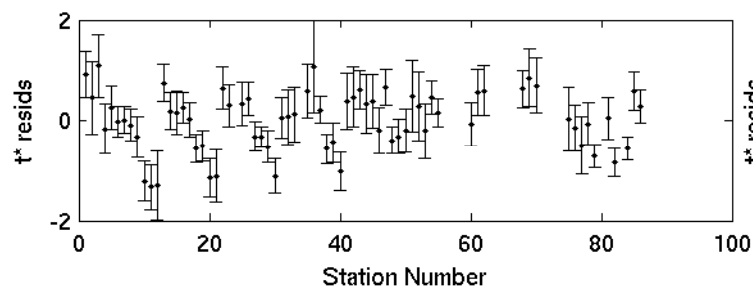


Event\_2009\_148\_08\_24\_45

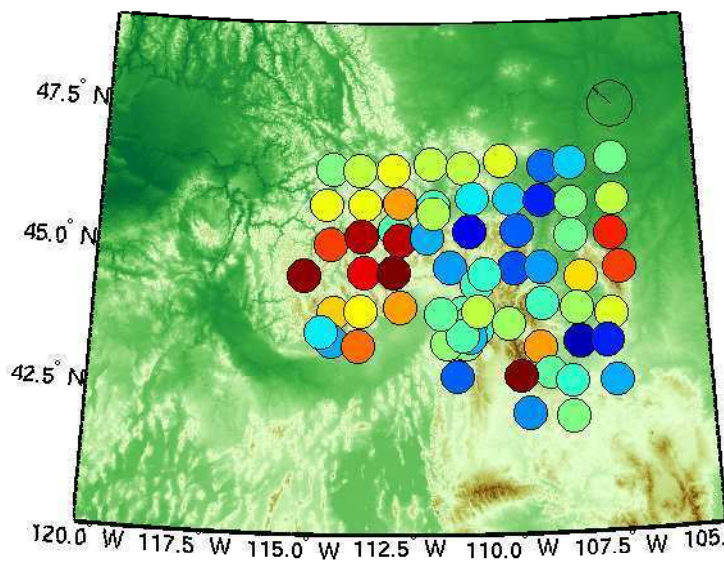
Stack



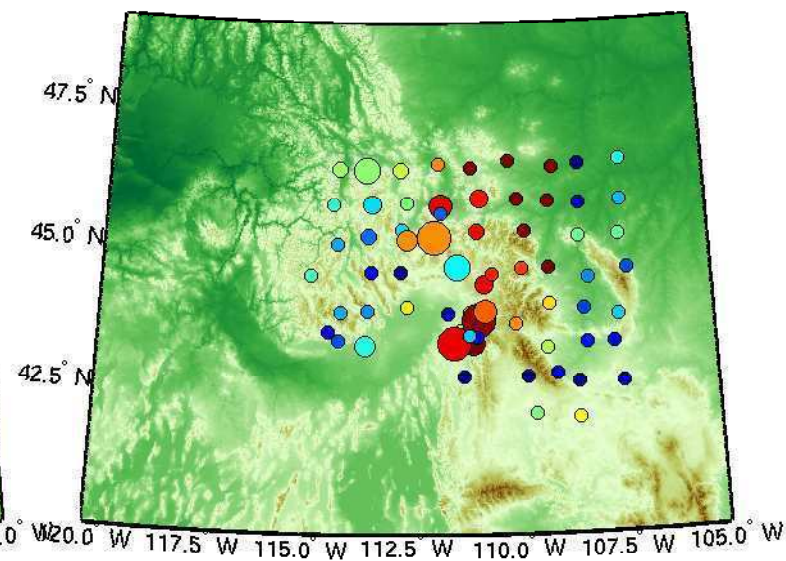
Baz = 135.7283  
Mean xcor value = 0.78913  
Range of t\* values is 2.4188  
Median t\* err is 0.42141



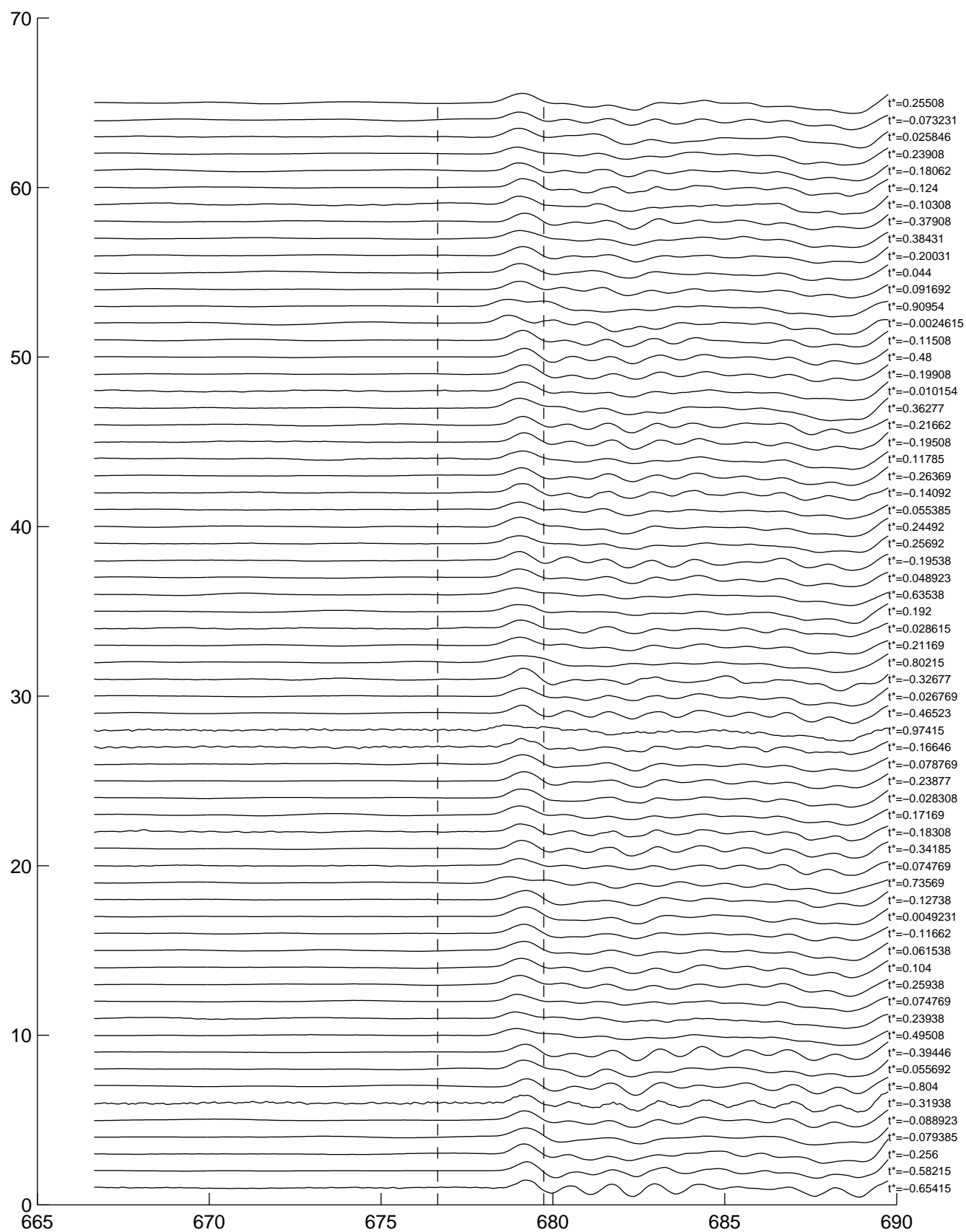
travel time residuals



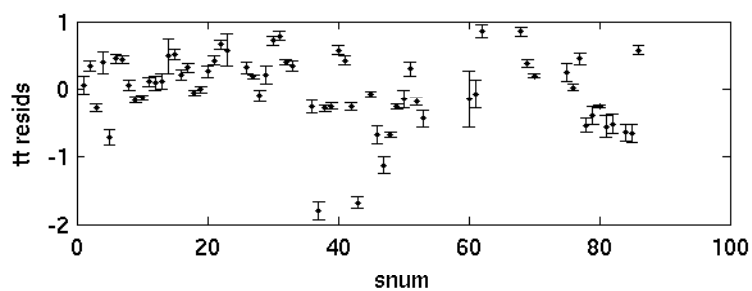
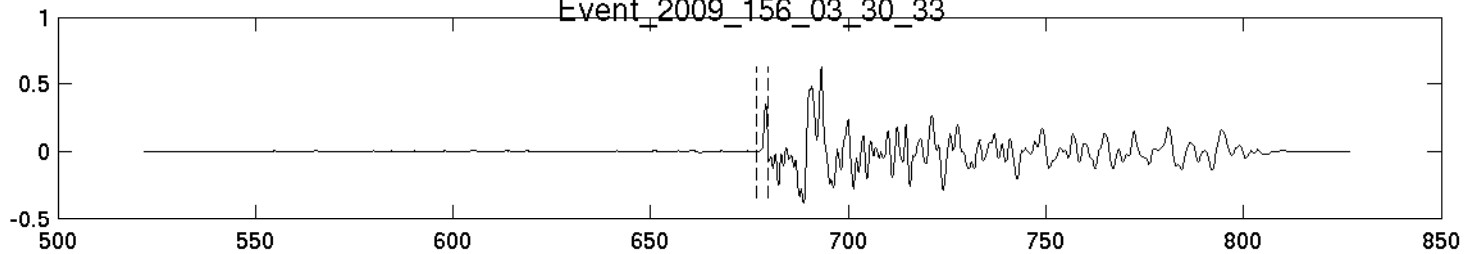
t\* values



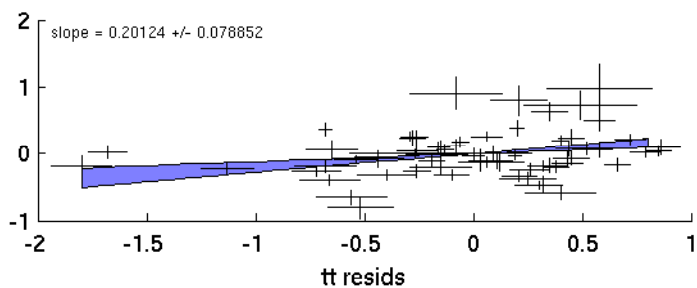
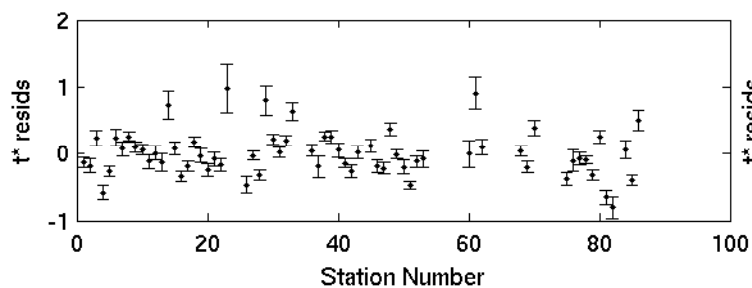
# Event\_2009\_156\_03\_30\_33



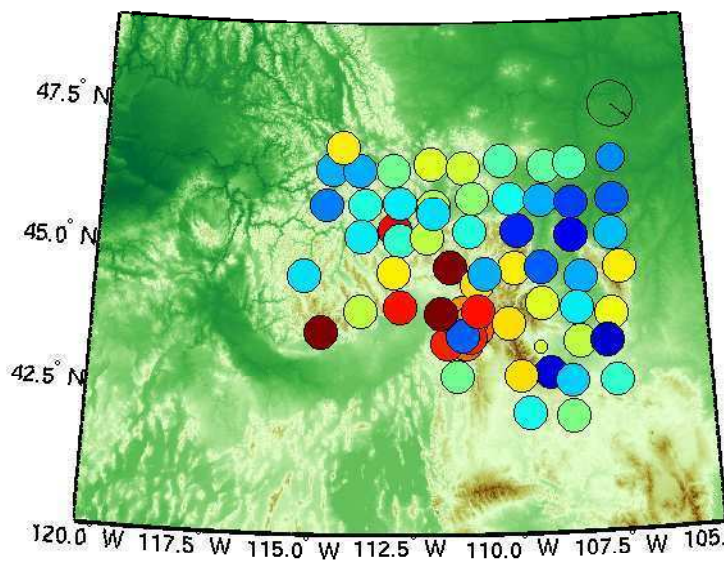
Stack  
Event\_2009\_156\_03\_30\_33



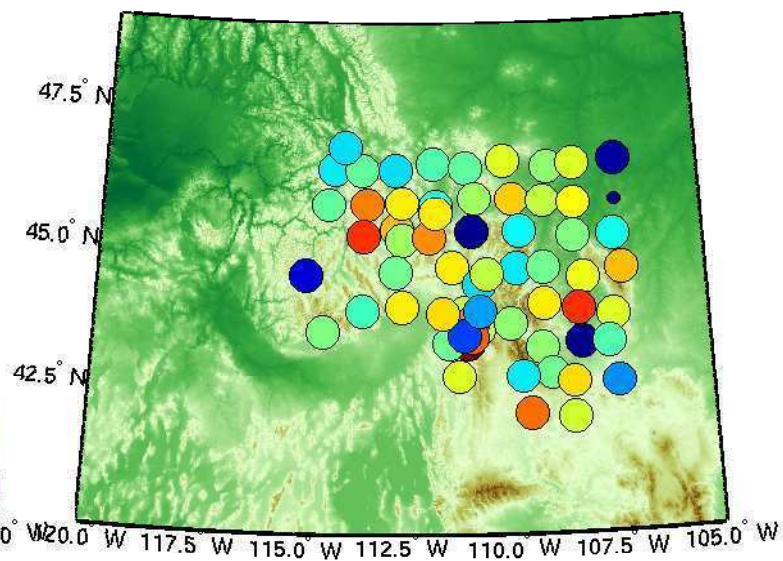
Baz = 310.7874  
Mean xcor value = 0.86385  
Range of  $t^*$  values is 1.7762  
Median  $t^*$  err is 0.099206

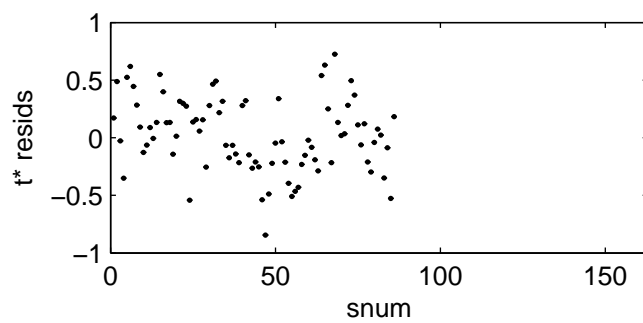
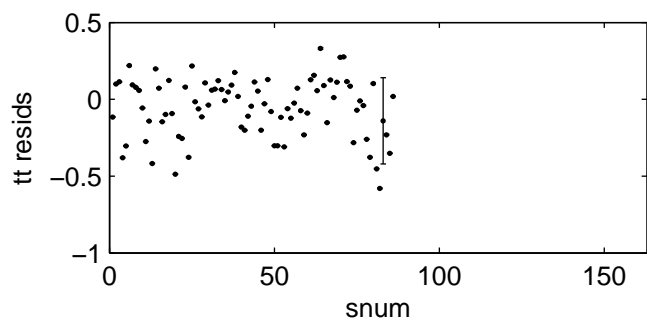
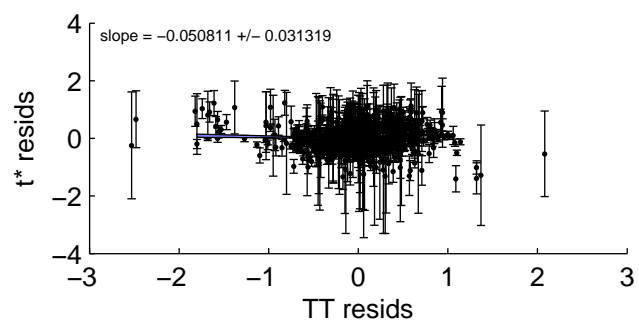
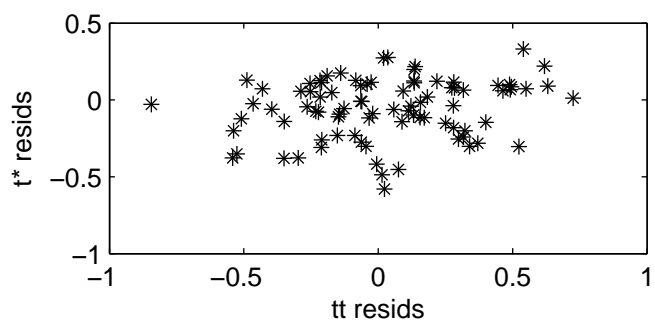


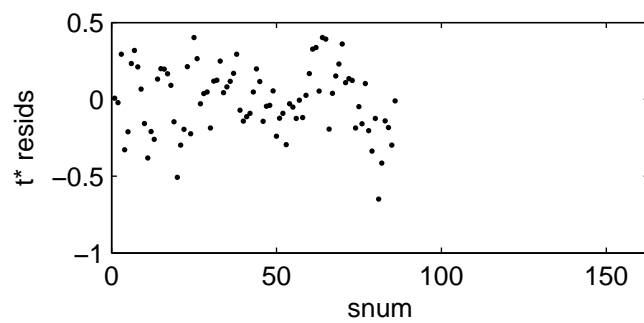
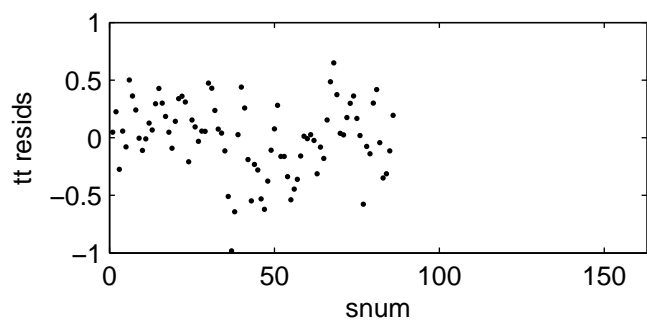
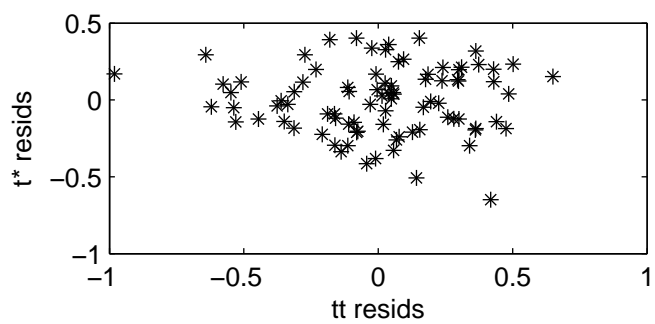
travel time residuals



$t^*$  values

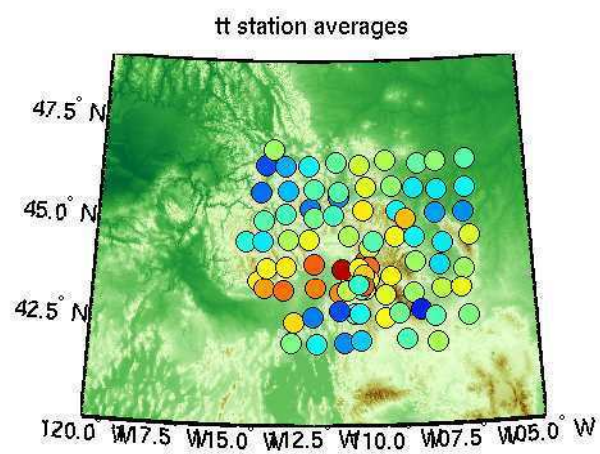
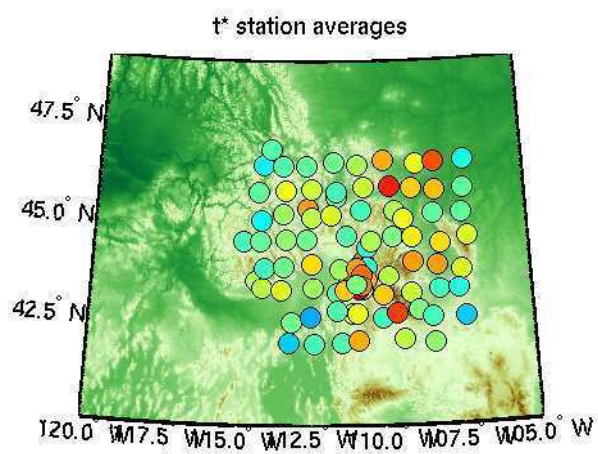
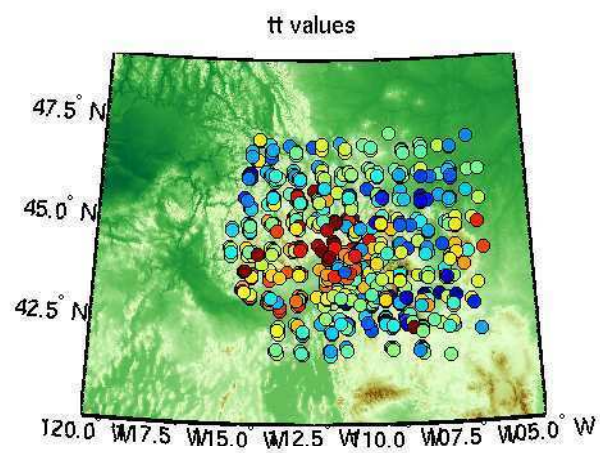
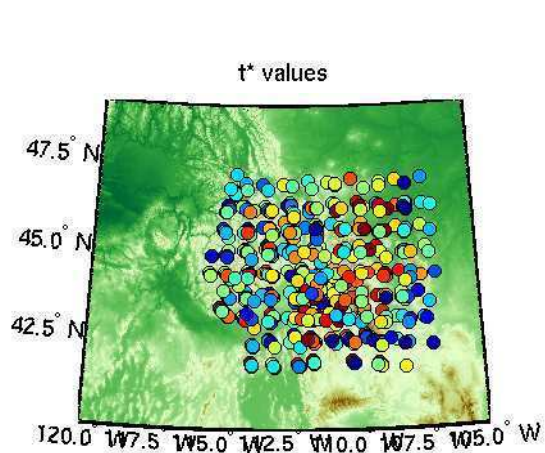








ALL DATA

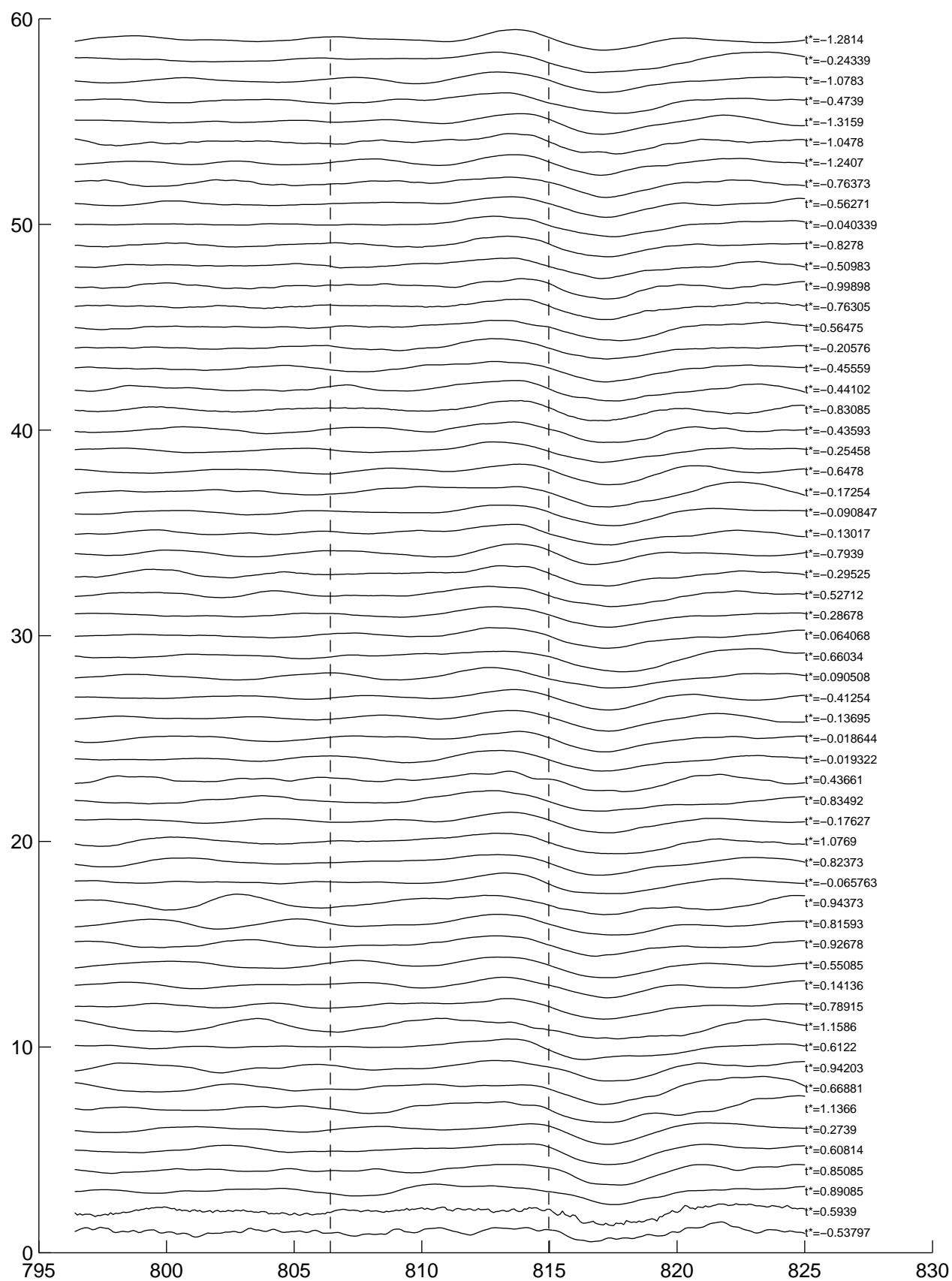


## CATEGORY 2

THE SELECTION OF THE MOST PROMINENT PULSE OF THE WAVEFORM

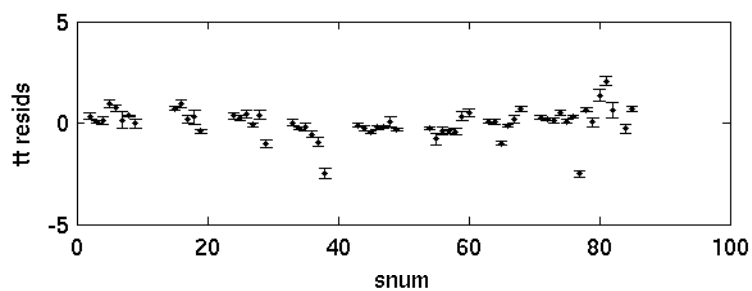
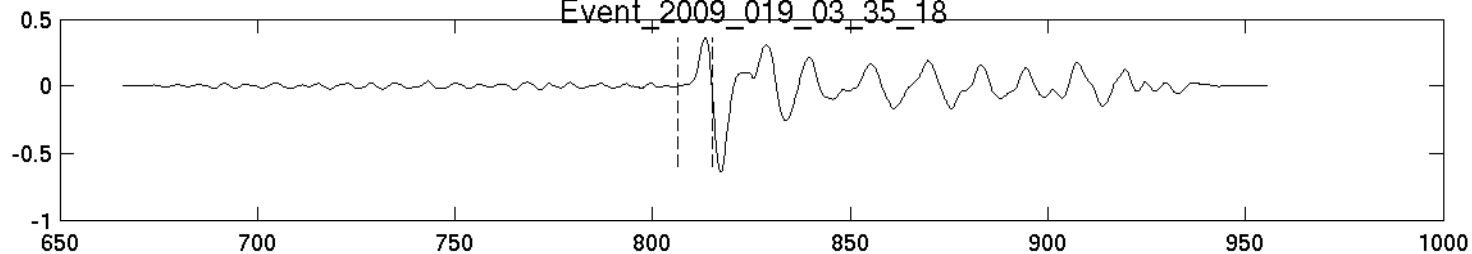


# Event\_2009\_019\_03\_35\_18

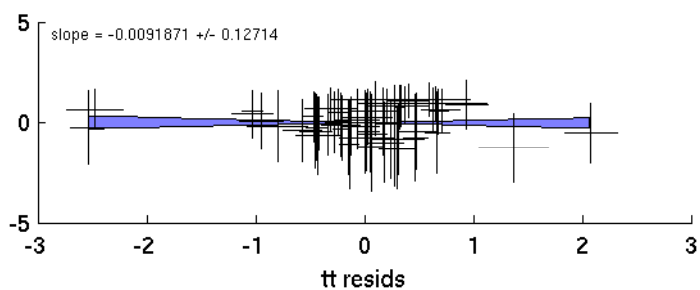
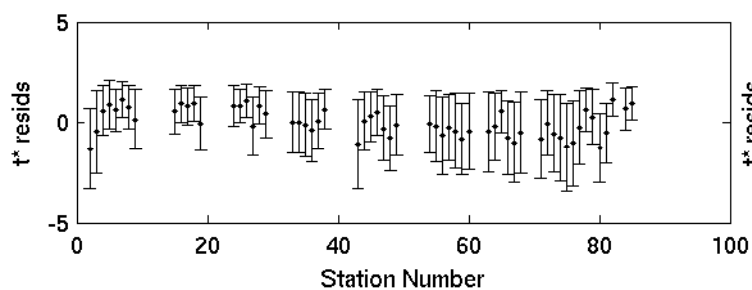


# Event 2009\_019\_03\_35\_18

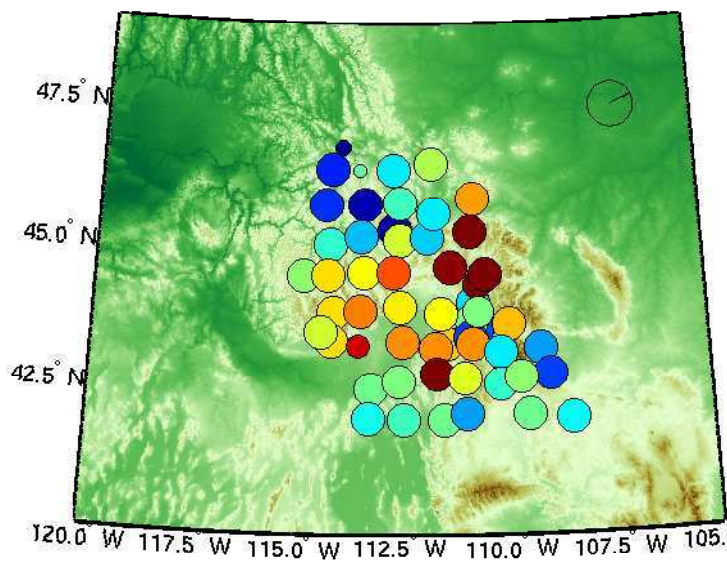
Stack



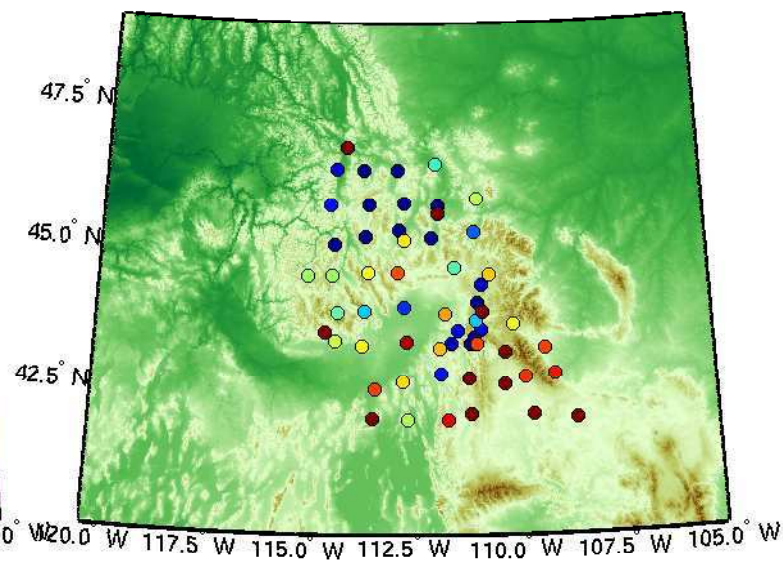
Baz = 245.8635  
Mean xcor value = 0.83102  
Range of t\* values is 2.4746  
Median t\* err is 1.4991



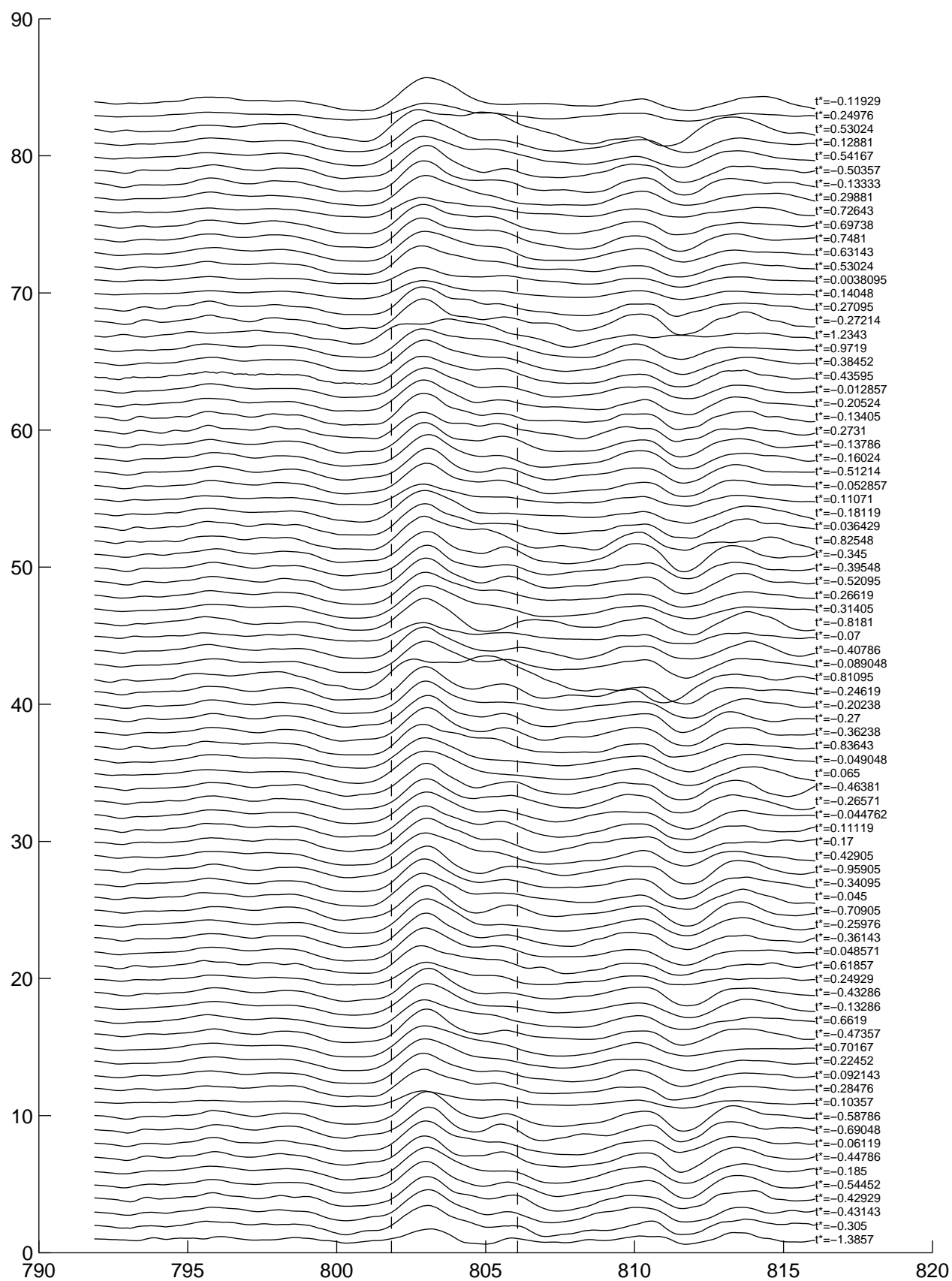
travel time residuals



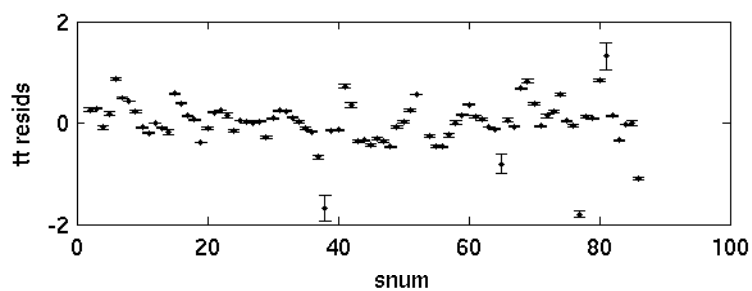
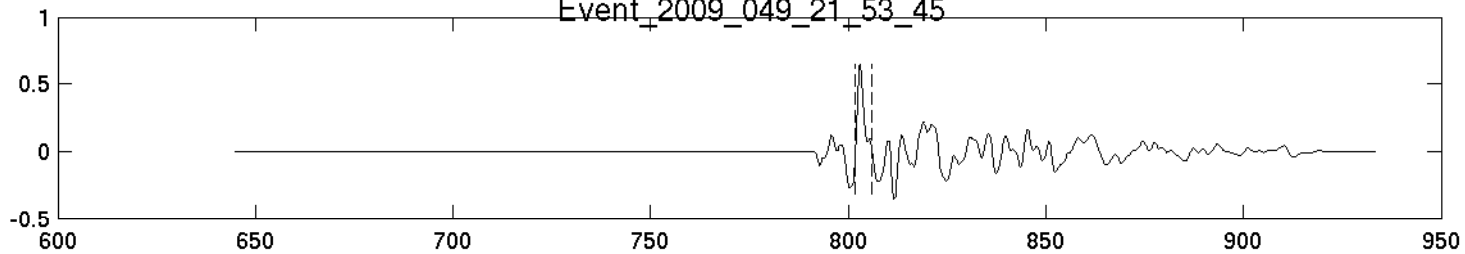
t\* values



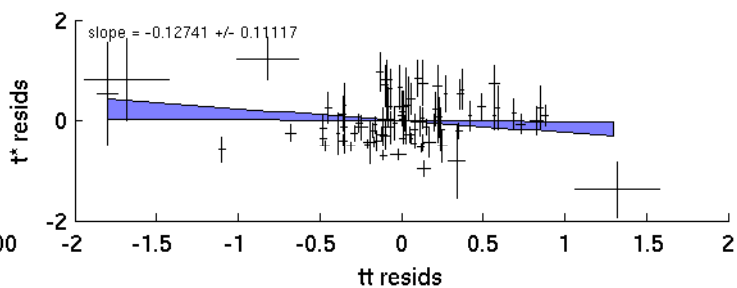
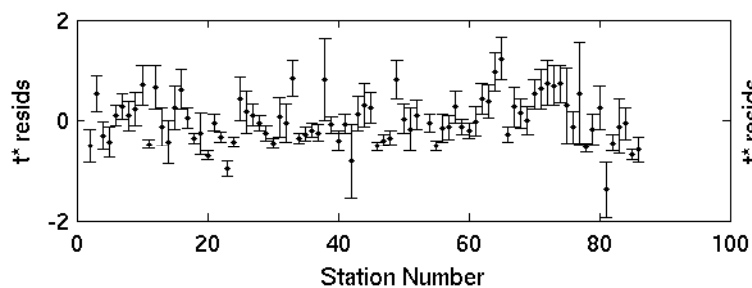
# Event\_2009\_049\_21\_53\_45



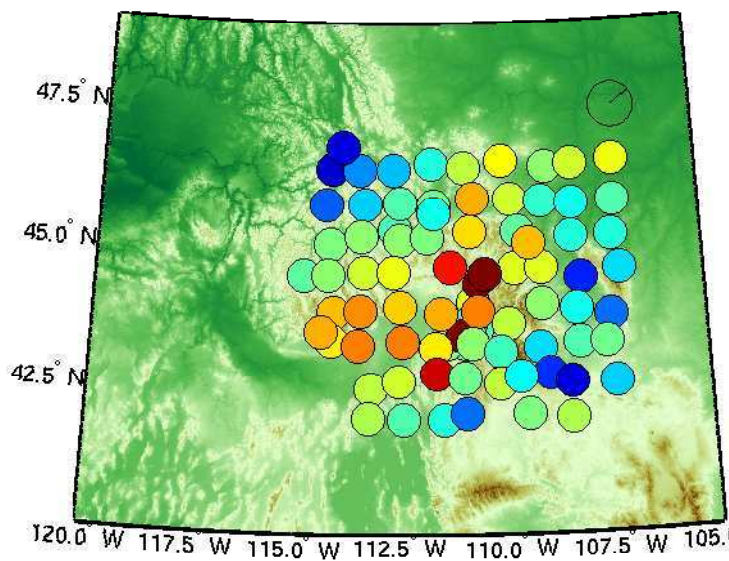
Stack  
Event\_2009\_049\_21\_53\_45



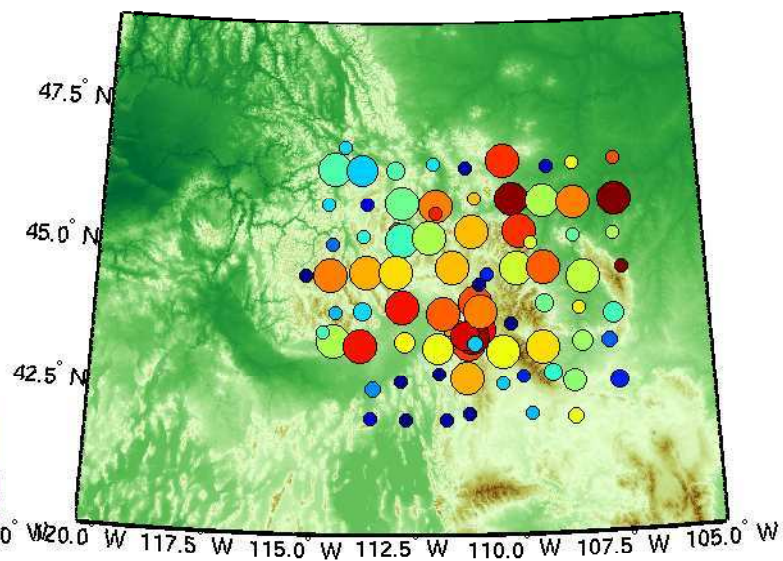
Baz = 234.0821  
Mean xcor value = 0.91262  
Range of  $t^*$  values is 2.62  
Median  $t^*$  err is 0.29759



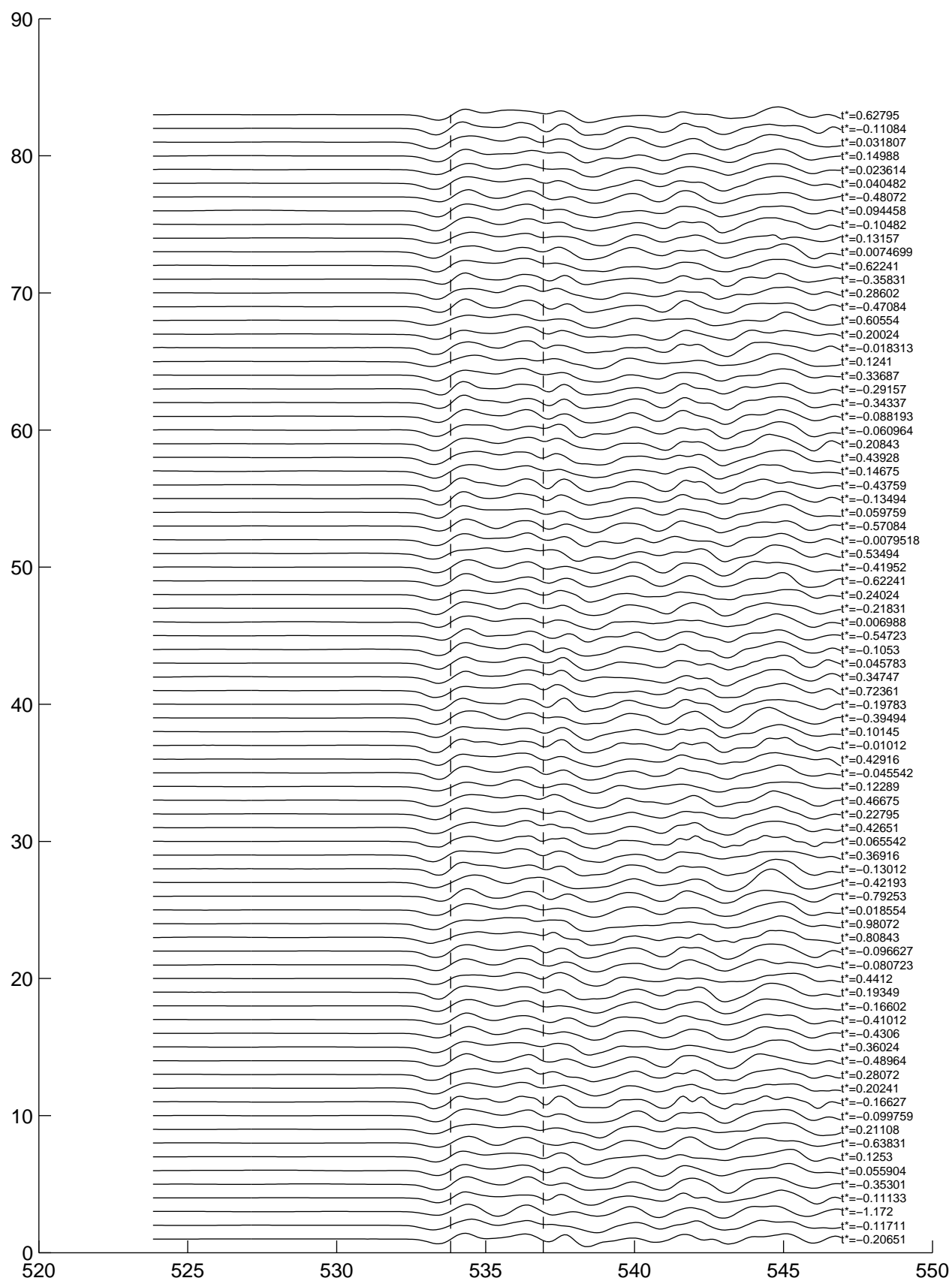
travel time residuals



$t^*$  values



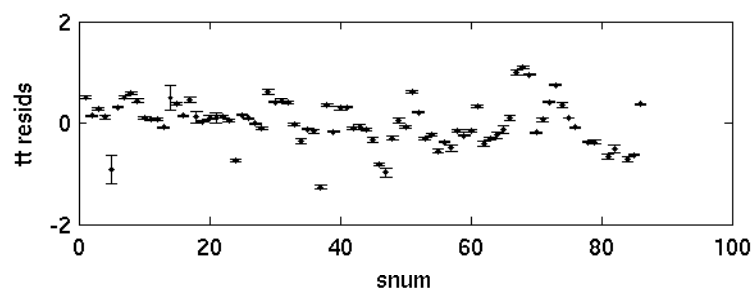
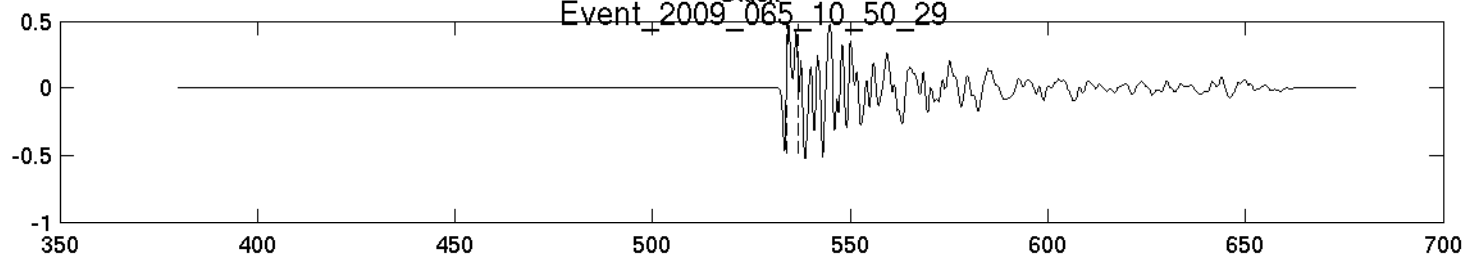
# Event\_2009\_065\_10\_50\_29



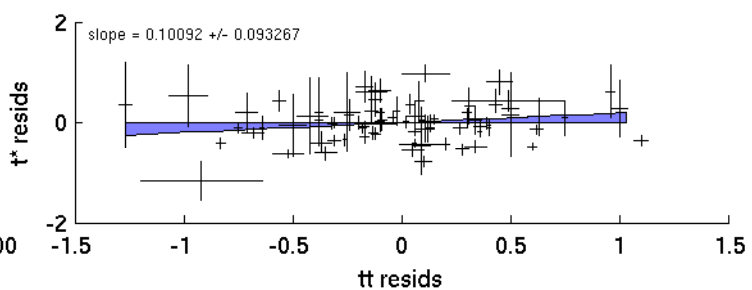
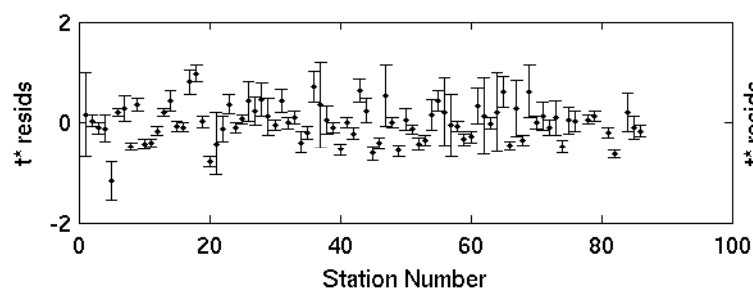


Event\_2009\_065\_10\_50\_29

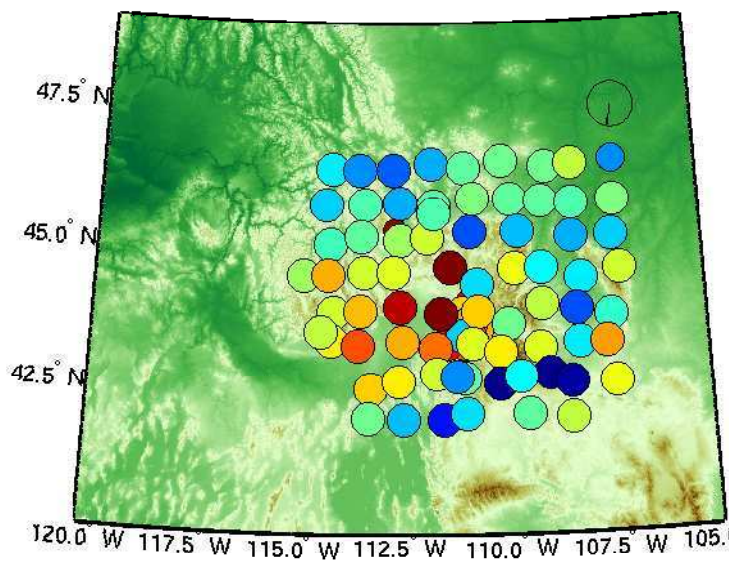
Stack



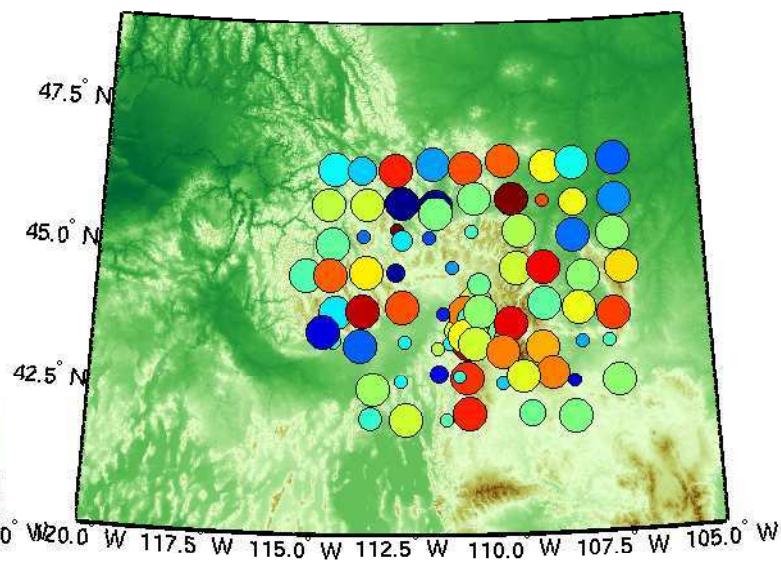
Baz = 12.102  
Mean xcor value = 0.80663  
Range of t\* values is 2.1528  
Median t\* err is 0.13081



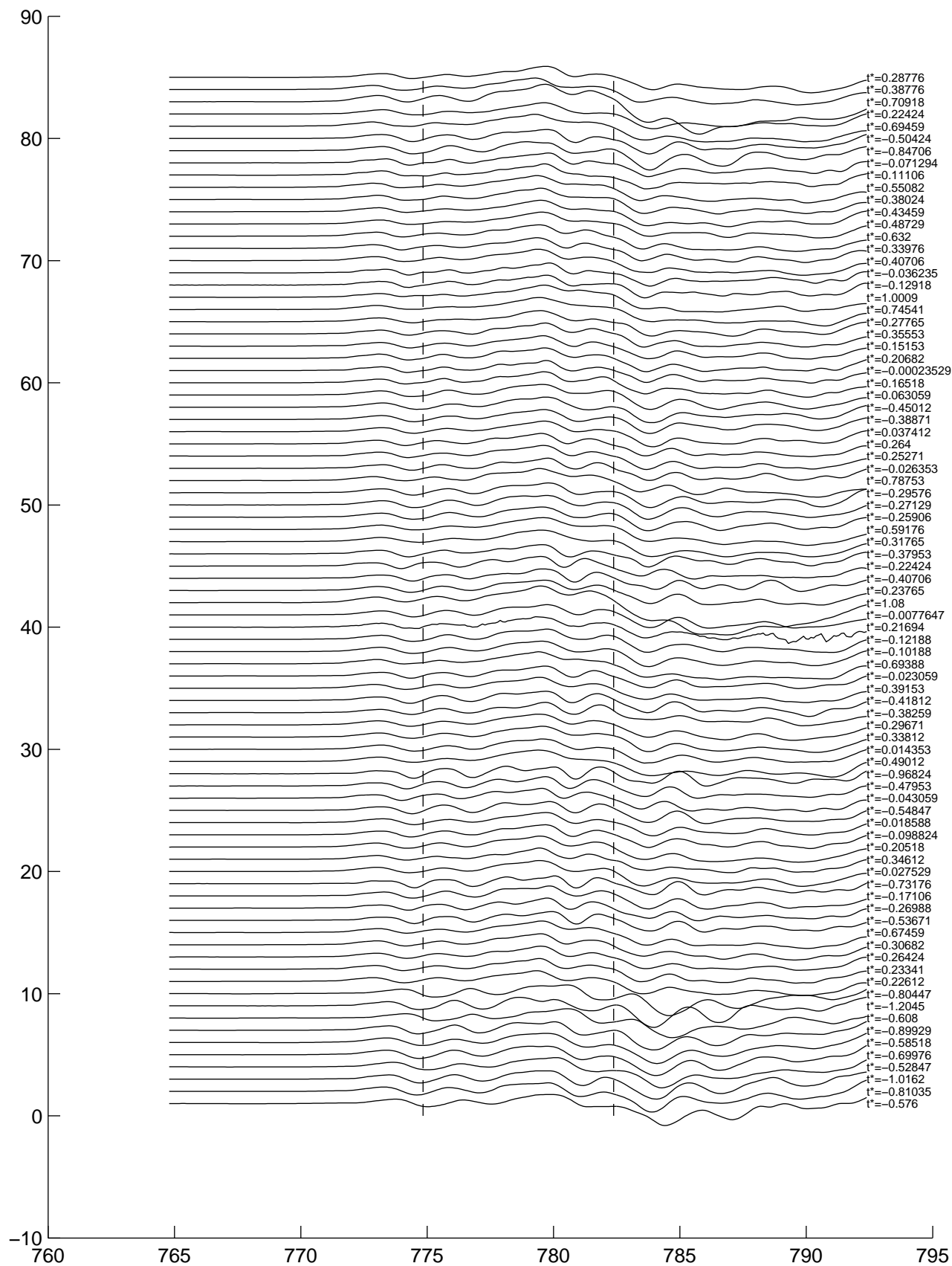
travel time residuals



t\* values

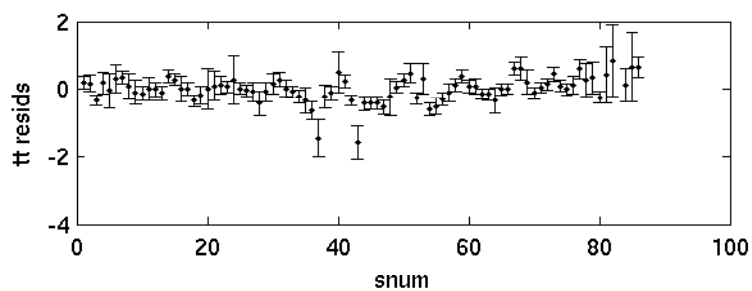
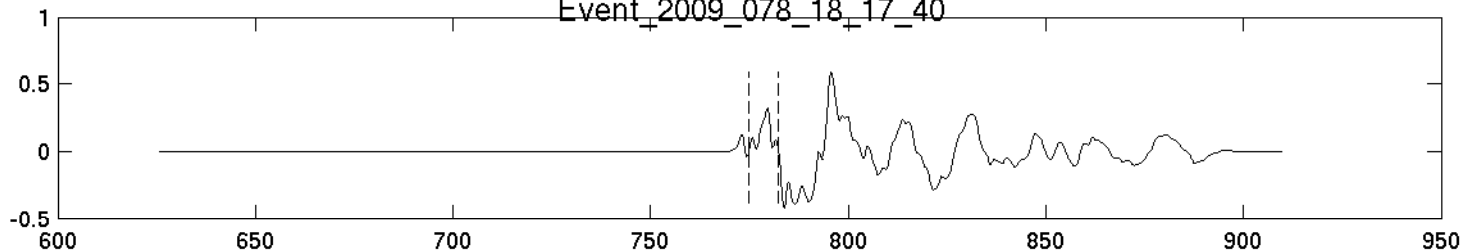


# Event\_2009\_078\_18\_17\_40

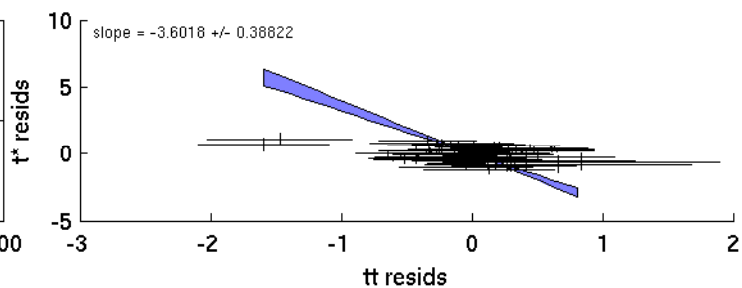
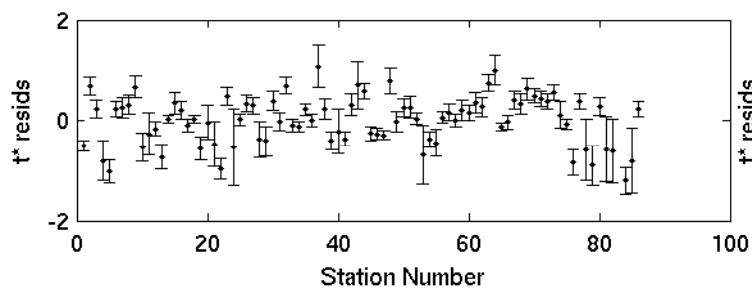




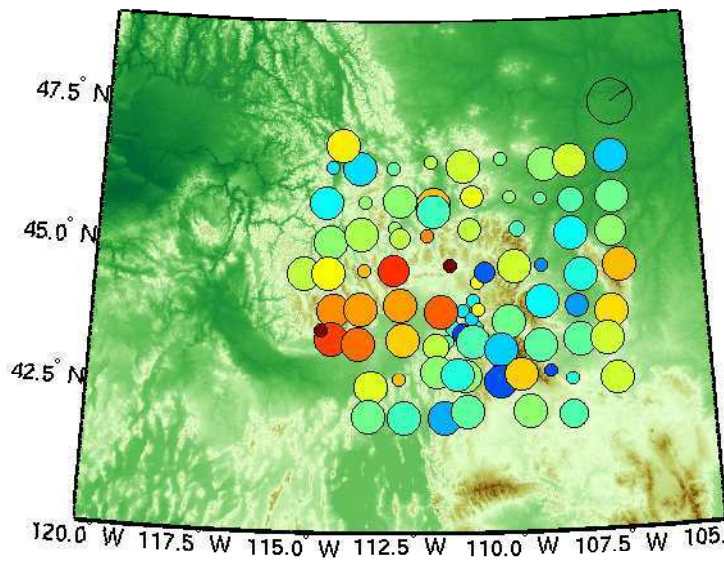
Stack  
Event\_2009\_078\_18\_17\_40



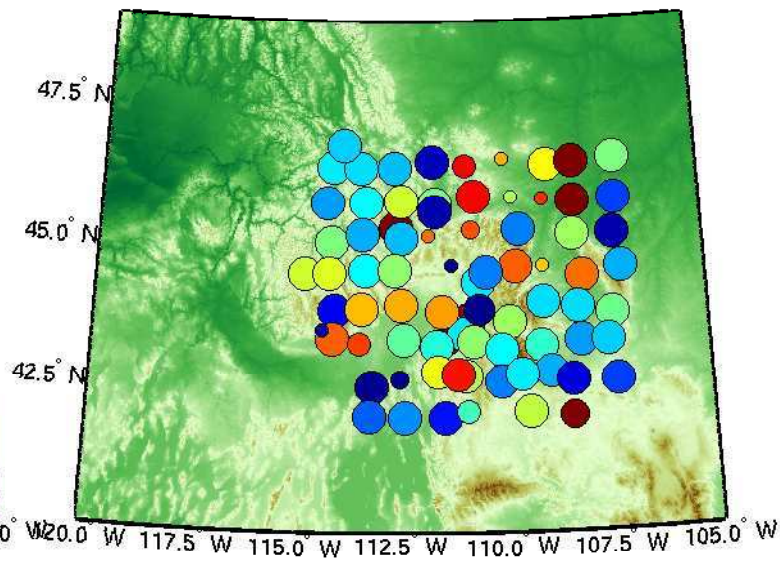
Baz = 235.7568  
Mean xcor value = 0.91024  
Range of t\* values is 2.2845  
Median t\* err is 0.18124



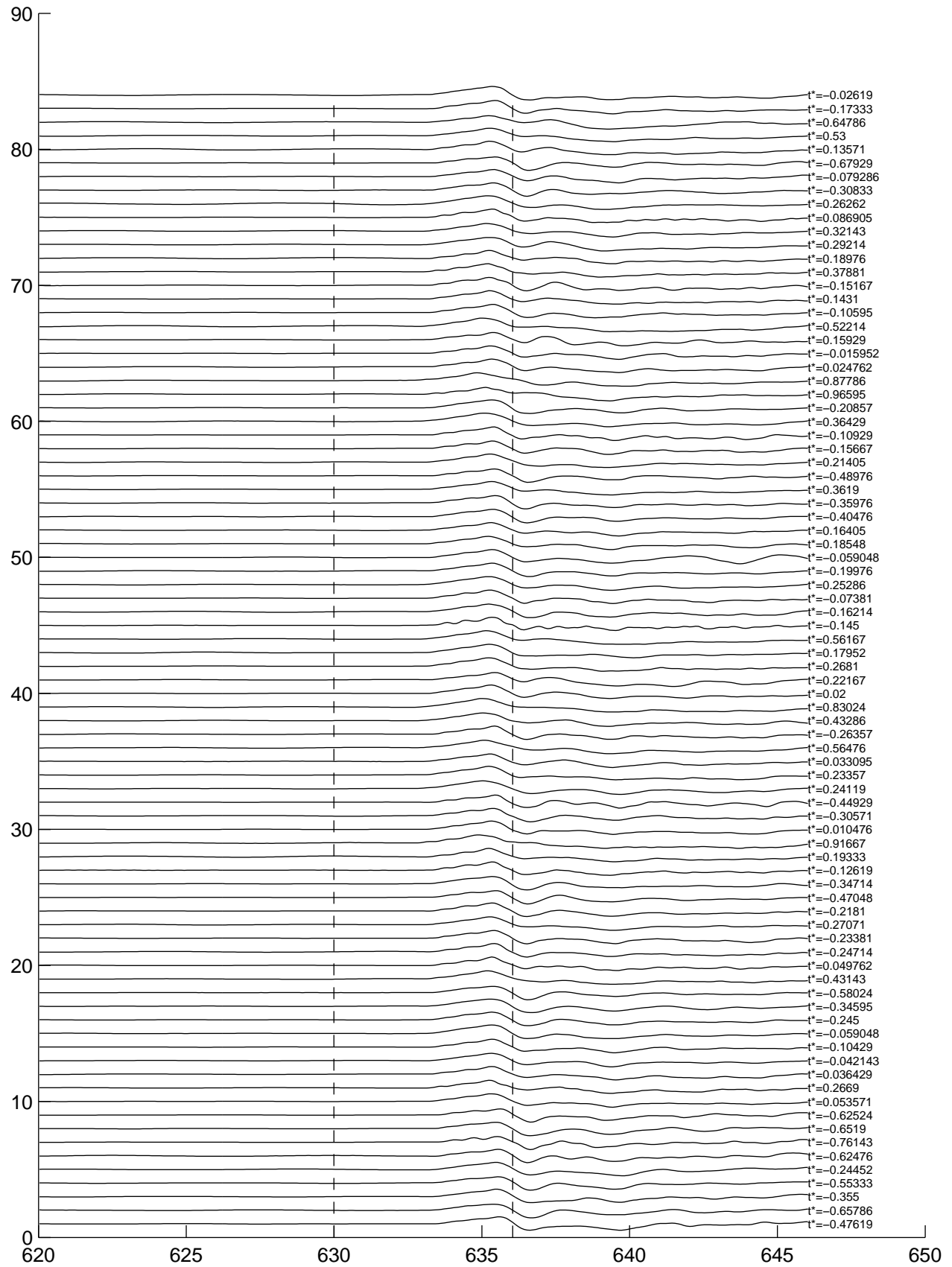
travel time residuals



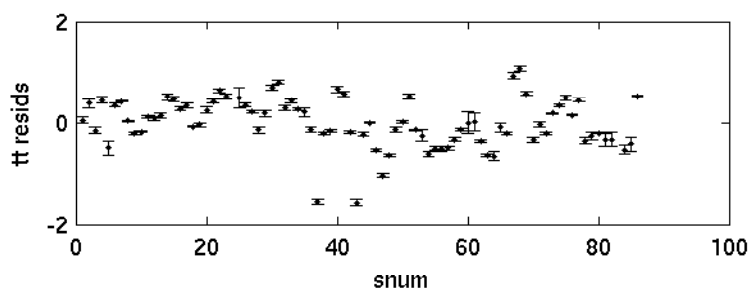
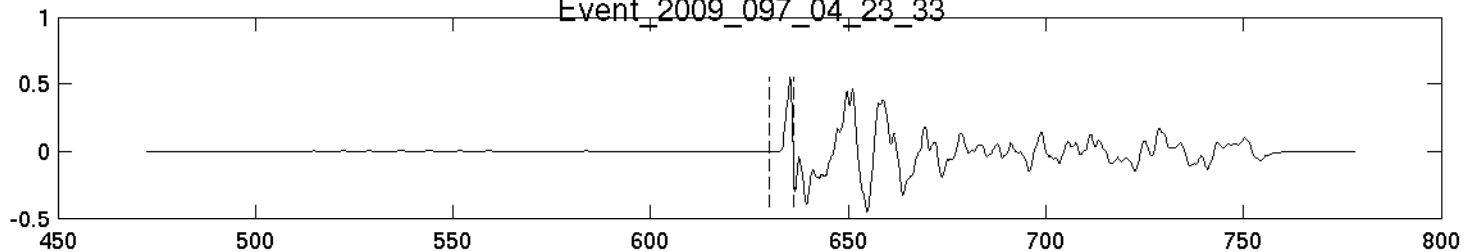
t\* values



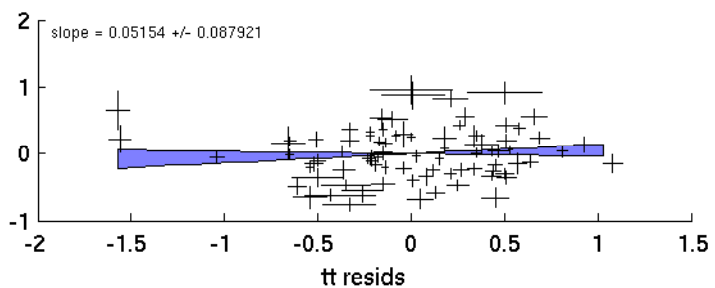
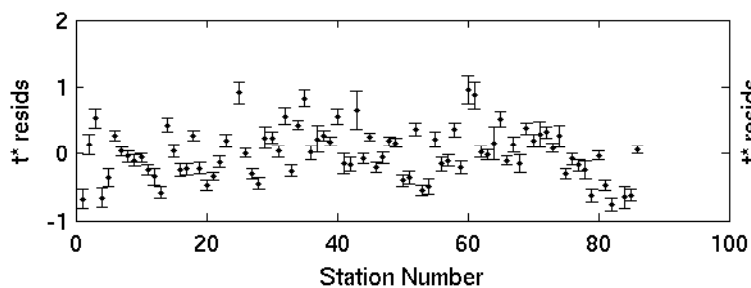
# Event\_2009\_097\_04\_23\_33



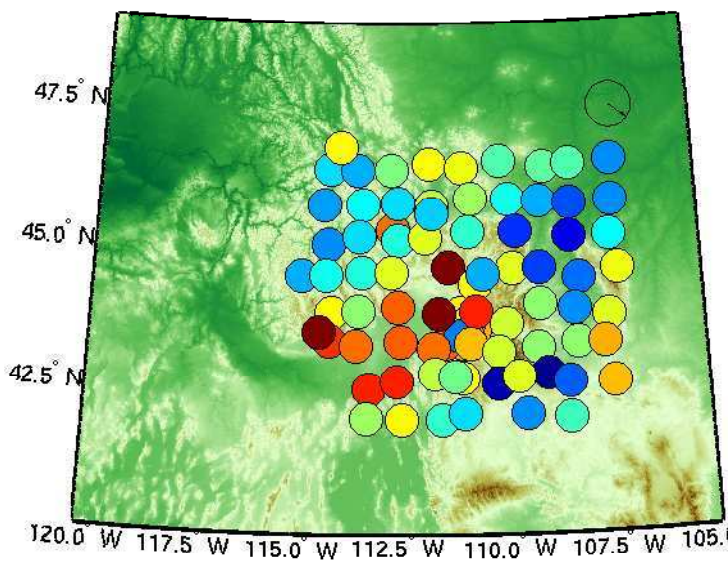
# Stack Event\_2009\_097\_04\_23\_33



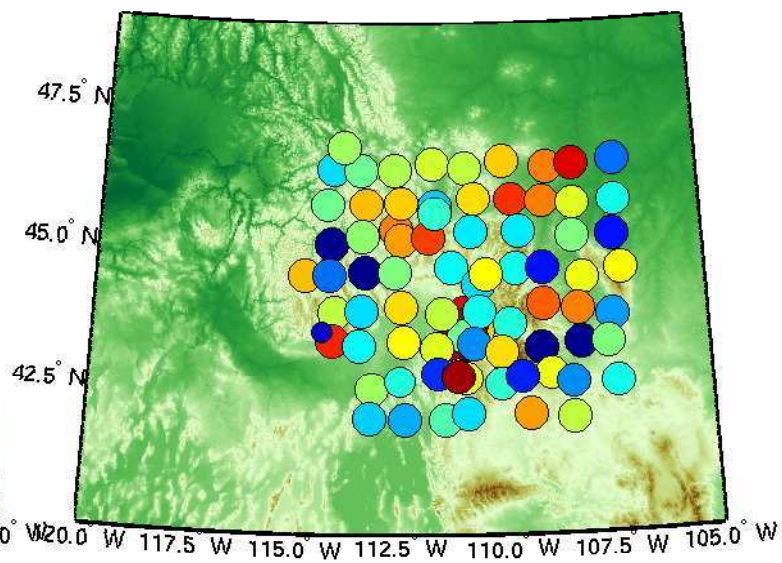
Baz = 309.996  
Mean xcor value = 0.90381  
Range of t\* values is 1.7274  
Median t\* err is 0.088882



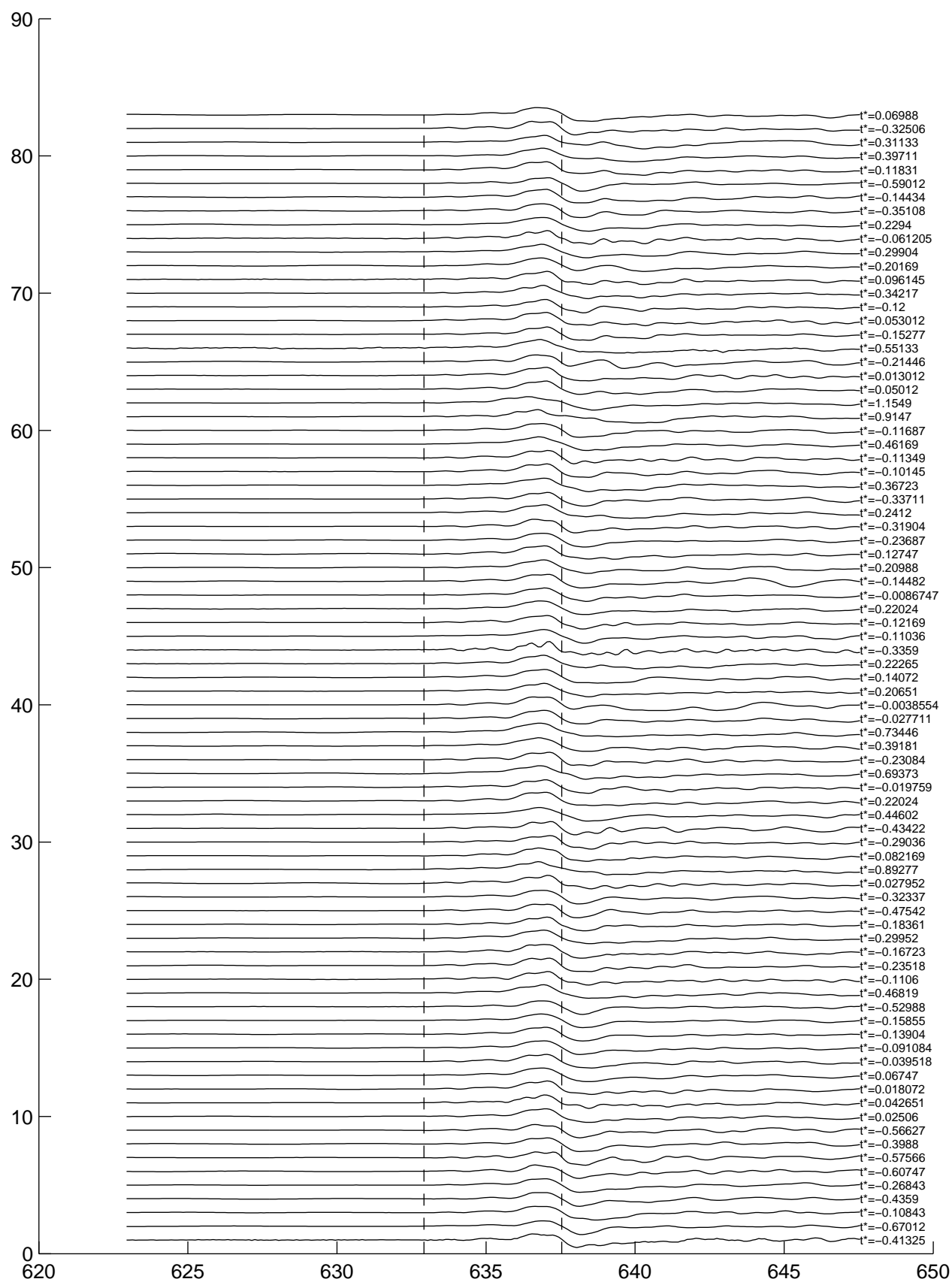
travel time residuals



t\* values

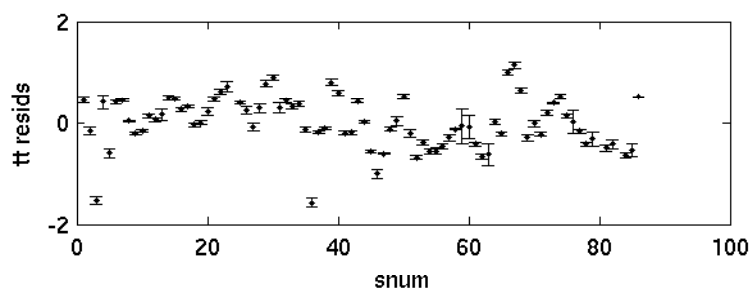
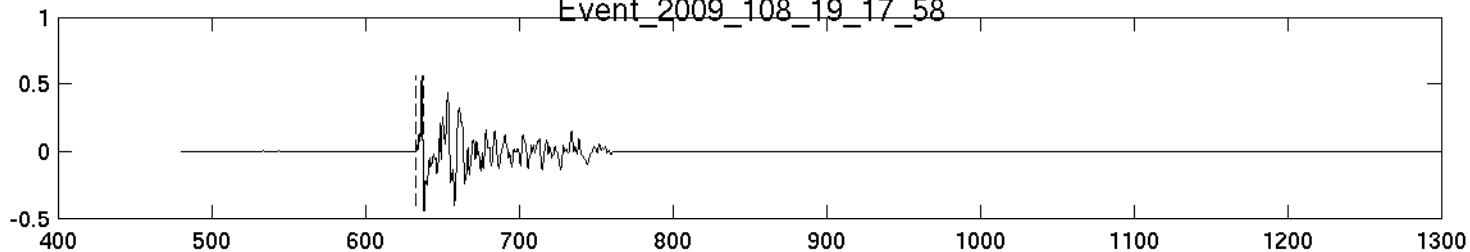


# Event\_2009\_108\_19\_17\_58

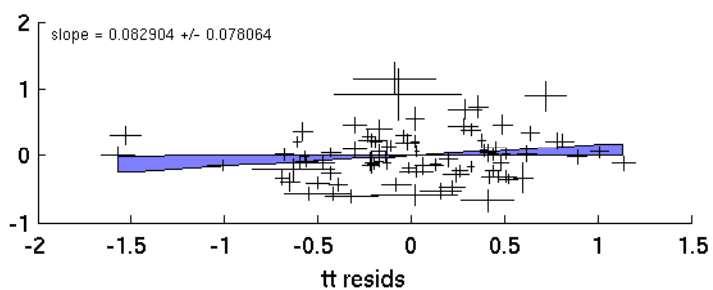
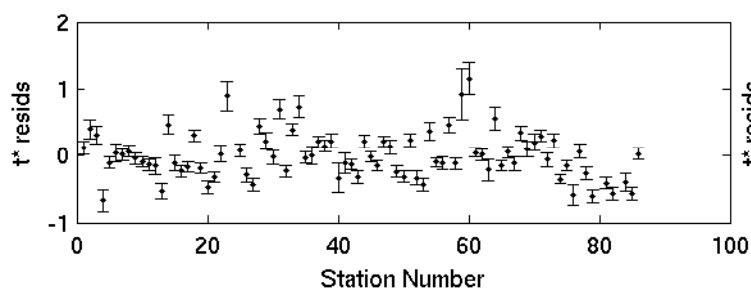




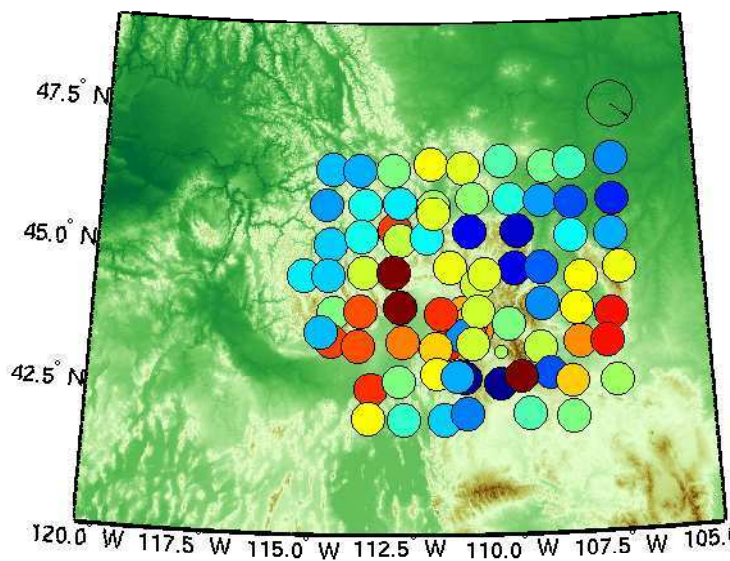
Stack  
Event\_2009\_108\_19\_17\_58



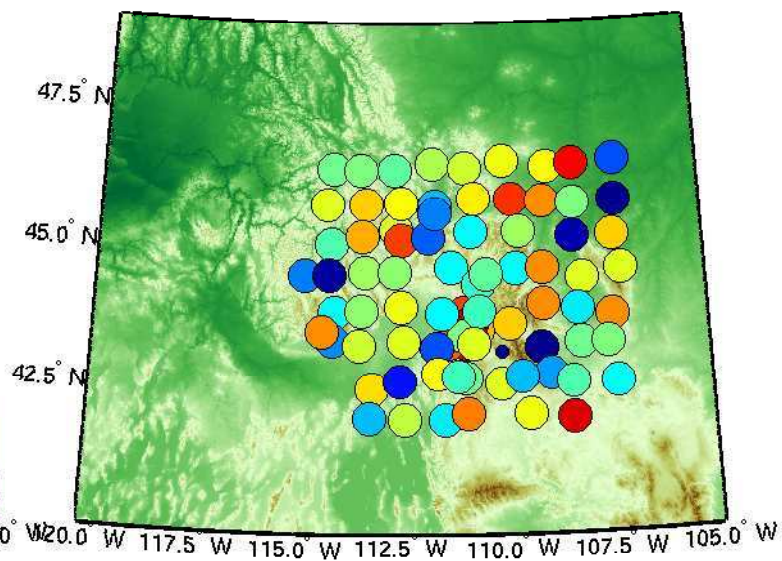
Baz = 310.0237  
Mean xcor value = 0.82976  
Range of  $t^*$  values is 1.6251  
Median  $t^*$  err is 0.097432



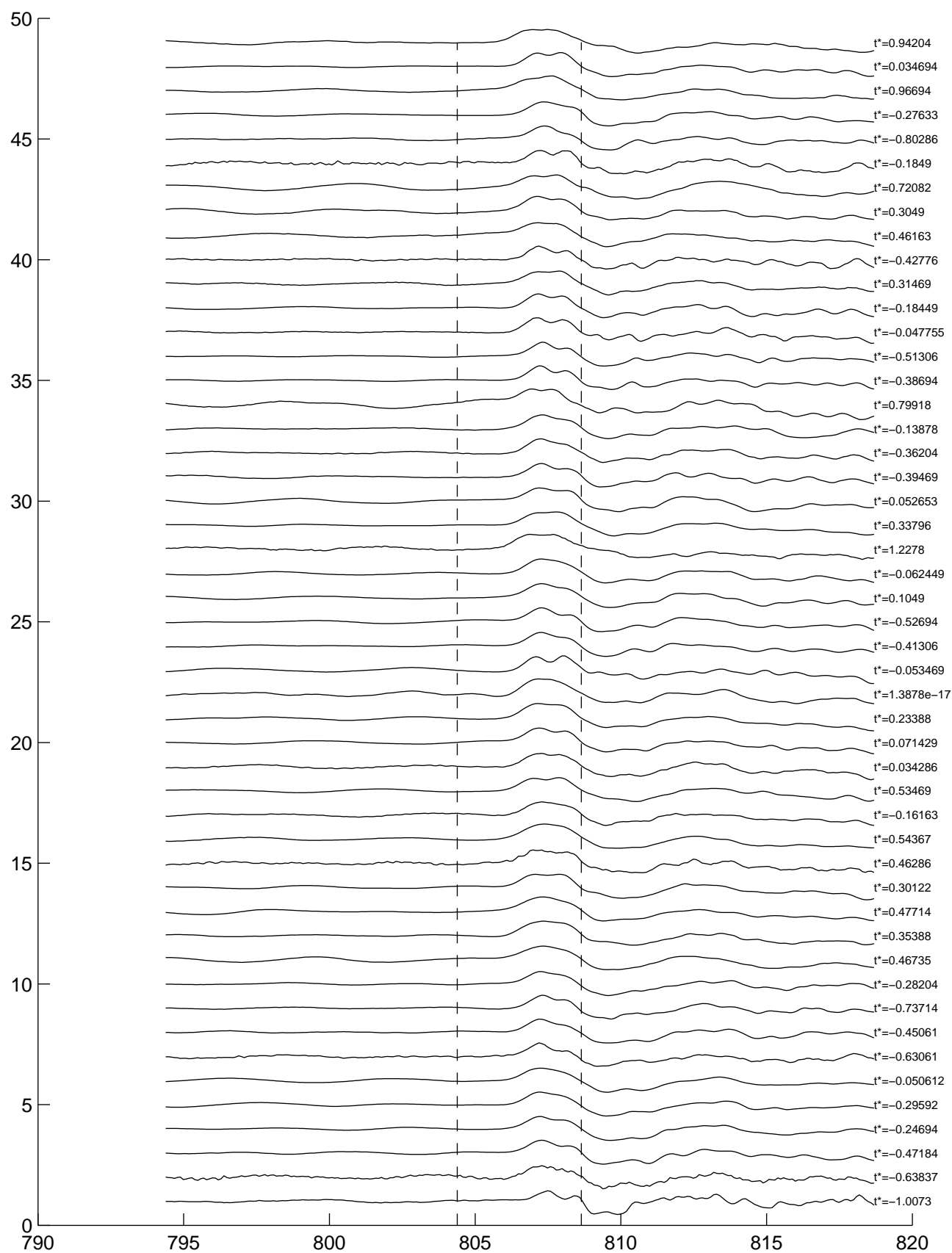
travel time residuals



$t^*$  values

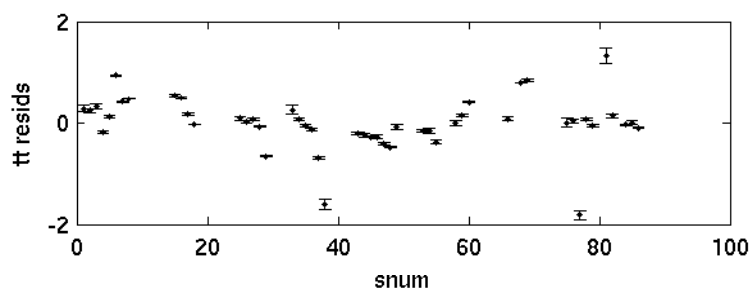
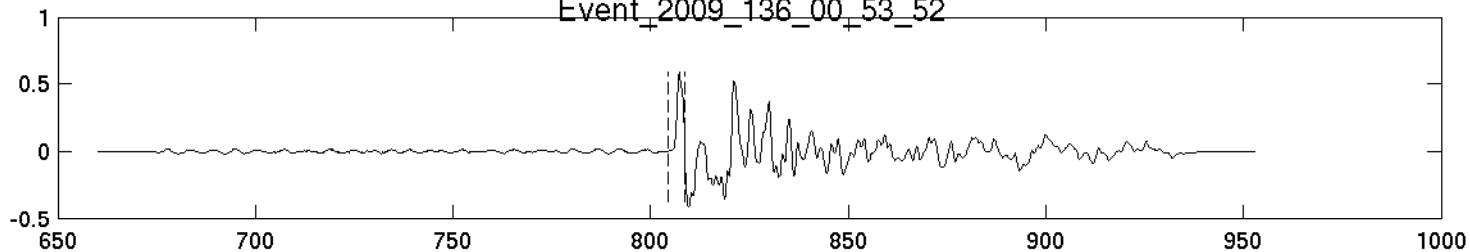


# Event\_2009\_136\_00\_53\_52

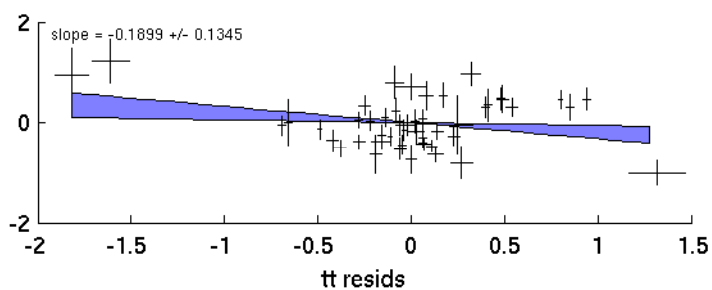
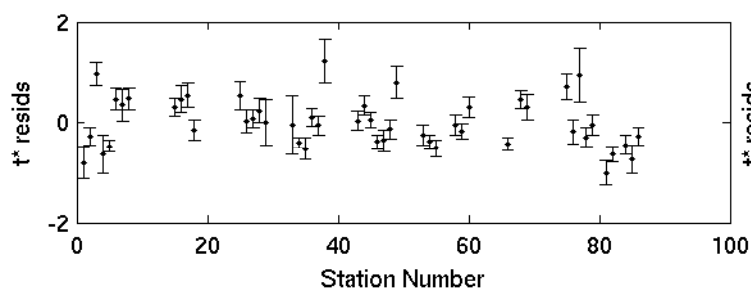




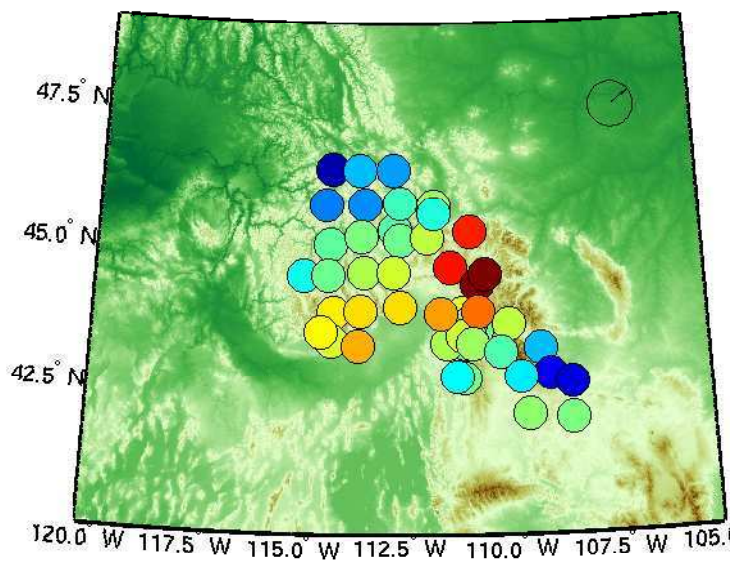
Stack  
Event\_2009\_136\_00\_53\_52



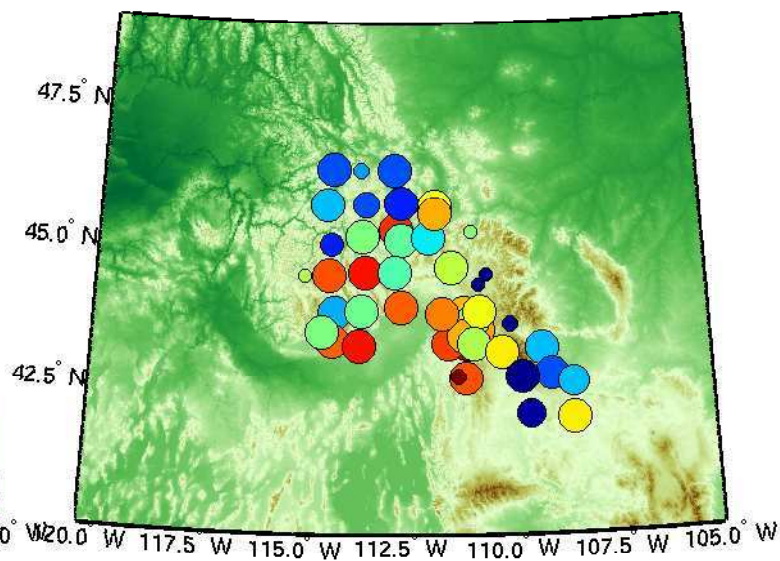
Baz = 233.09  
Mean xcor value = 0.84469  
Range of t\* values is 2.2351  
Median t\* err is 0.2064



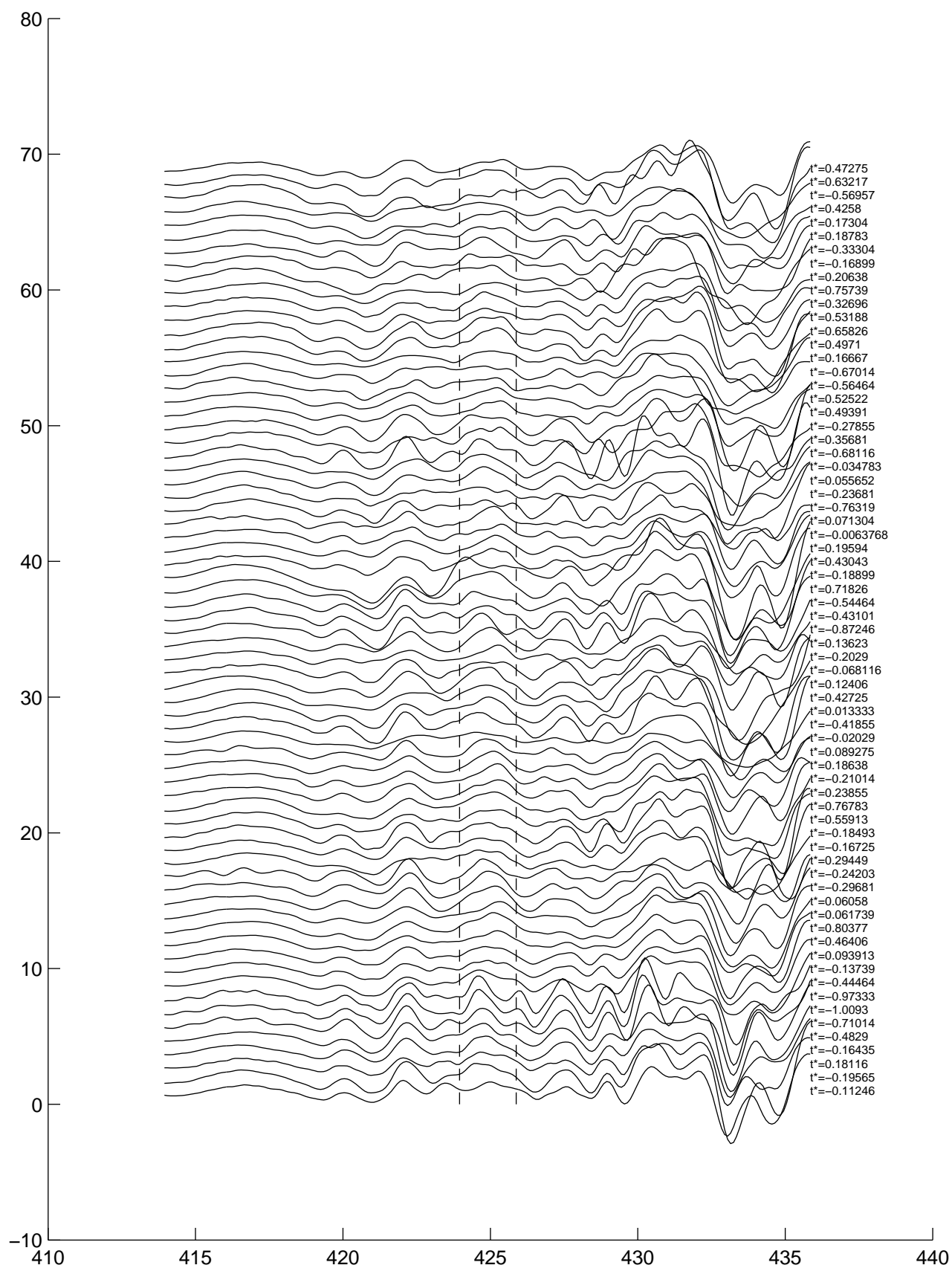
travel time residuals



t\* values

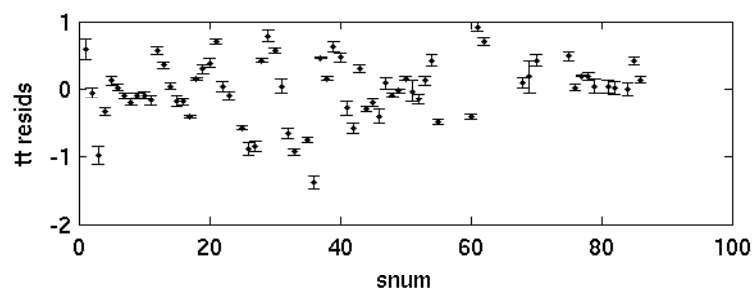
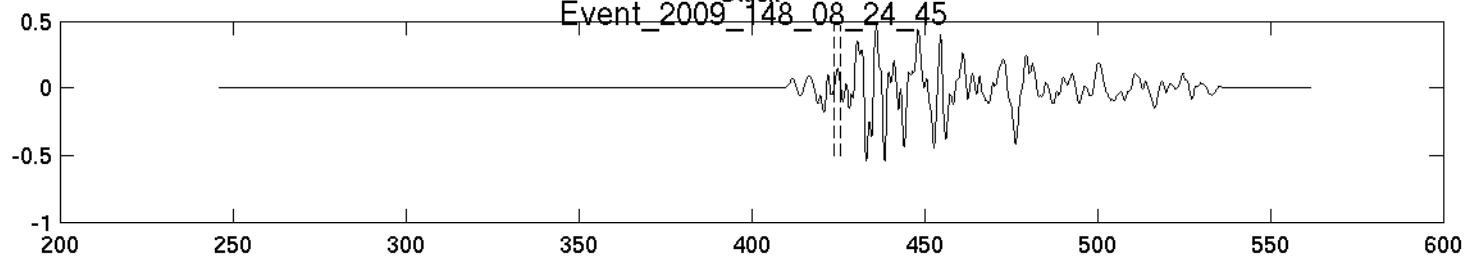


# Event\_2009\_148\_08\_24\_45

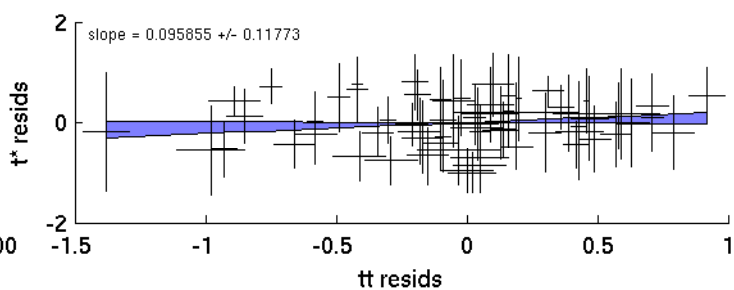
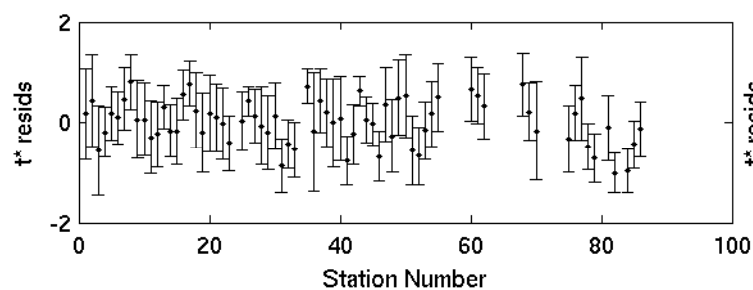


Event\_2009\_148\_08\_24\_45

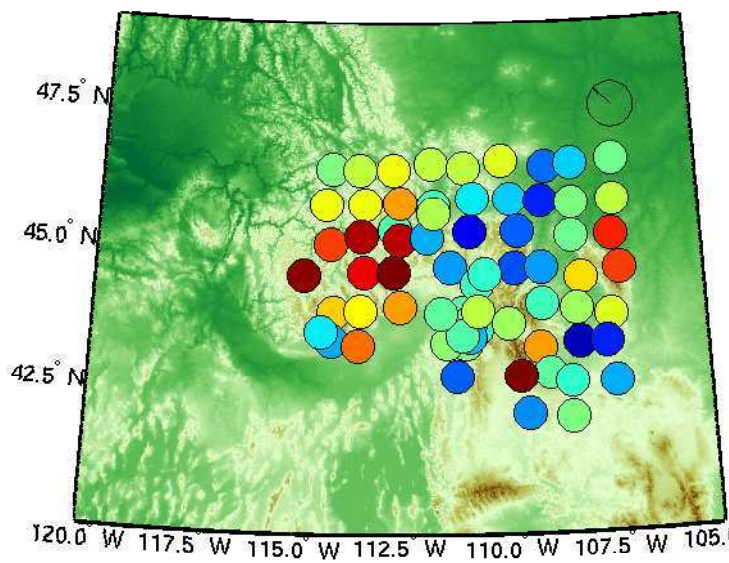
Stack



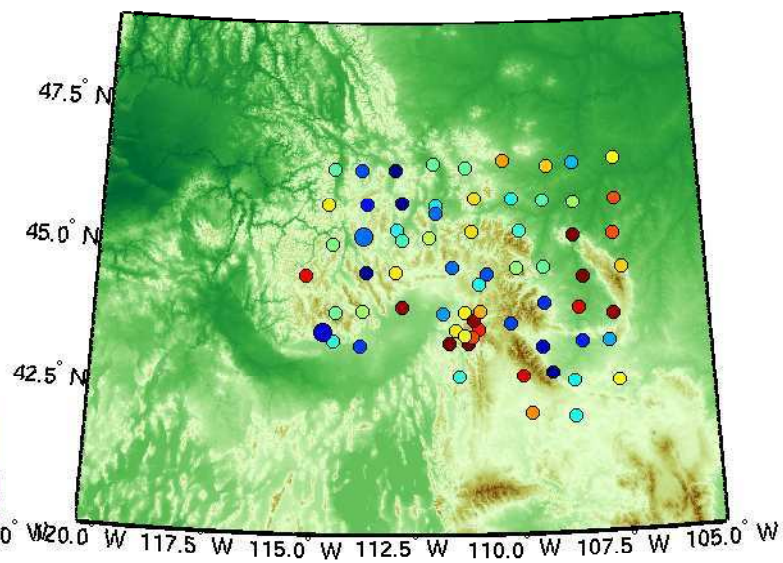
Baz = 135.7283  
Mean xcor value = 0.78913  
Range of t\* values is 1.813  
Median t\* err is 0.62799



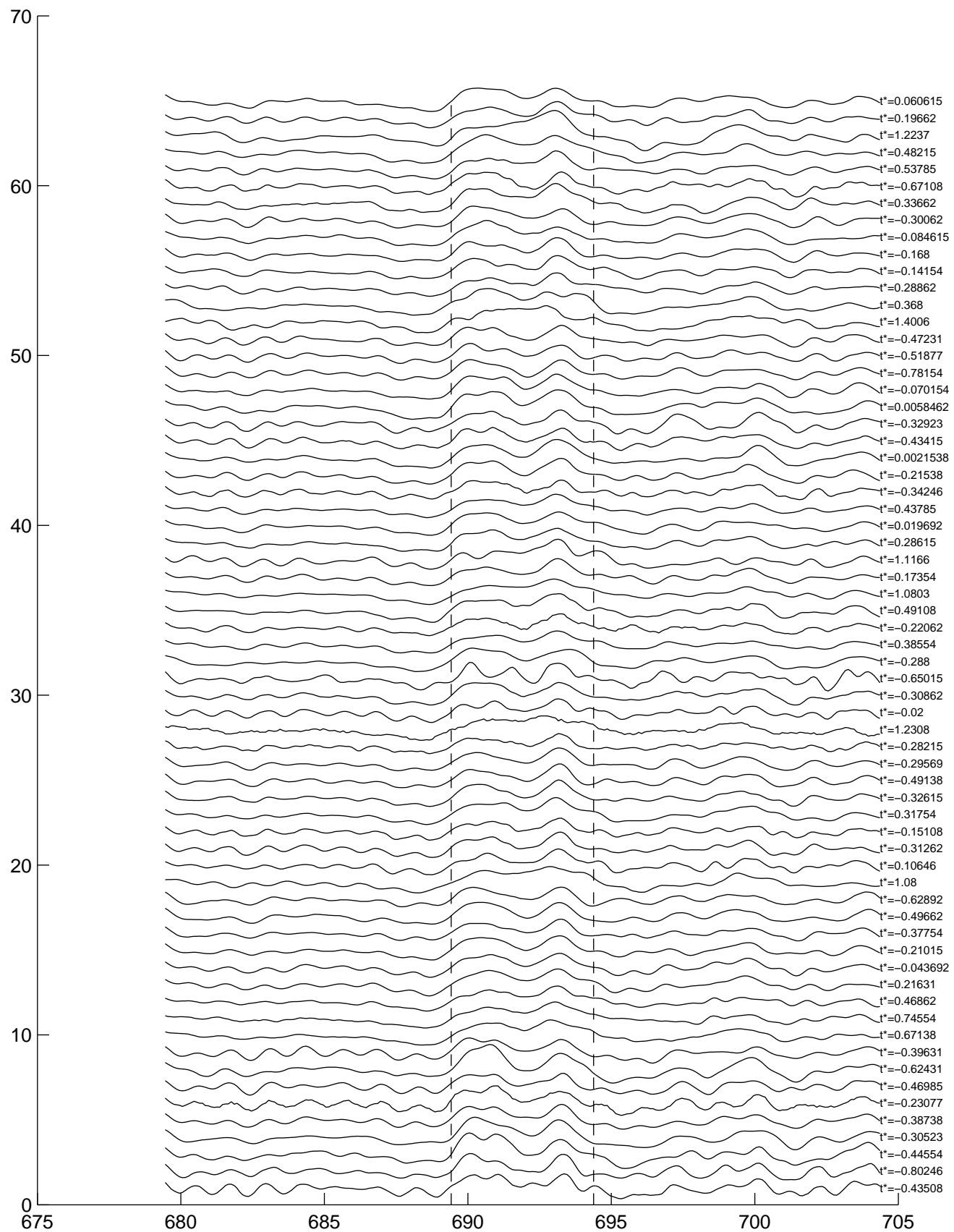
travel time residuals



t\* values

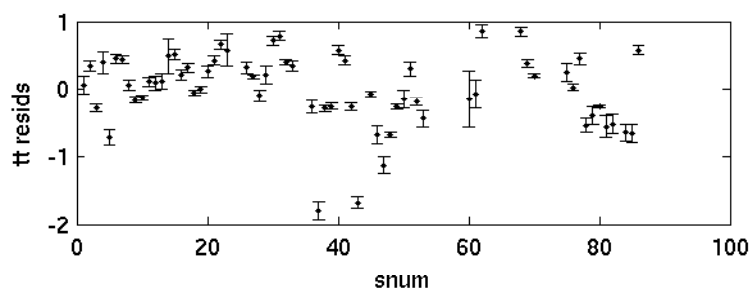
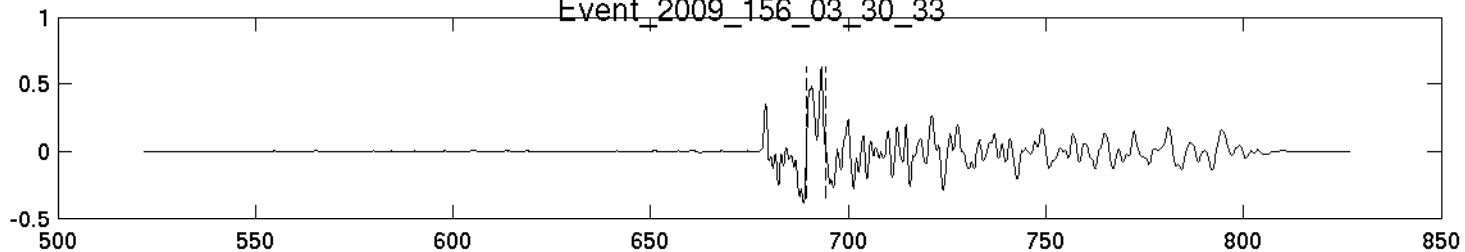


# Event\_2009\_156\_03\_30\_33

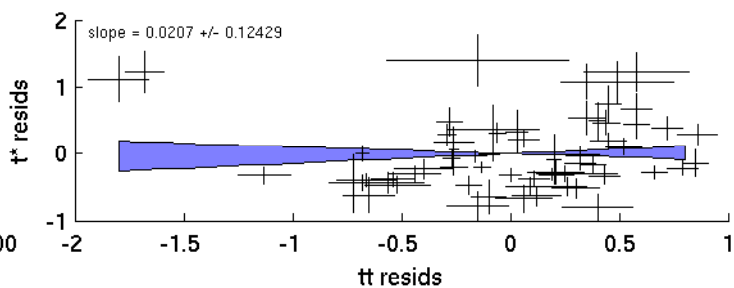
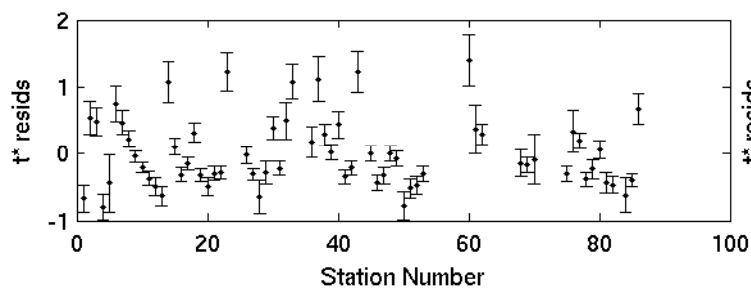




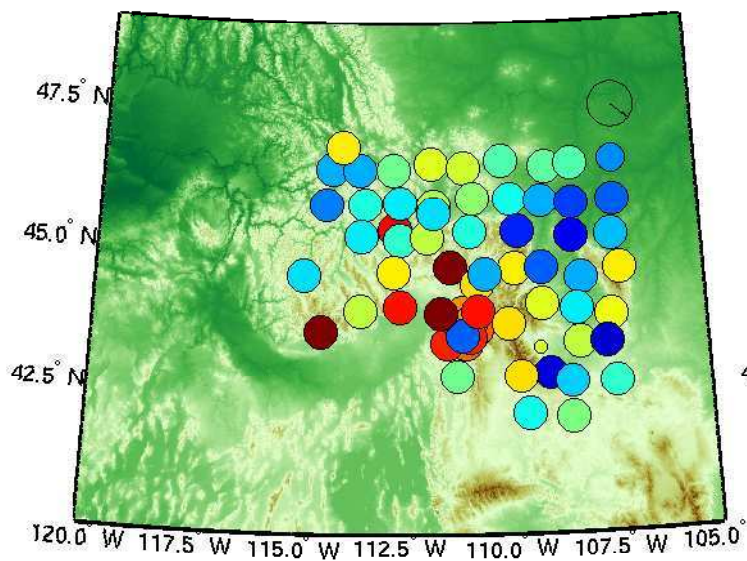
Stack  
Event\_2009\_156\_03\_30\_33



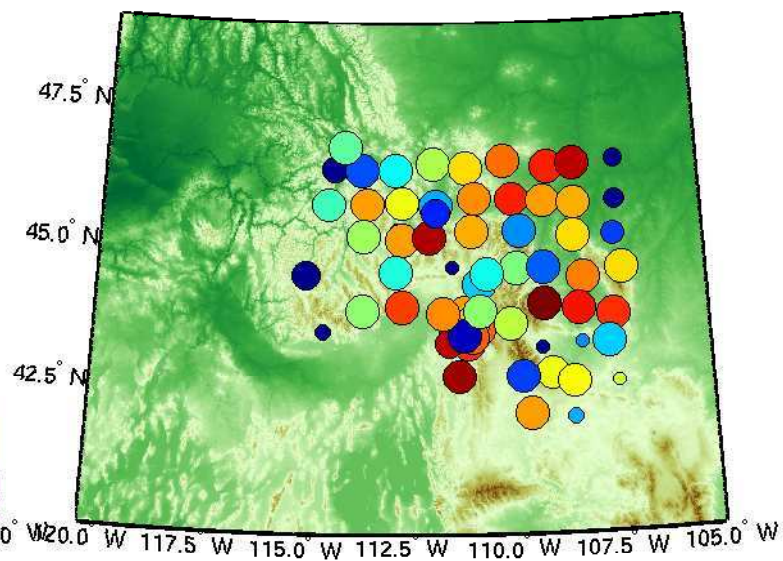
Baz = 310.7874  
Mean xcor value = 0.86385  
Range of  $t^*$  values is 2.2031  
Median  $t^*$  err is 0.13908

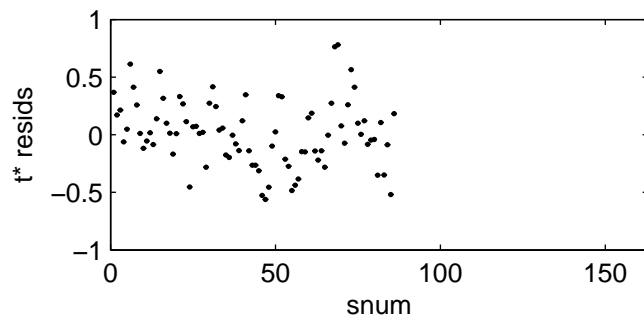
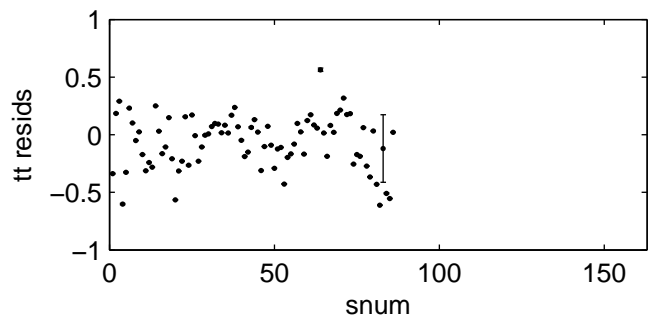
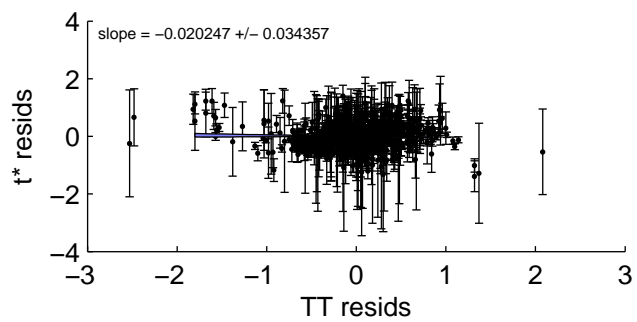
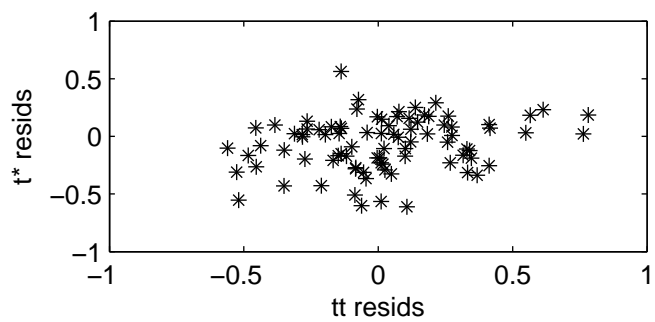


travel time residuals

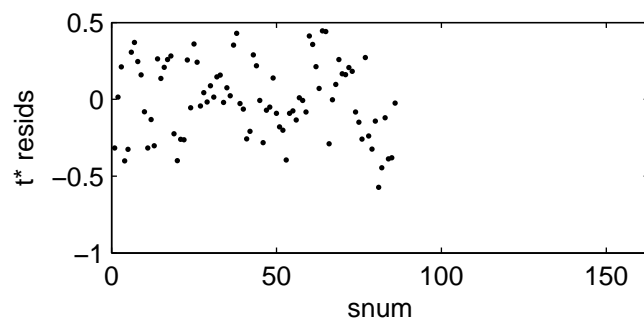
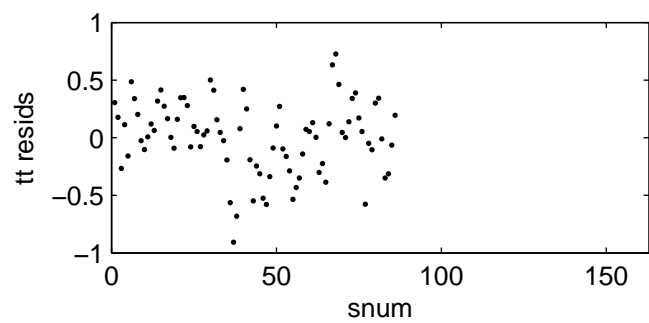
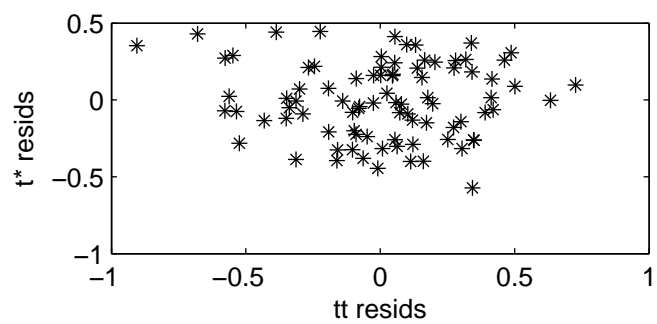


$t^*$  values

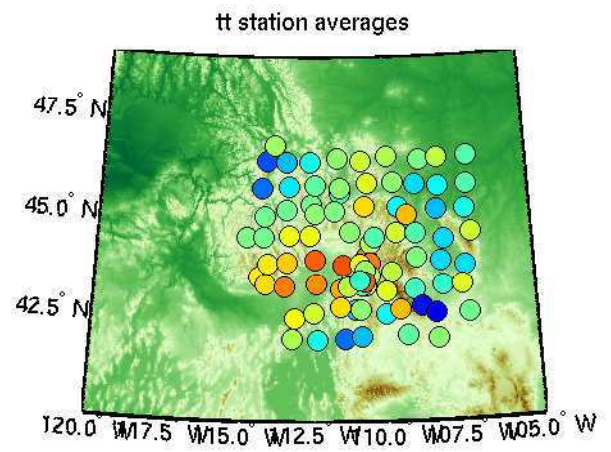
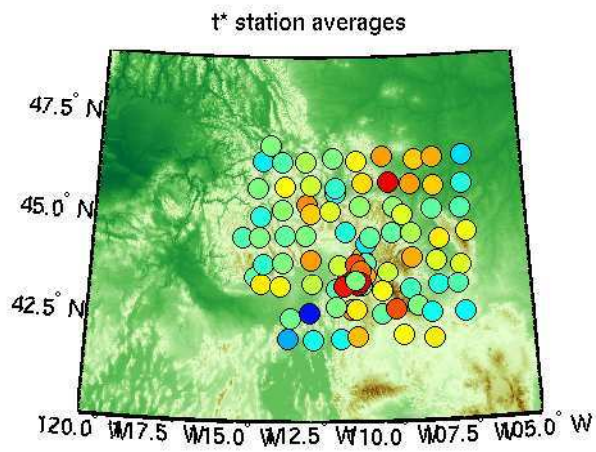
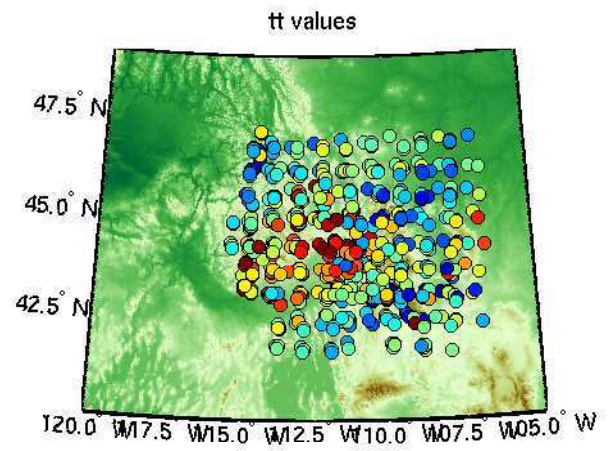
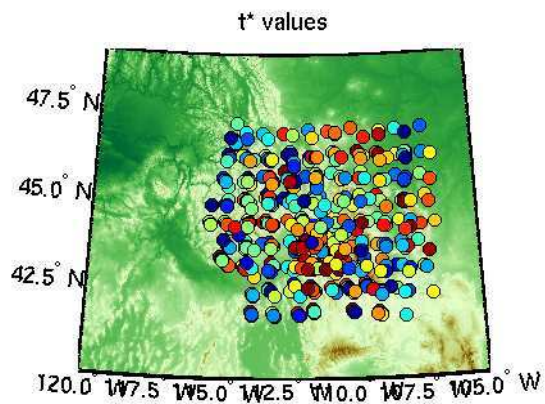








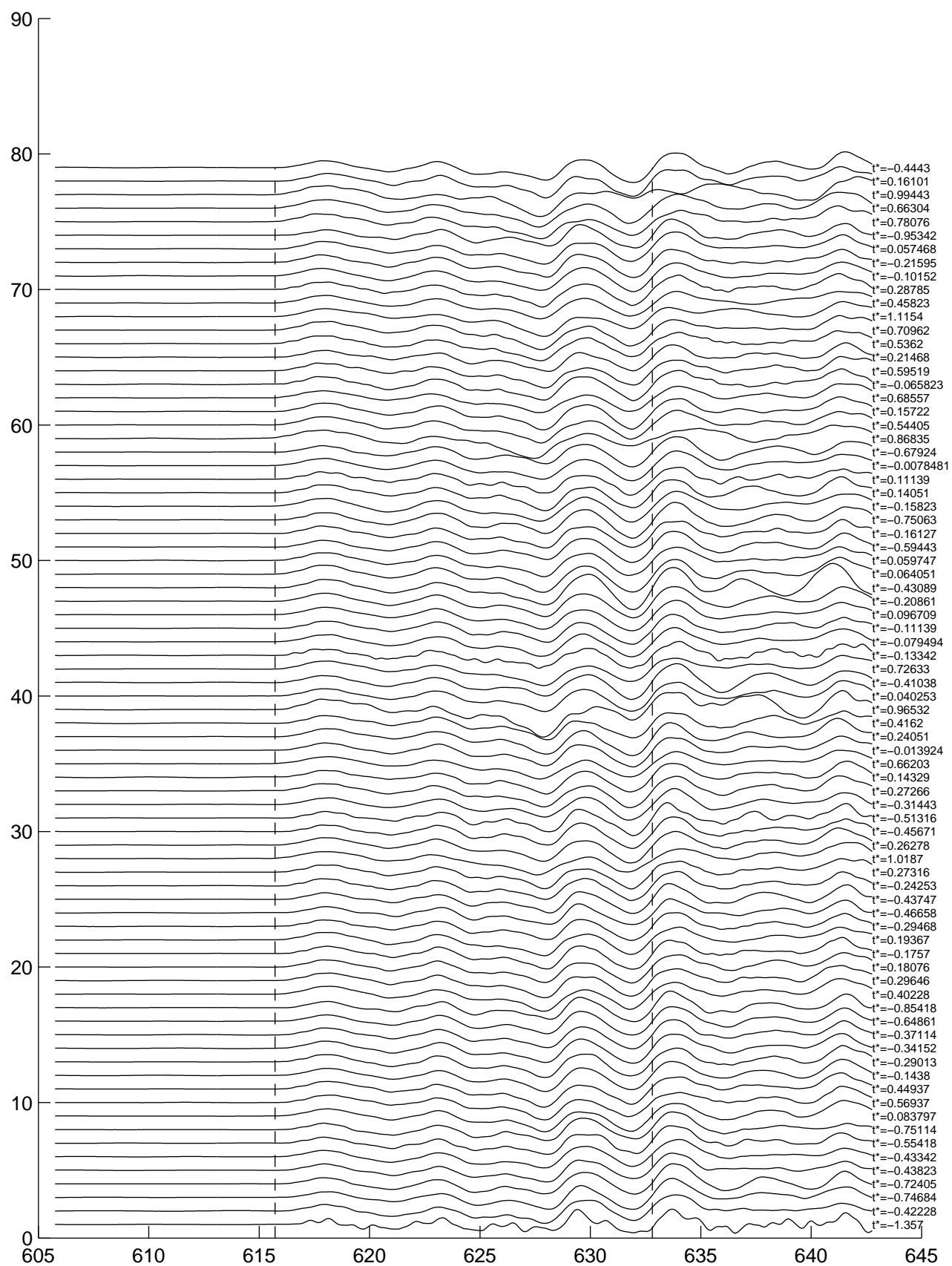
ALL DATA



### CATEGORY 3

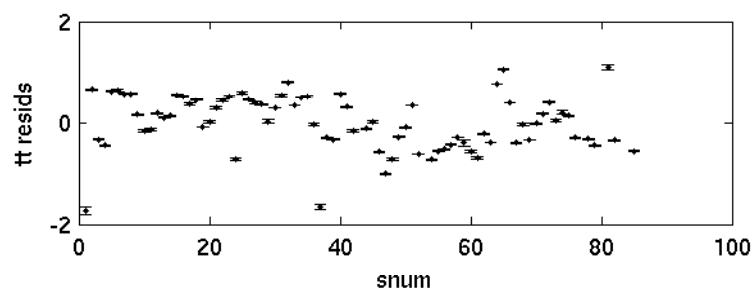
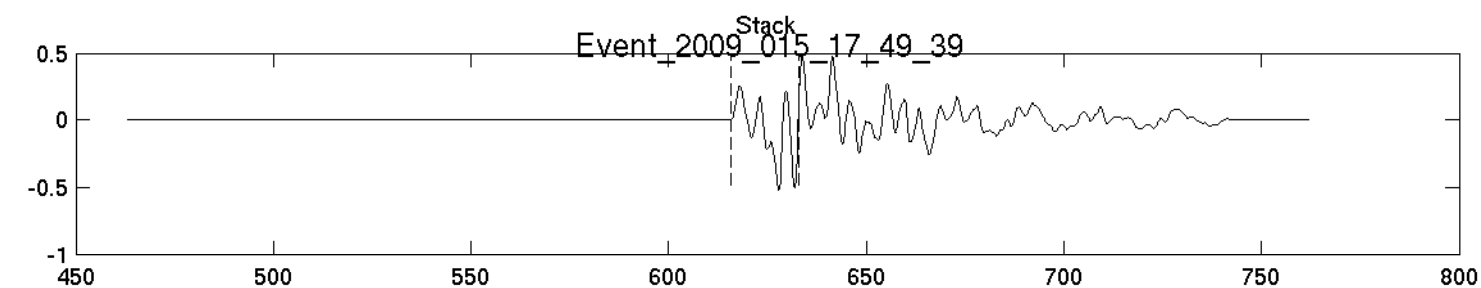
THE SELECTION OF A LARGER UNIT OF THE P WAVEFORM

# Event\_2009\_015\_17\_49\_39

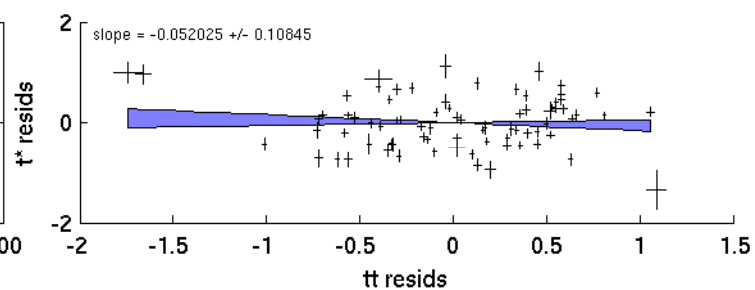
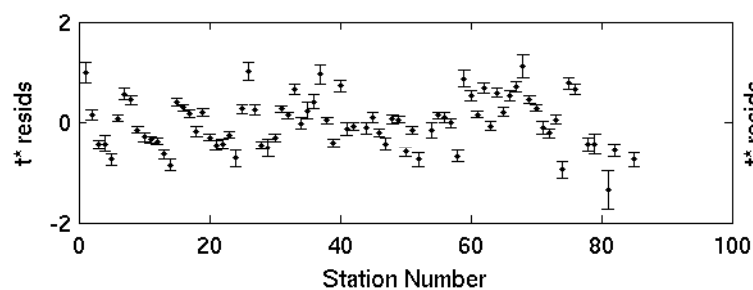


Event 2009\_015\_17\_49\_39

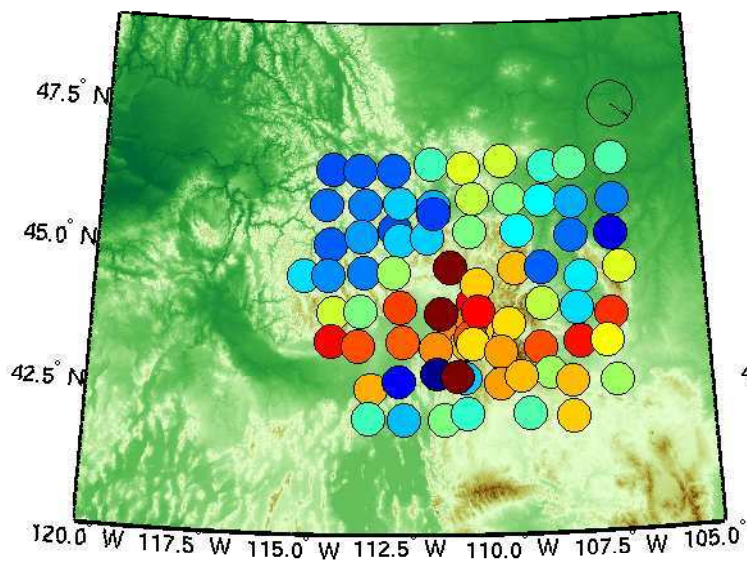
Stack



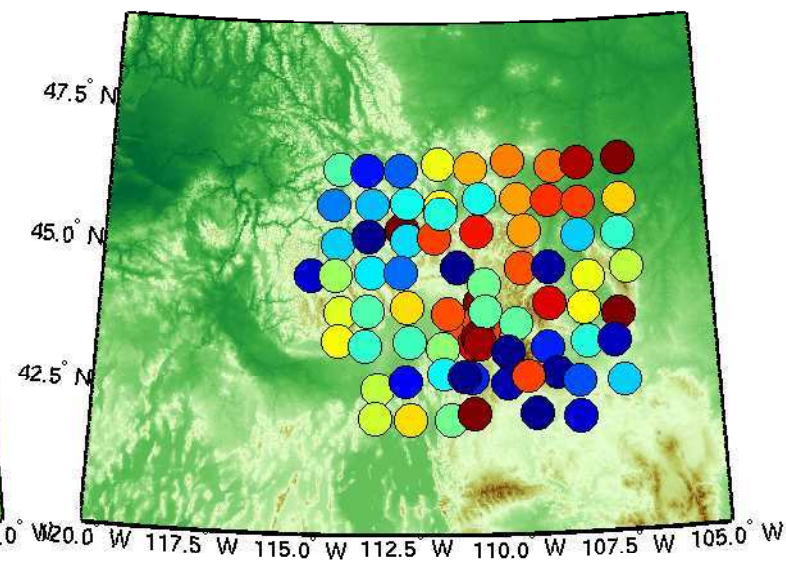
Baz = 309.043  
Mean xcor value = 0.89747  
Range of t\* values is 2.4724  
Median t\* err is 0.096155



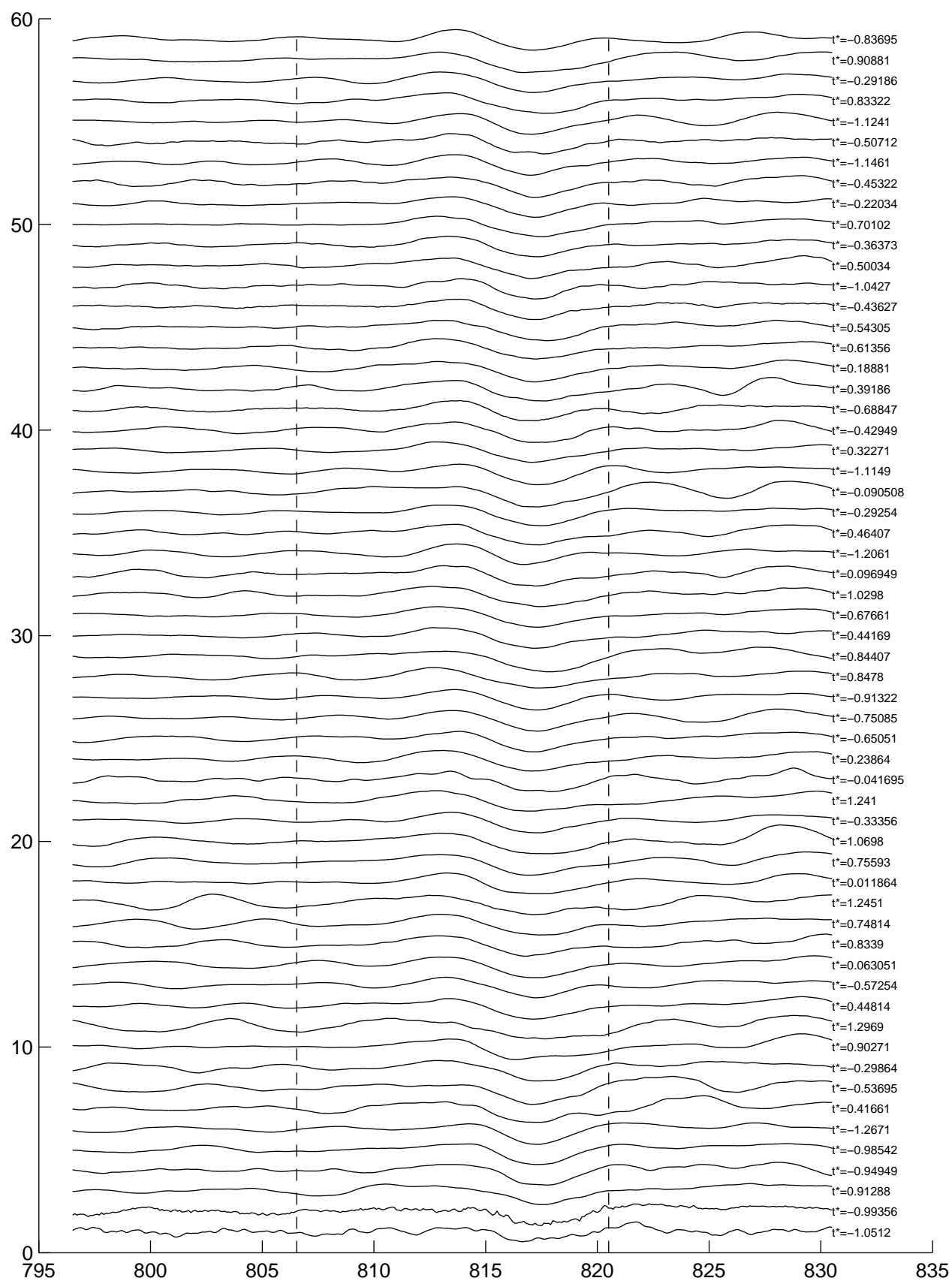
travel time residuals



t\* values



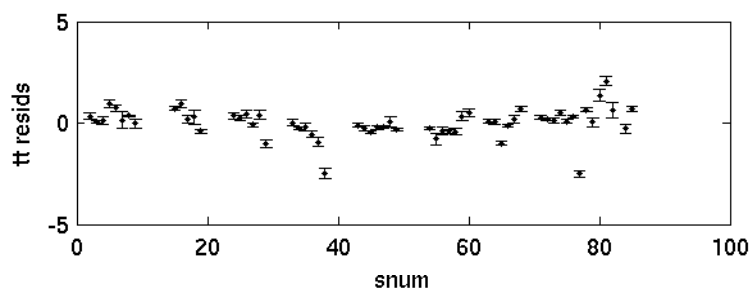
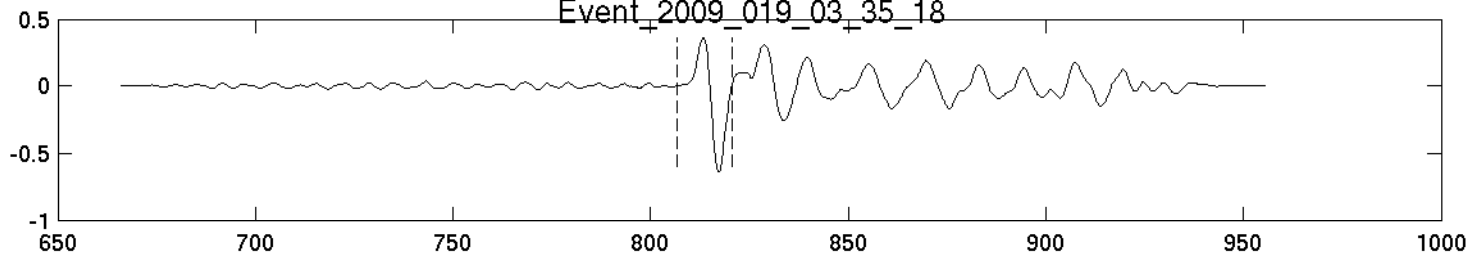
# Event\_2009\_019\_03\_35\_18



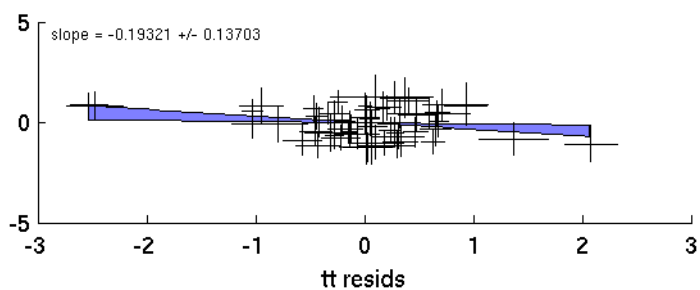
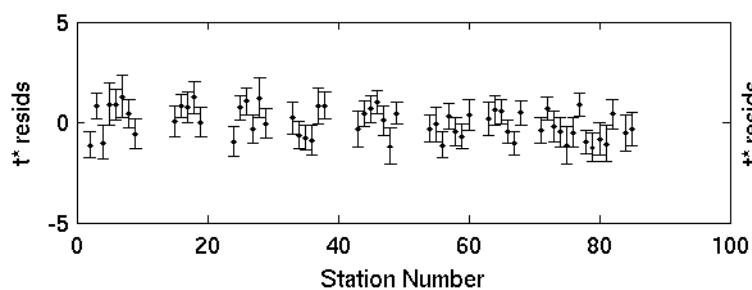


Event 2009\_019\_03\_35\_18

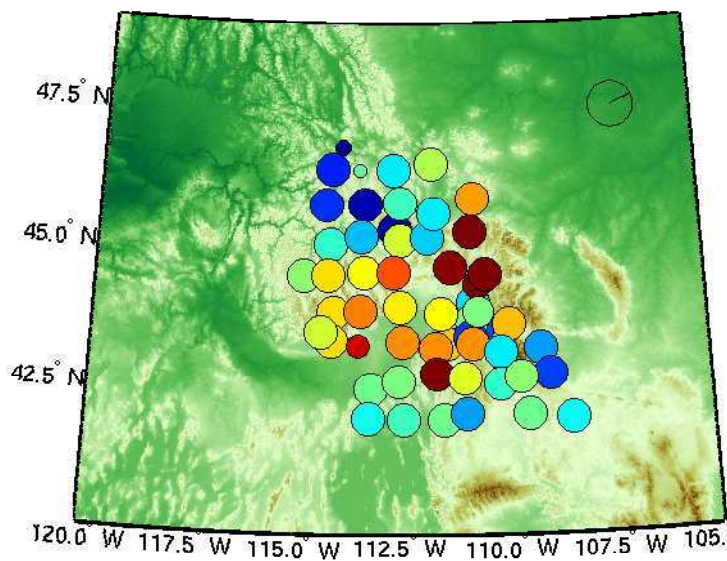
Stack



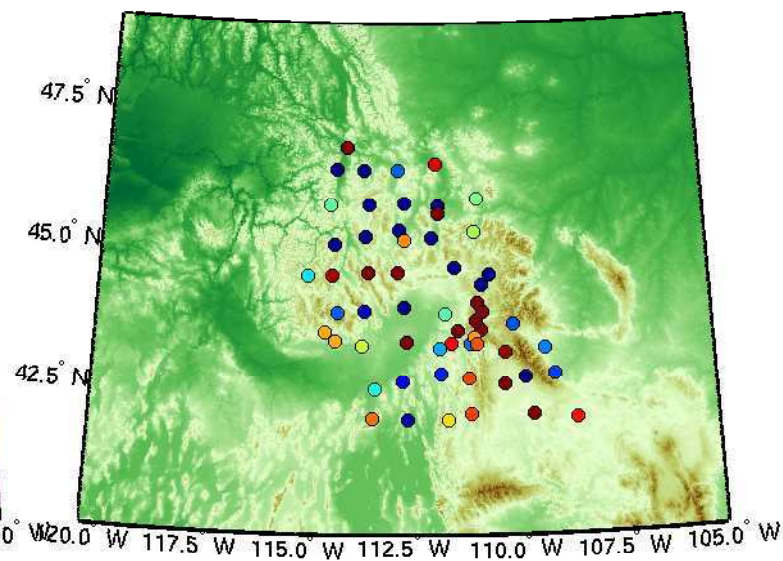
Baz = 245.8635  
Mean xcor value = 0.83102  
Range of t\* values is 2.5641  
Median t\* err is 0.71506



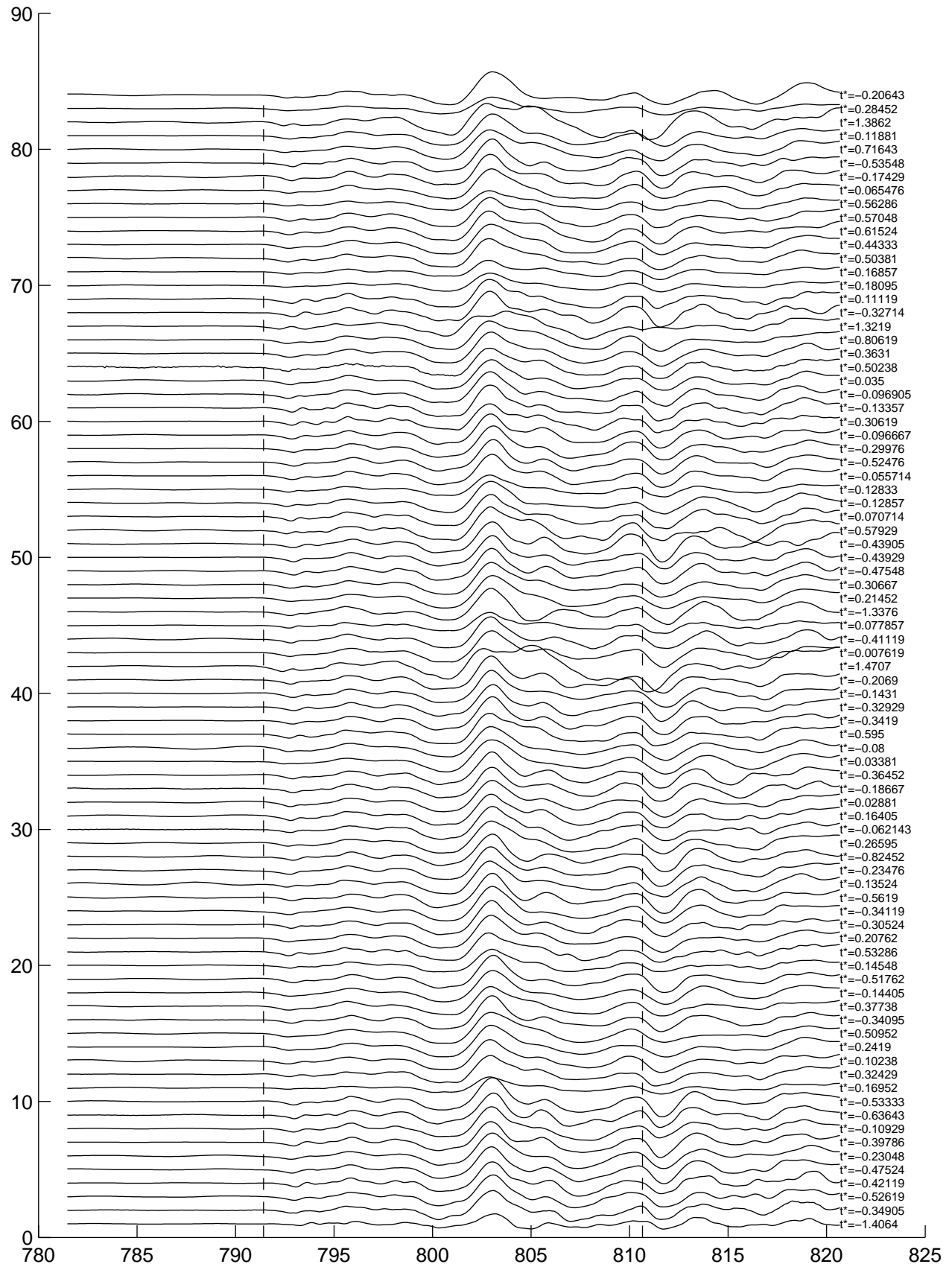
travel time residuals



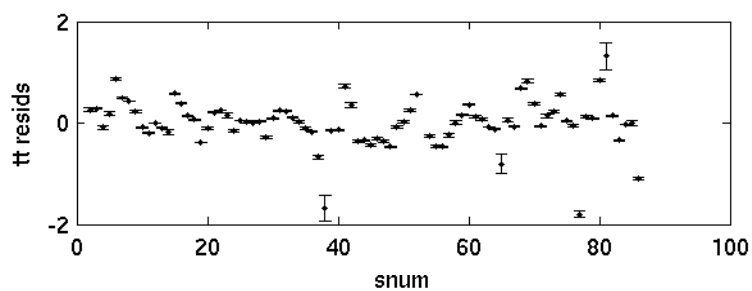
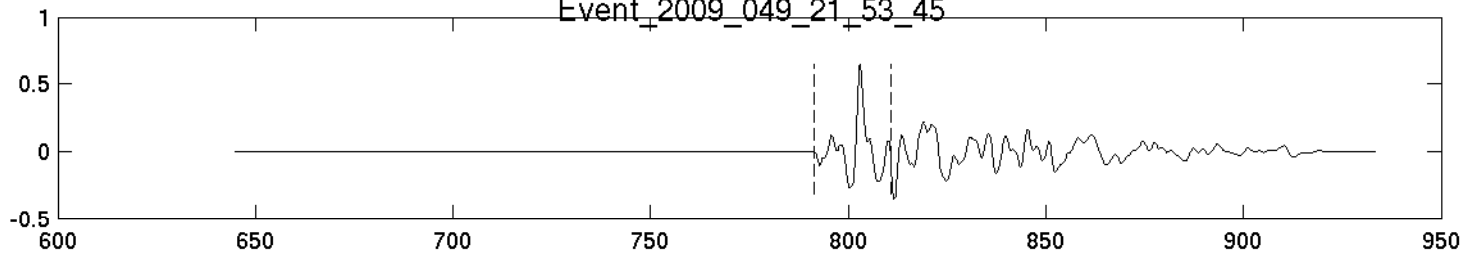
t\* values



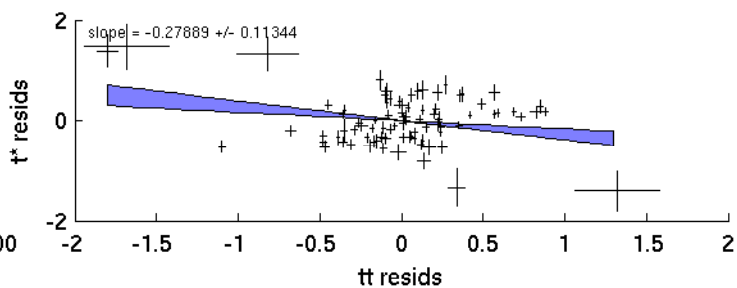
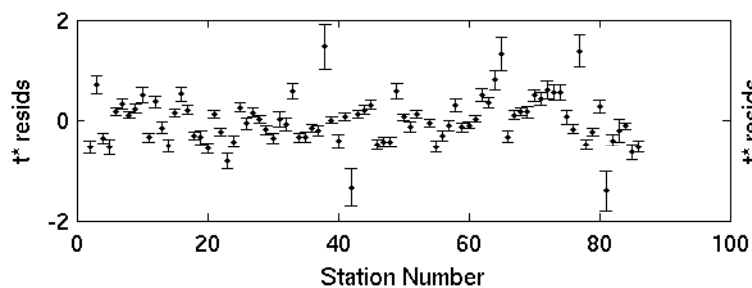
# Event\_2009\_049\_21\_53\_45



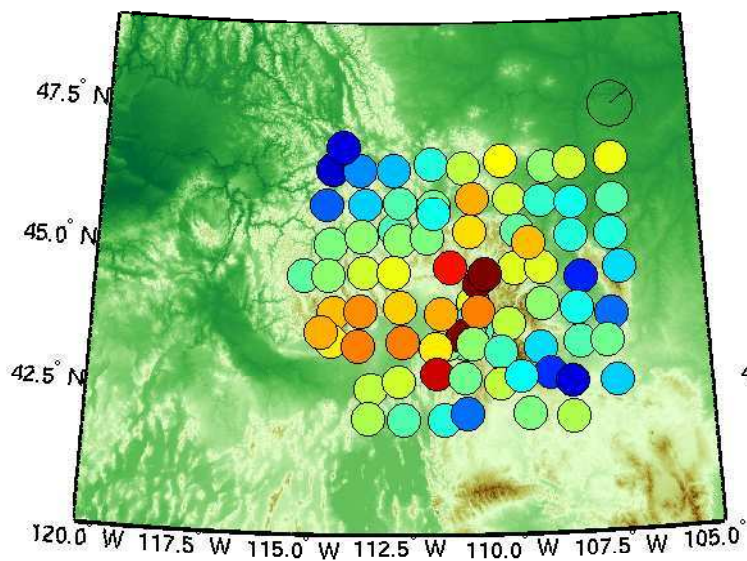
Stack  
Event\_2009\_049\_21\_53\_45



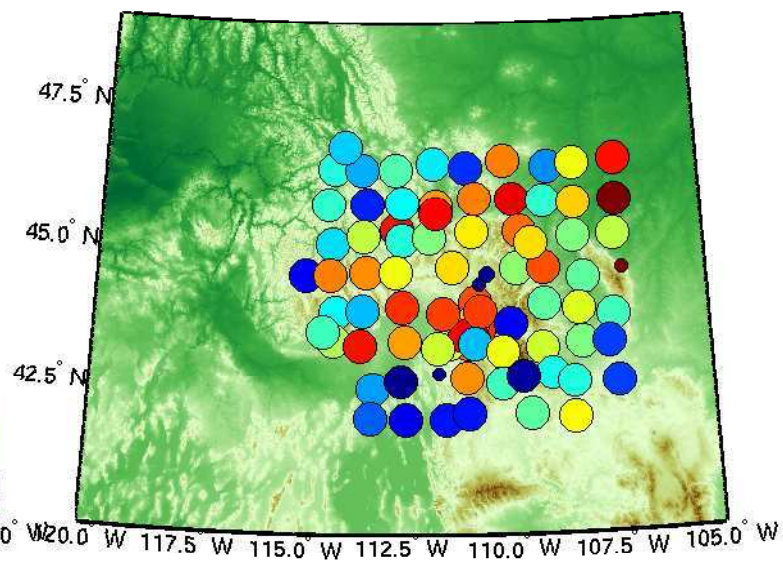
Baz = 234.0821  
Mean xcor value = 0.91262  
Range of t\* values is 2.8771  
Median t\* err is 0.1052



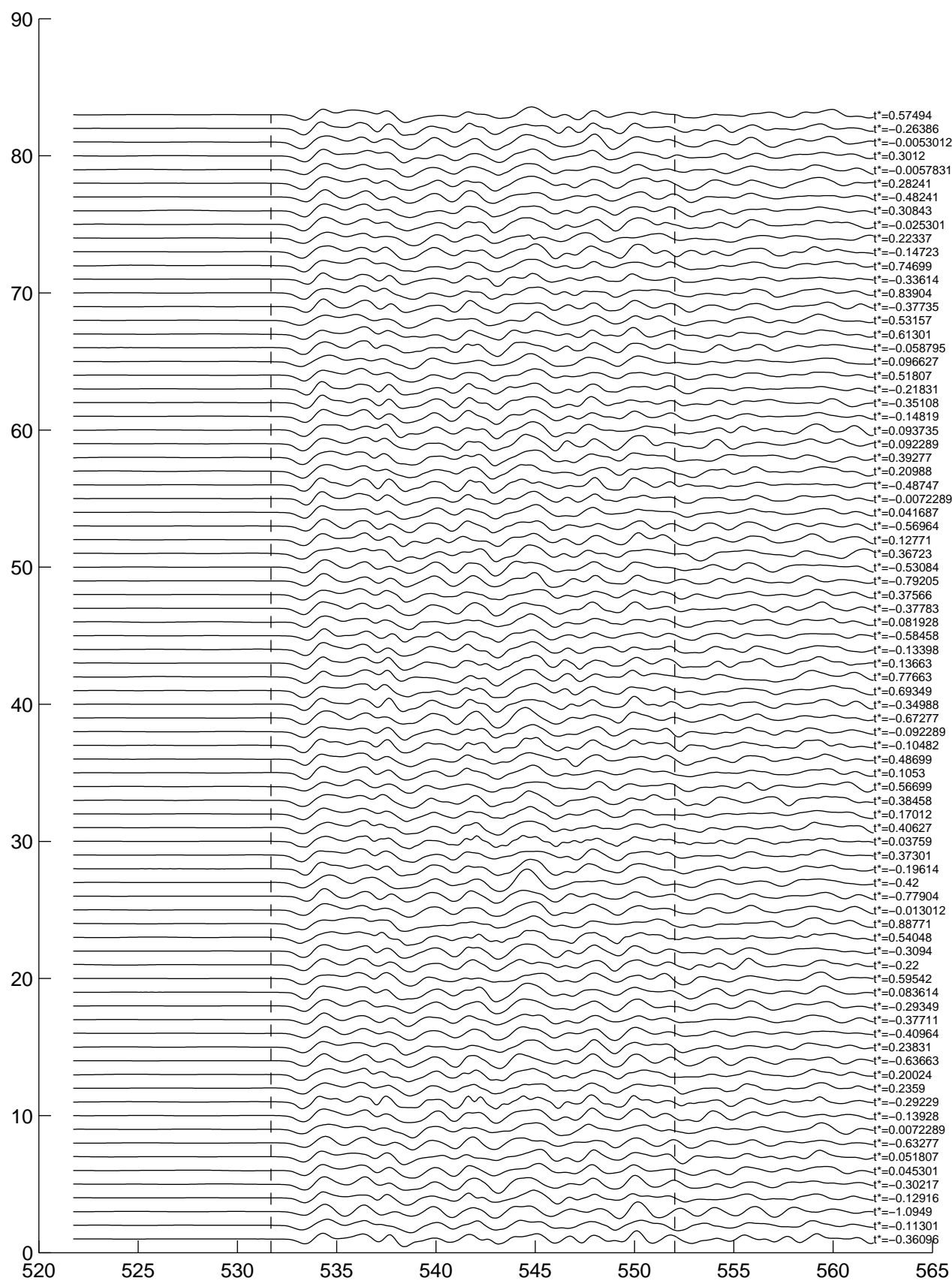
travel time residuals



t\* values



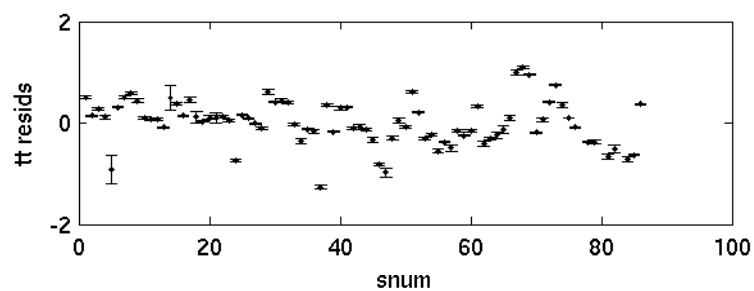
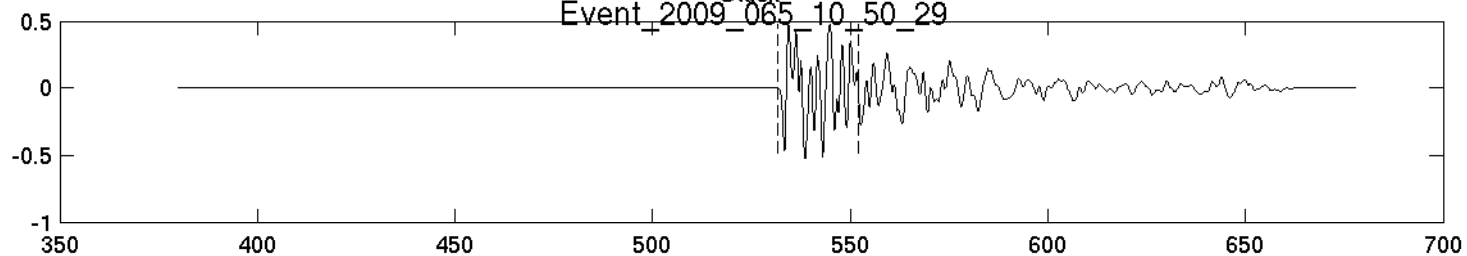
# Event\_2009\_065\_10\_50\_29



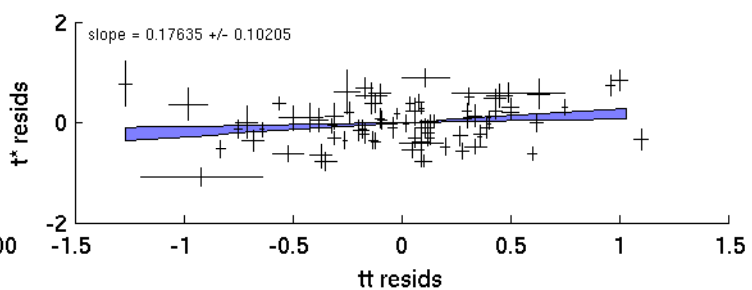
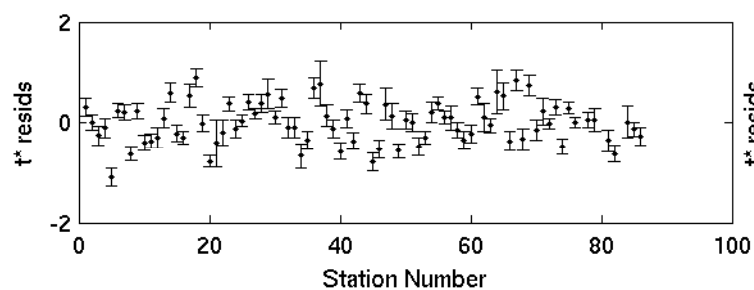


Event\_2009\_065 10\_50\_29

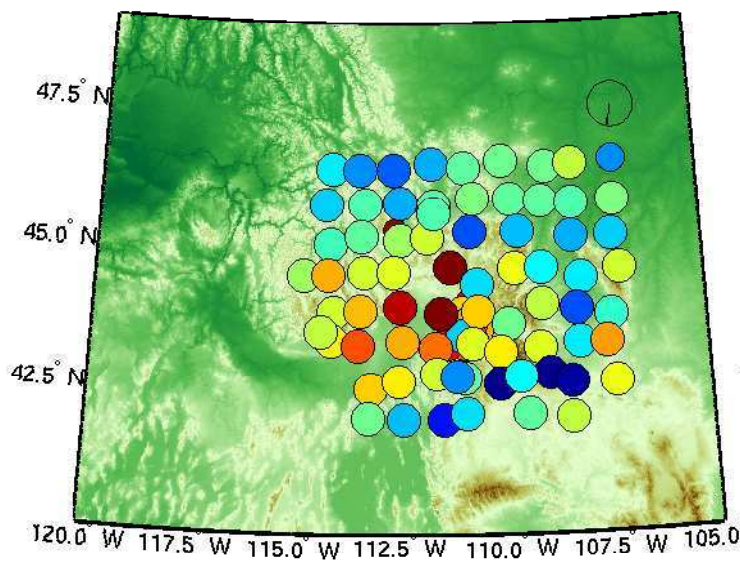
Stack



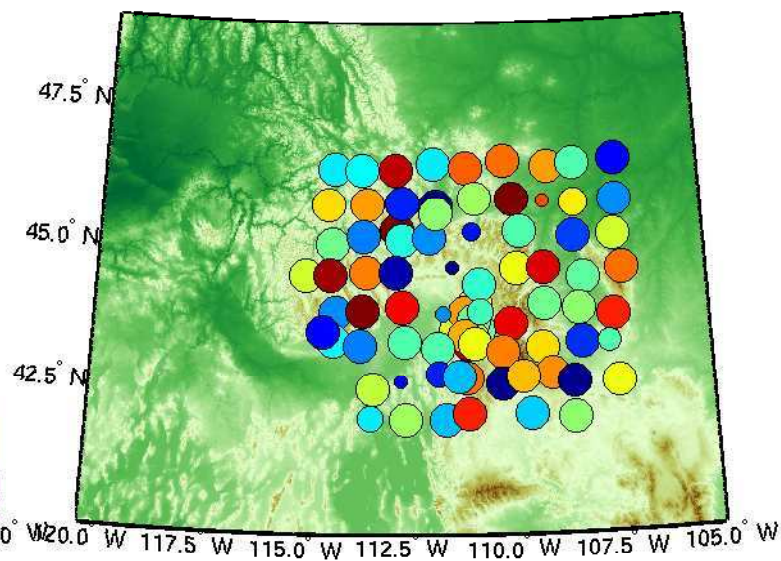
Baz = 12.102  
Mean xcor value = 0.80663  
Range of t\* values is 1.9827  
Median t\* err is 0.17724



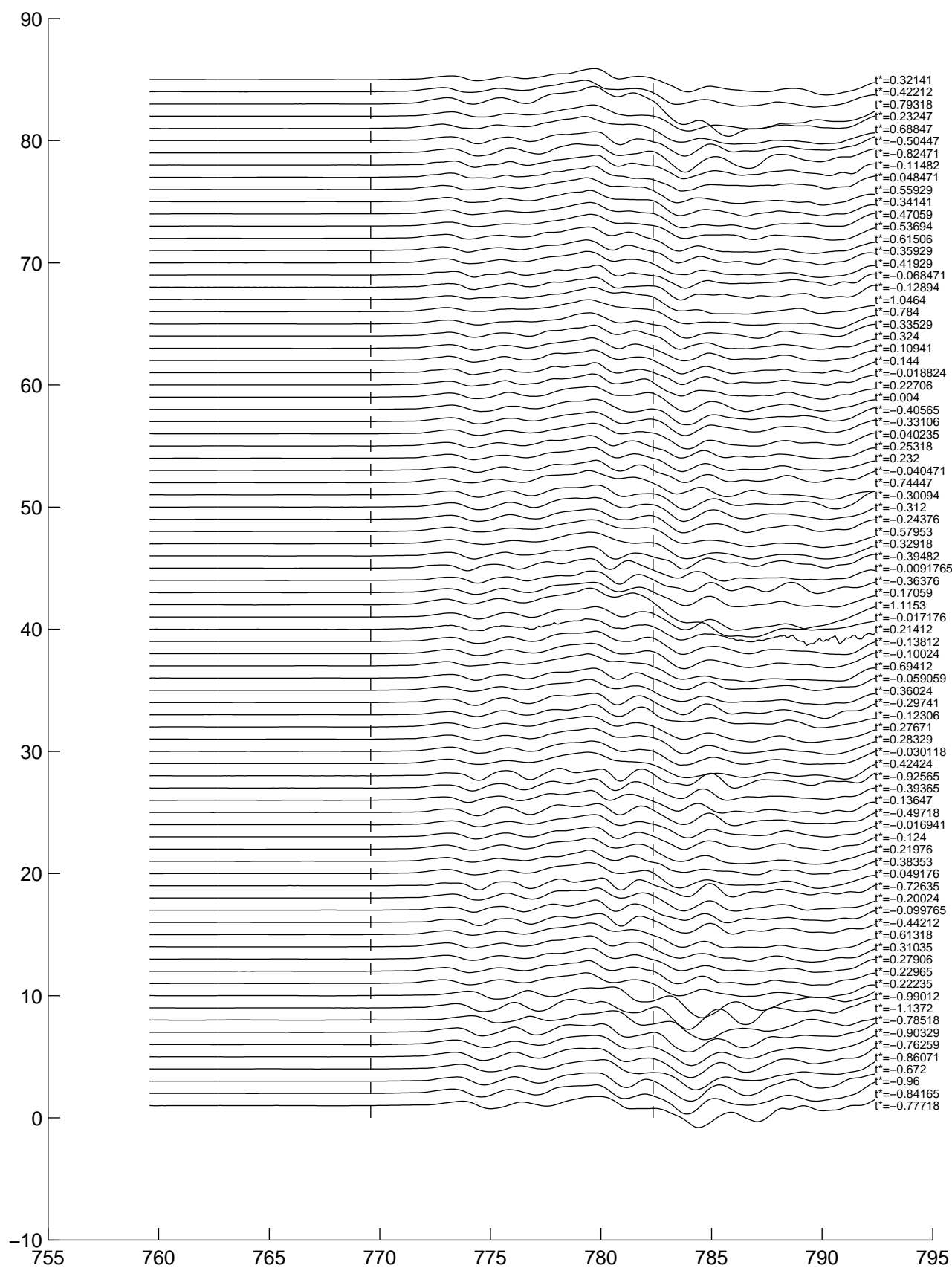
travel time residuals



t\* values

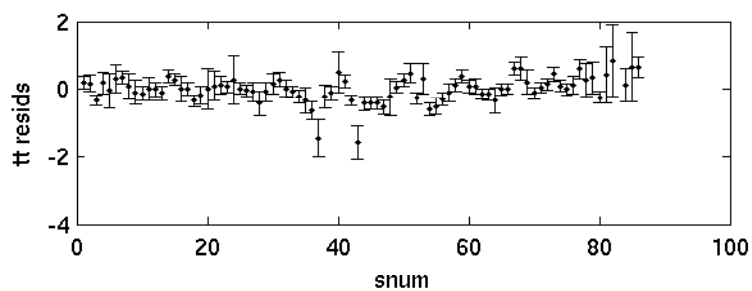
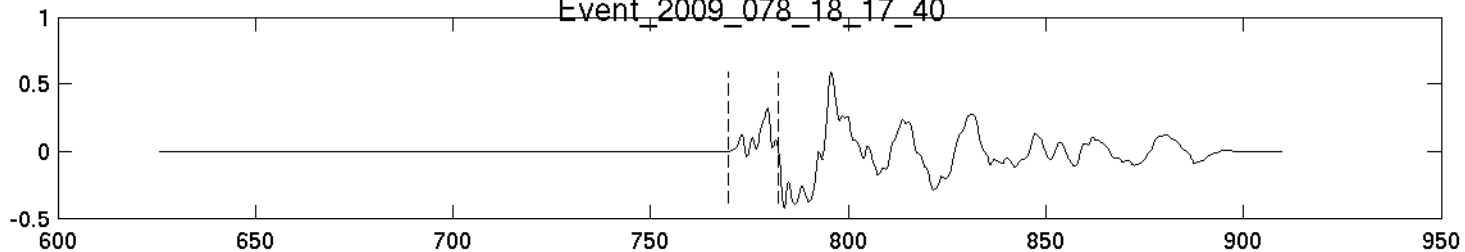


# Event\_2009\_078\_18\_17\_40

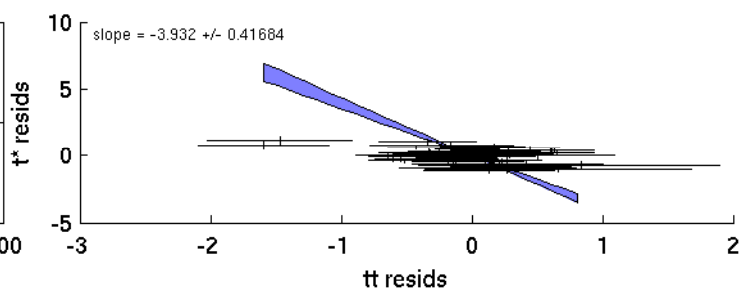
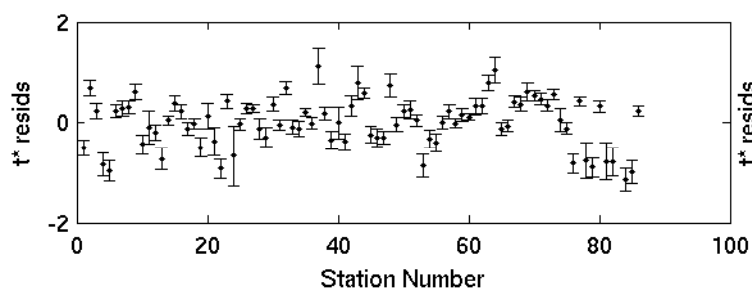




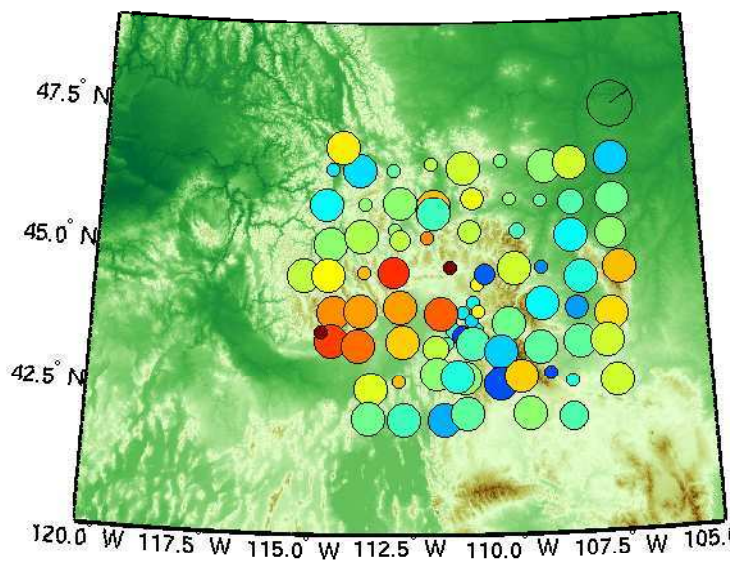
Stack  
Event\_2009\_078\_18\_17\_40



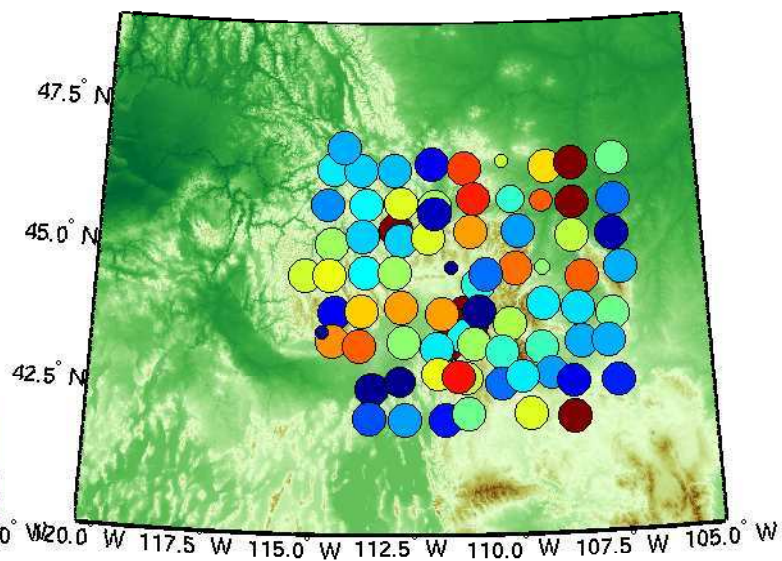
Baz = 235.7568  
Mean xcor value = 0.91024  
Range of  $t^*$  values is 2.2525  
Median  $t^*$  err is 0.14797



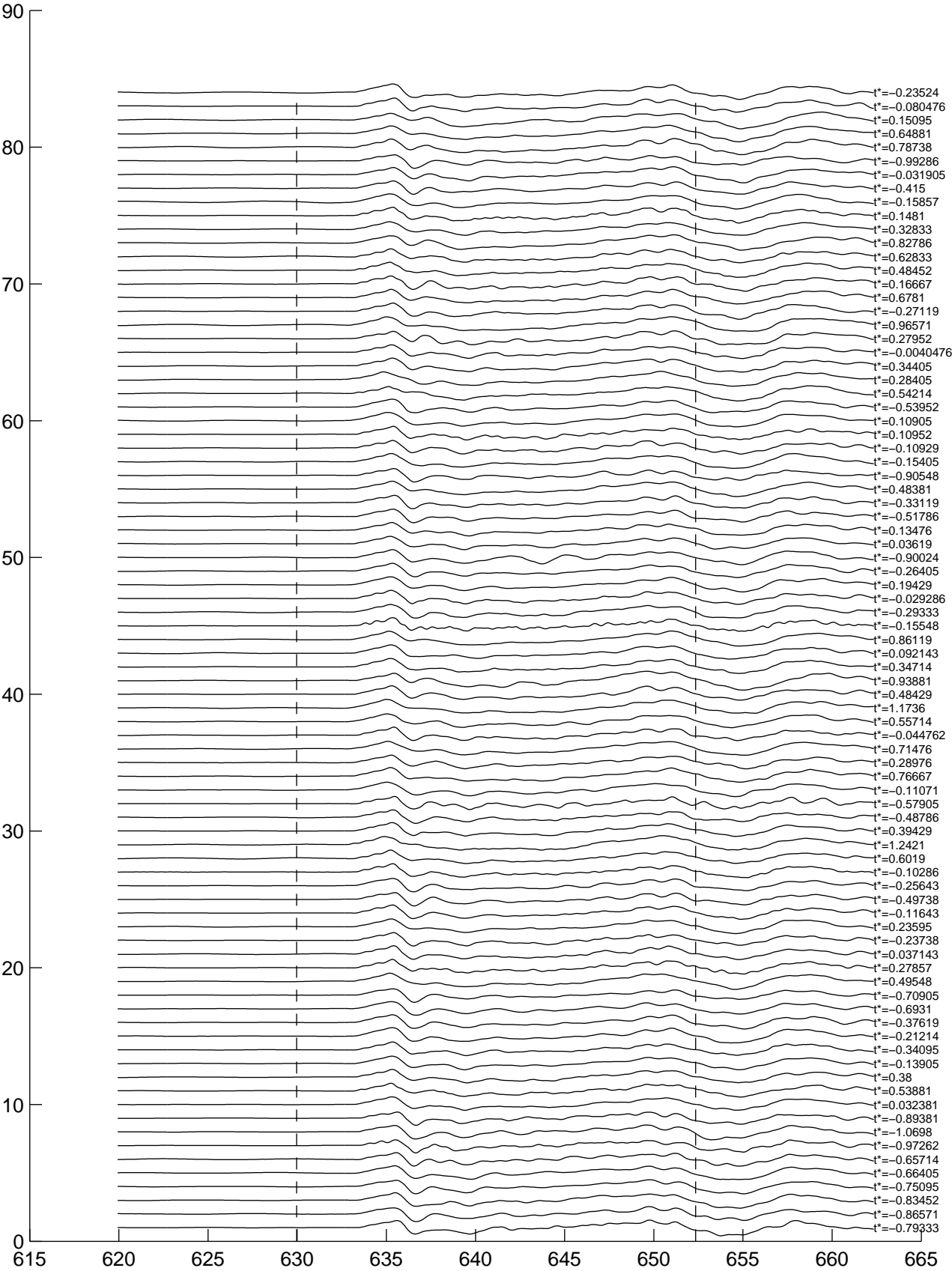
travel time residuals



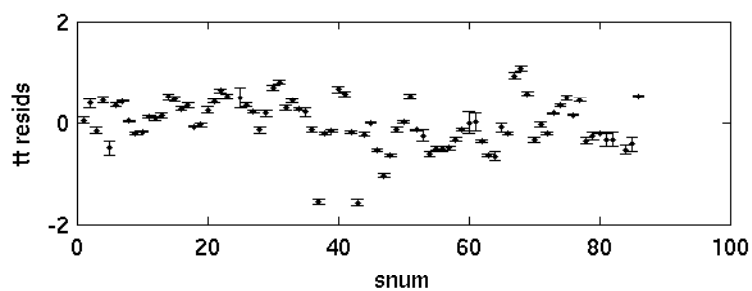
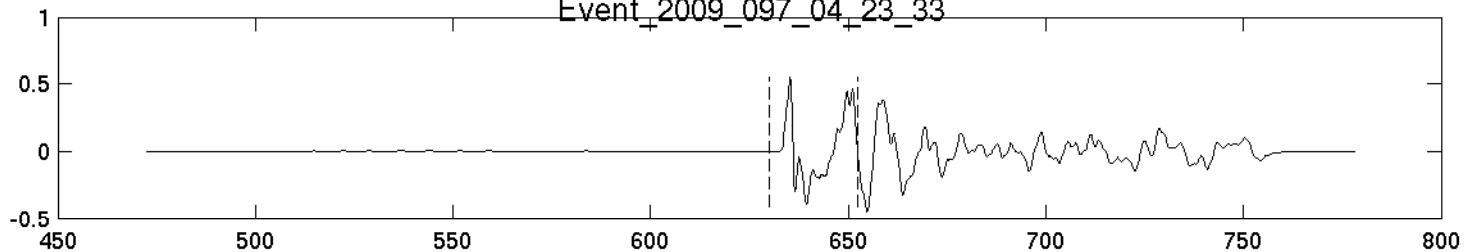
$t^*$  values



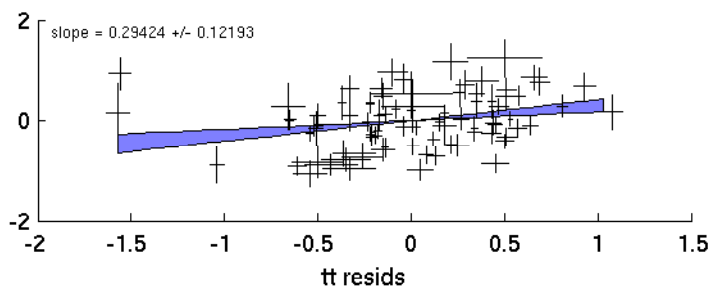
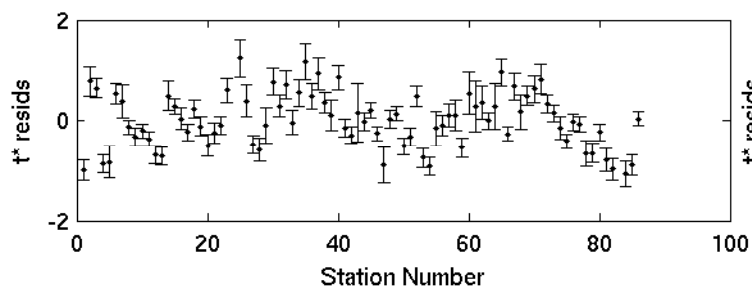
Event\_2009\_097\_04\_23\_33



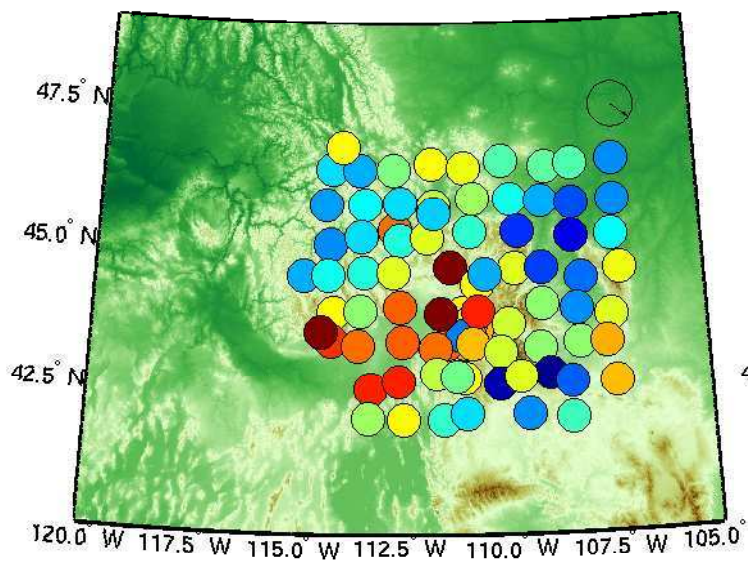
# Stack Event\_2009\_09\_04\_23\_33



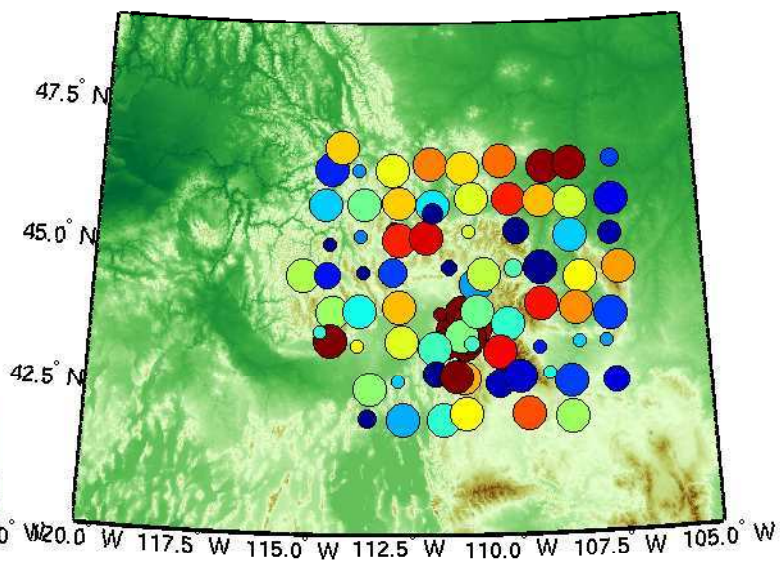
Baz = 309.996  
Mean xcor value = 0.90381  
Range of t\* values is 2.3119  
Median t\* err is 0.20207



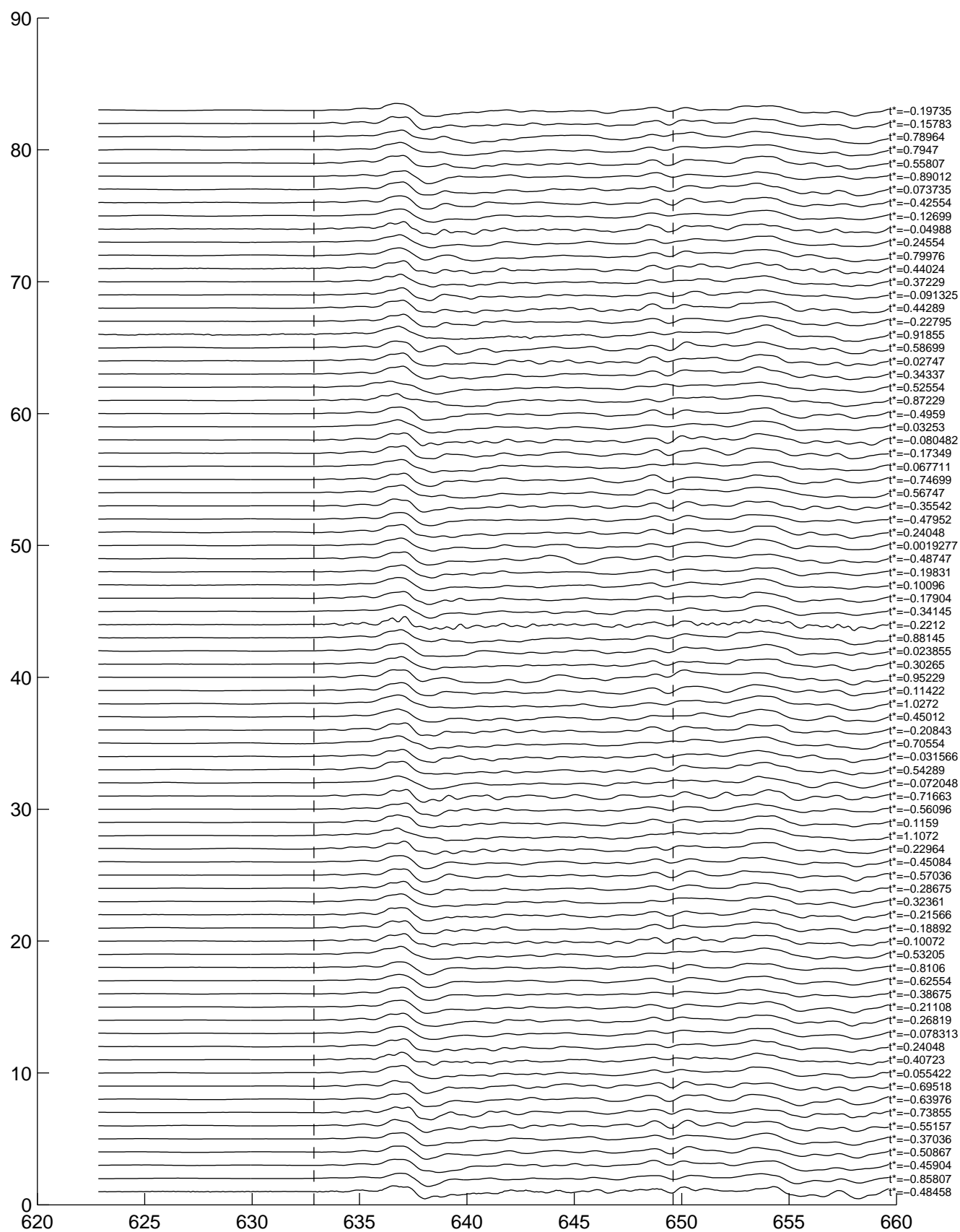
travel time residuals



t\* values



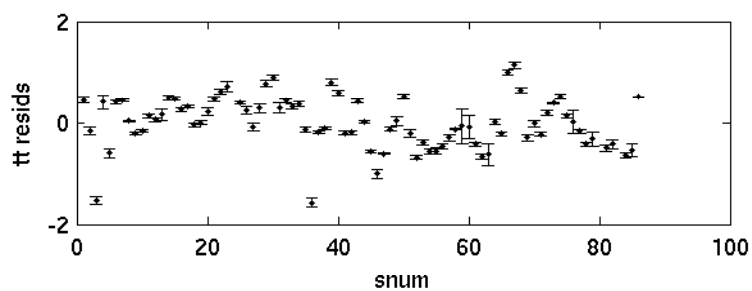
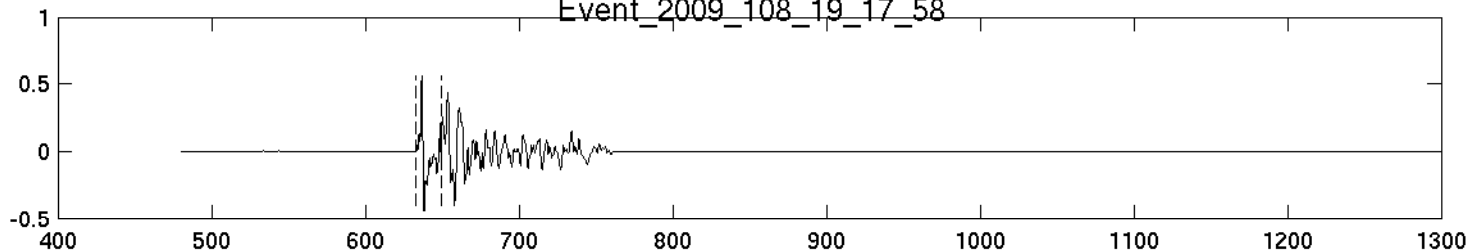
# Event\_2009\_108\_19\_17\_58



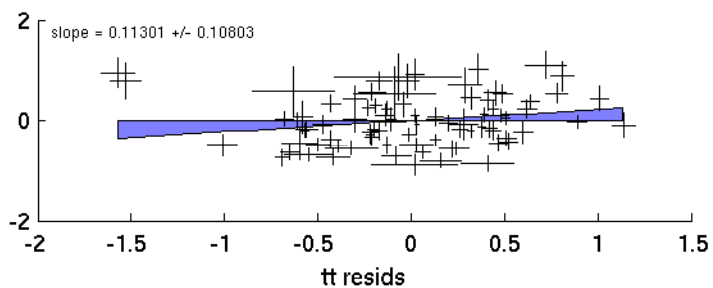
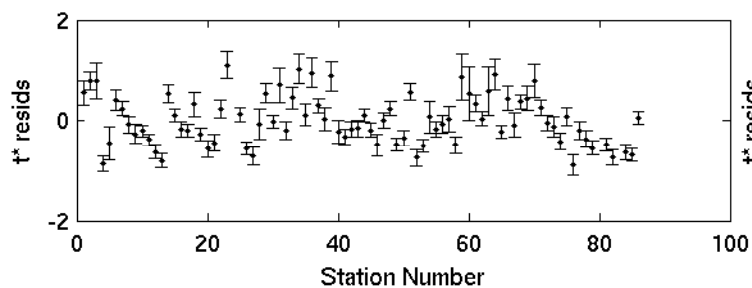


# Event\_2009\_108\_19\_17\_58

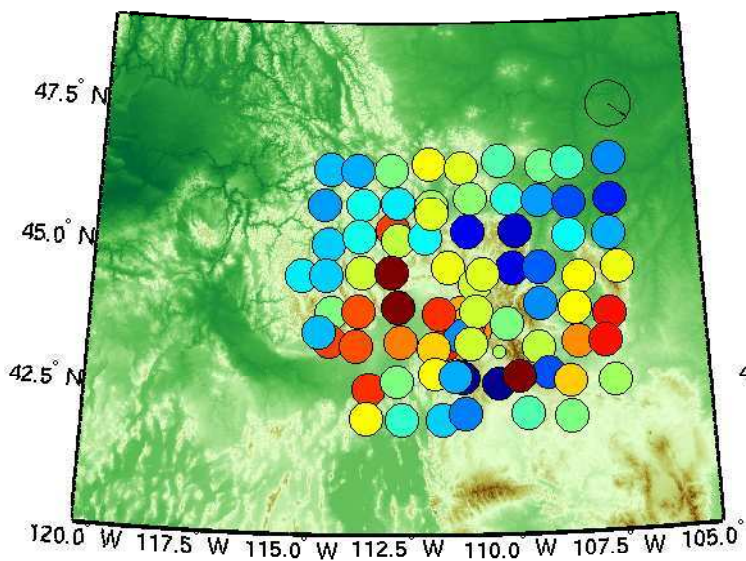
Stack



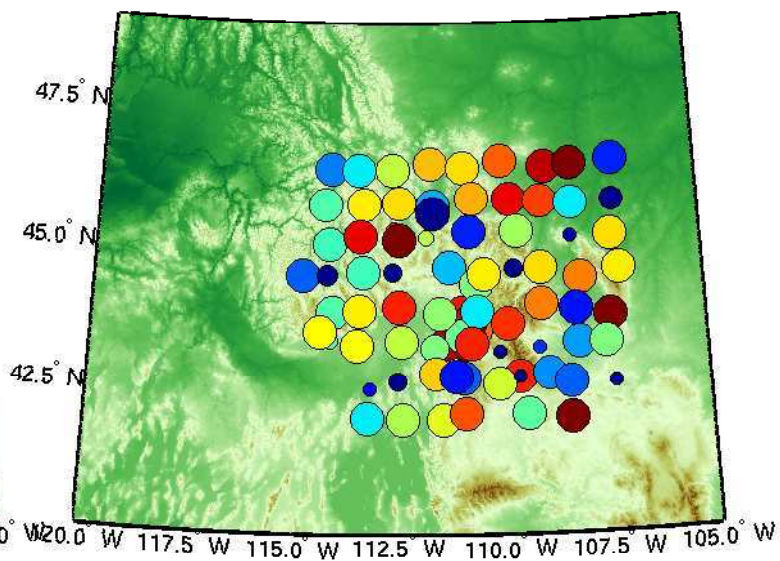
Baz = 310.0237  
Mean xcor value = 0.82976  
Range of t\* values is 1.9973  
Median t\* err is 0.16865



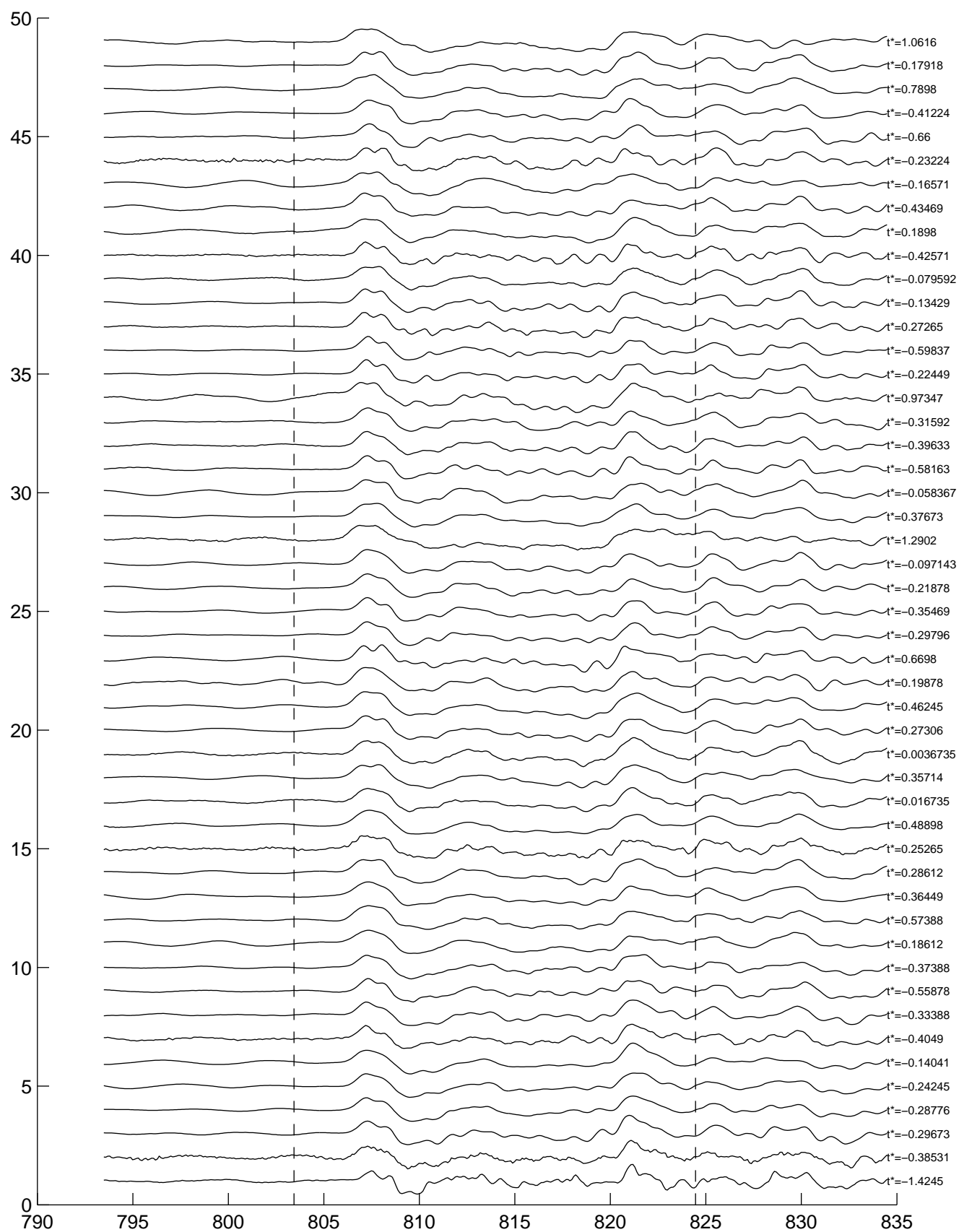
travel time residuals



t\* values



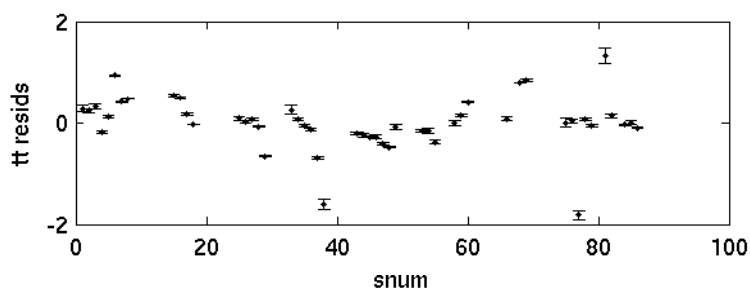
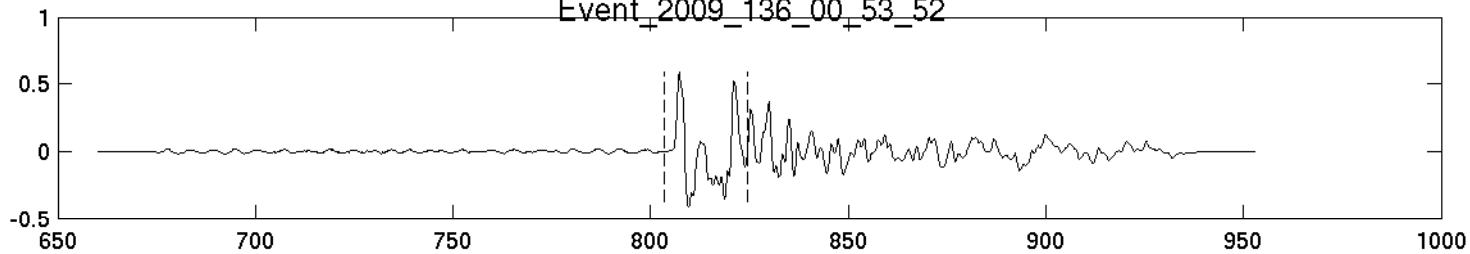
# Event\_2009\_136\_00\_53\_52



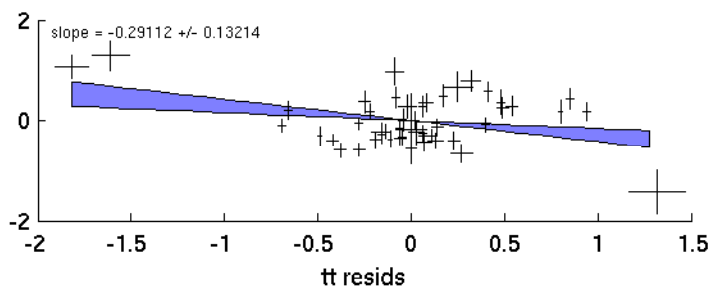
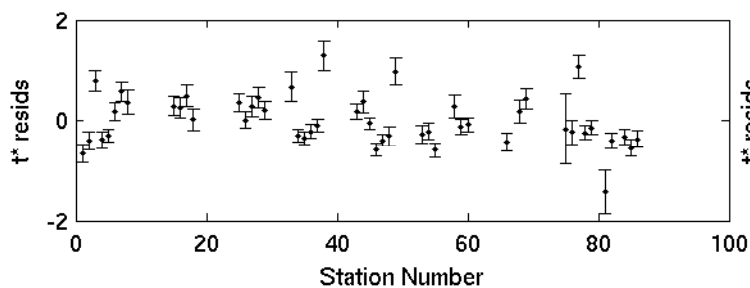


# Event 2009\_136\_00\_53\_52

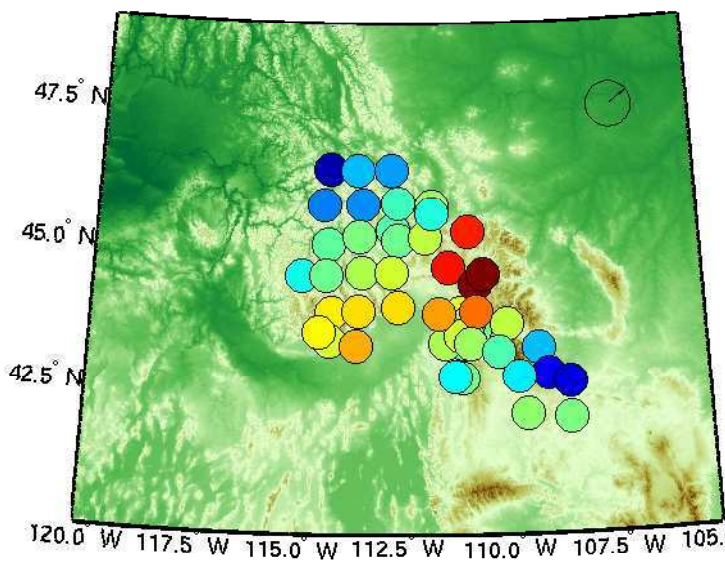
Stack



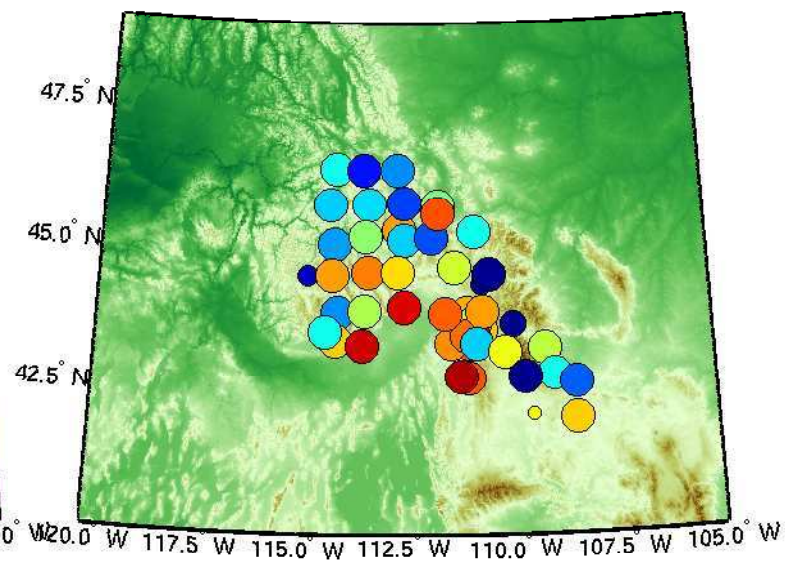
Baz = 233.09  
Mean xcor value = 0.84469  
Range of t\* values is 2.7147  
Median t\* err is 0.17672



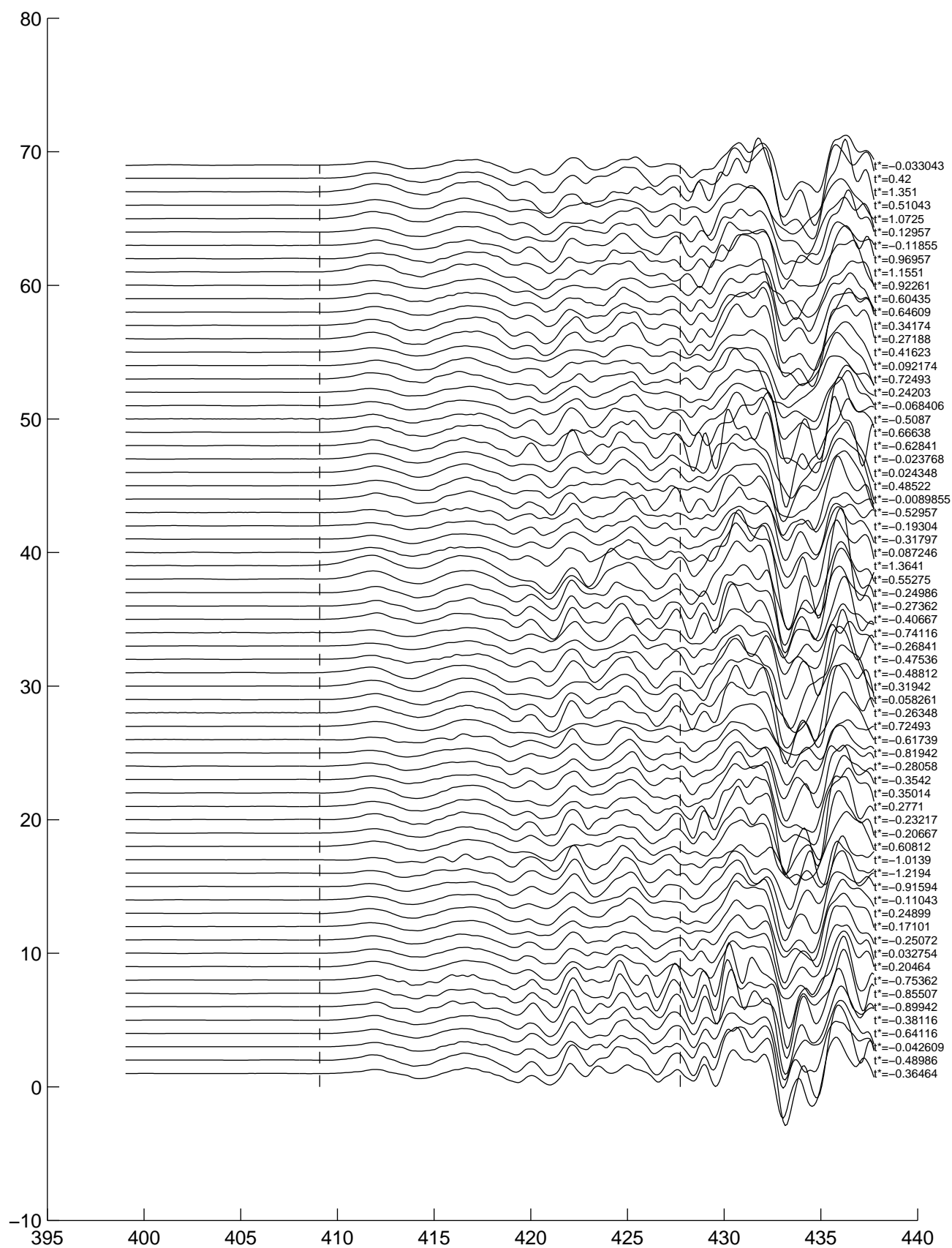
travel time residuals



t\* values

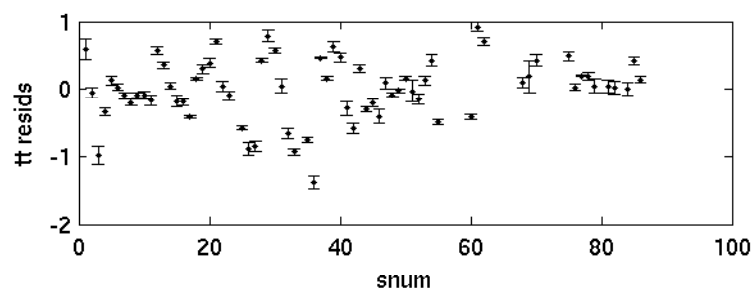
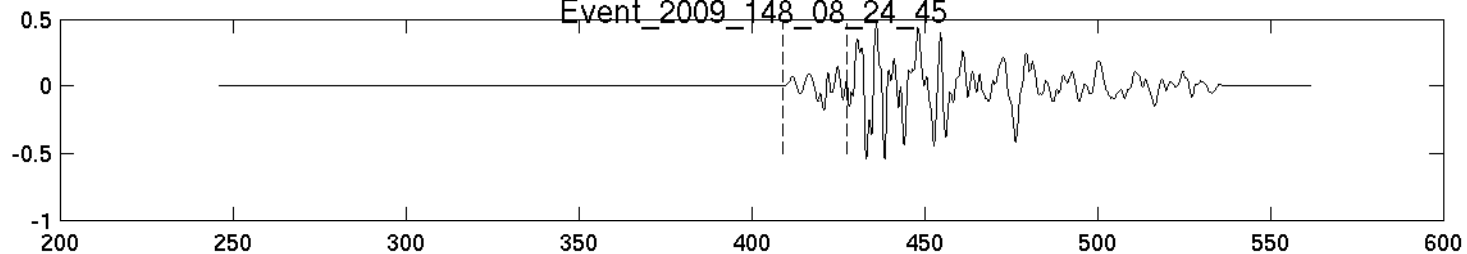


# Event\_2009\_148\_08\_24\_45

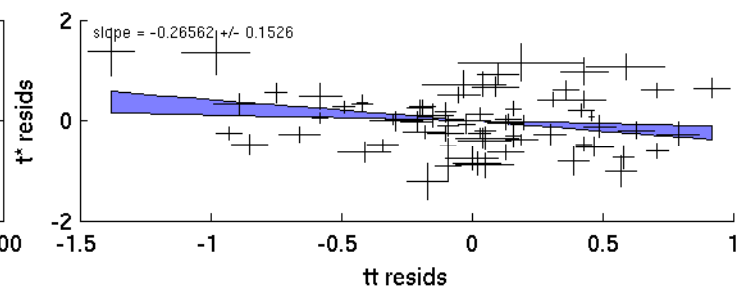
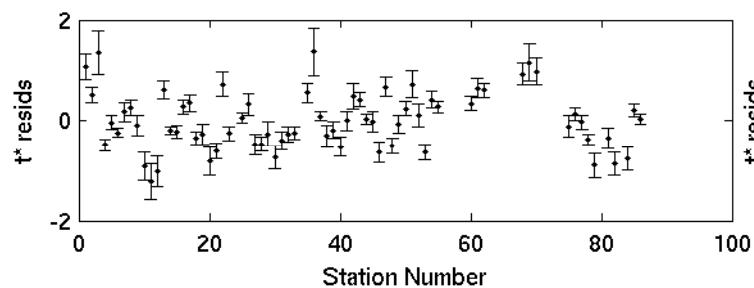


Event\_2009\_148\_08\_24\_45

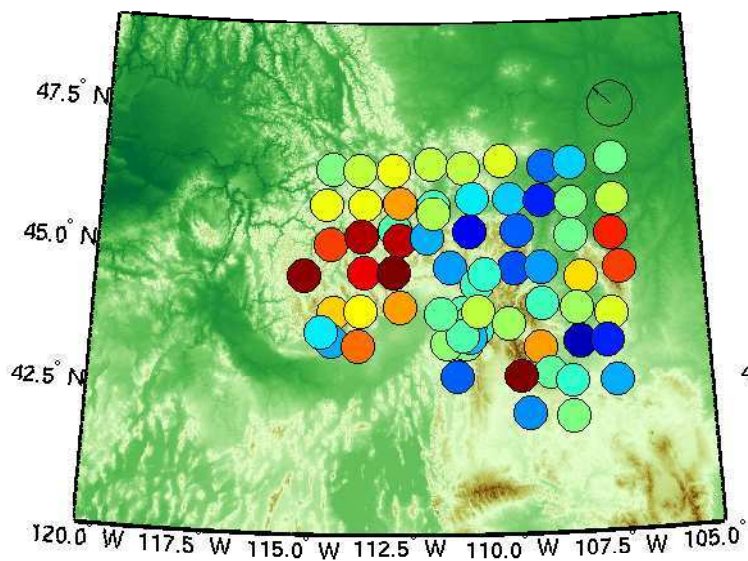
Stack



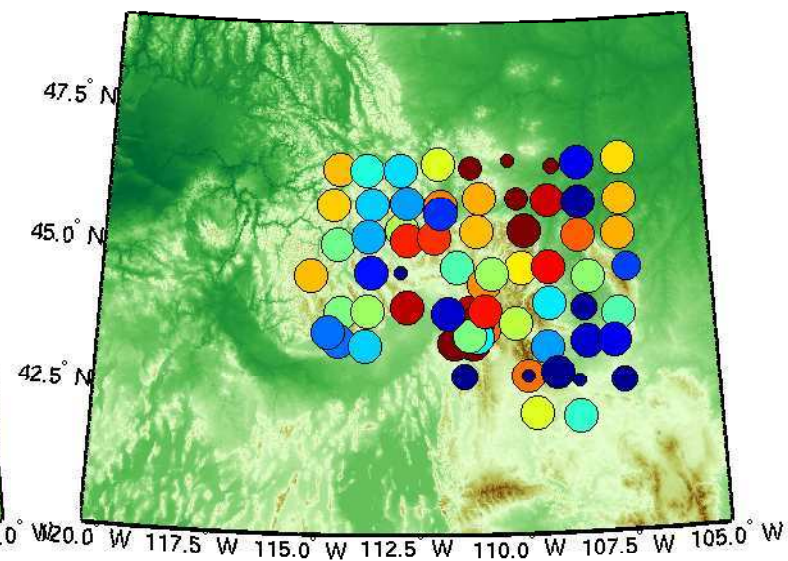
Baz = 135.7283  
Mean xcor value = 0.78913  
Range of t\* values is 2.5635  
Median t\* err is 0.1829



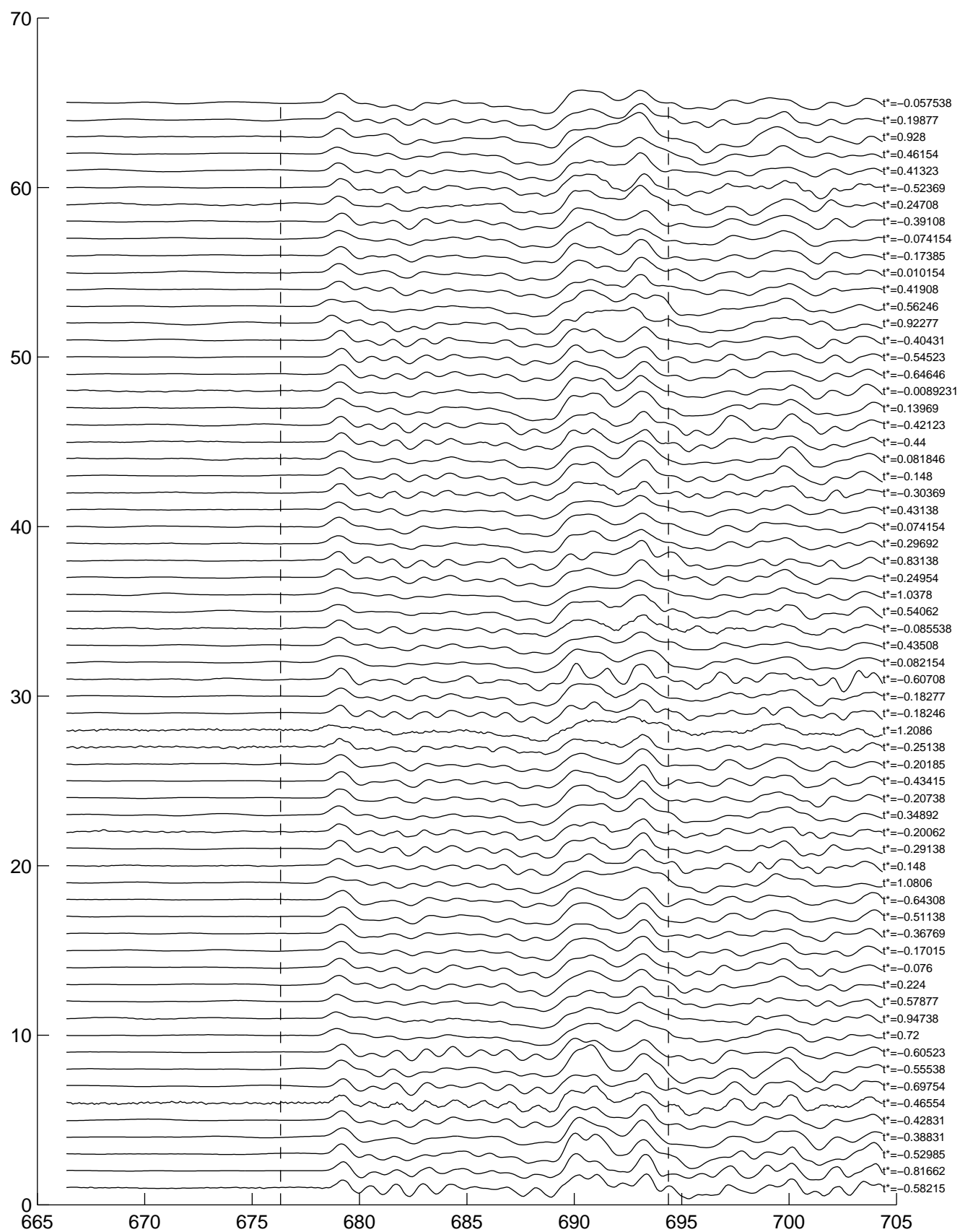
travel time residuals



t\* values

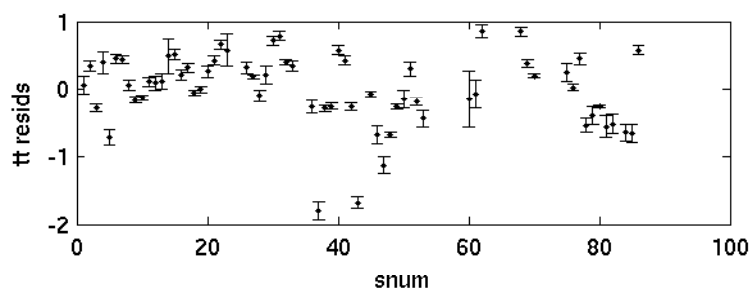
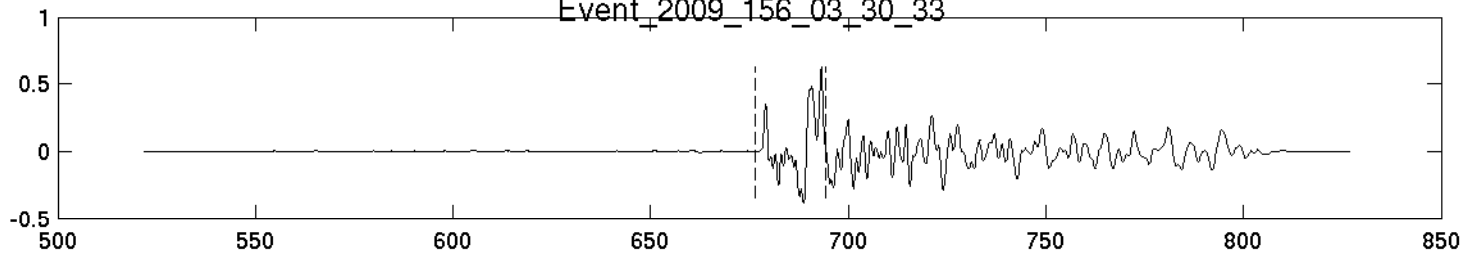


# Event\_2009\_156\_03\_30\_33

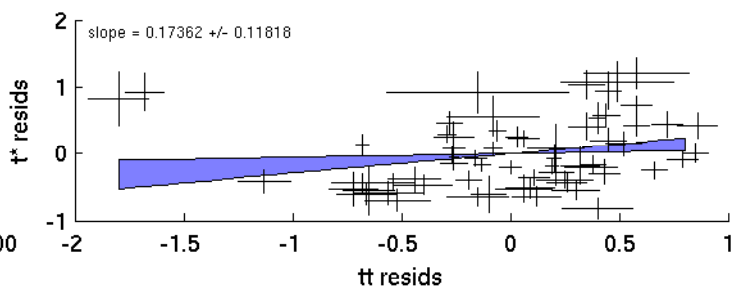
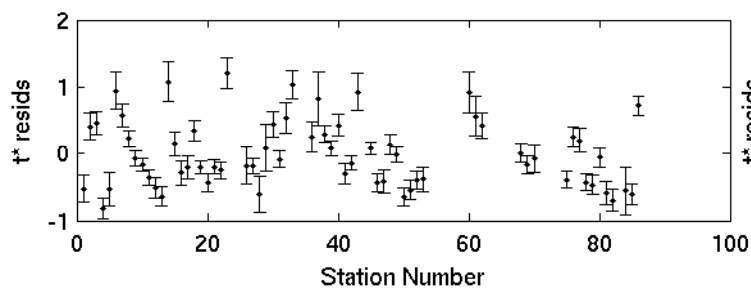




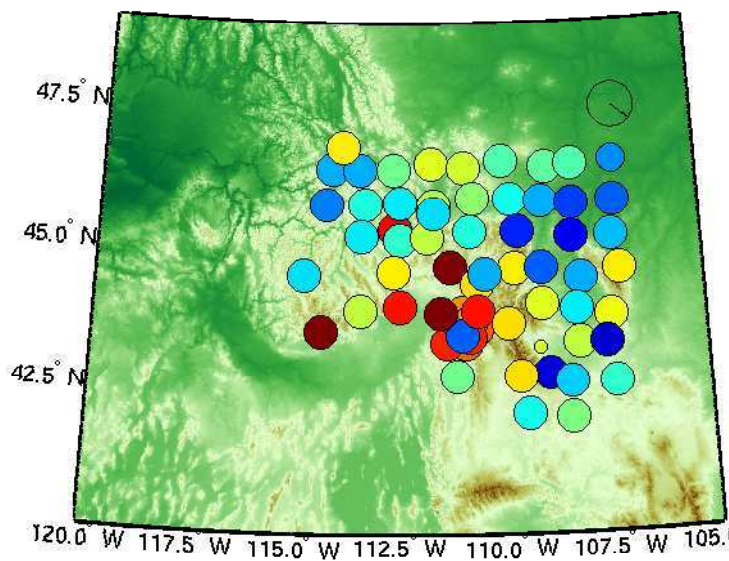
Stack  
Event\_2009\_156\_03\_30\_33



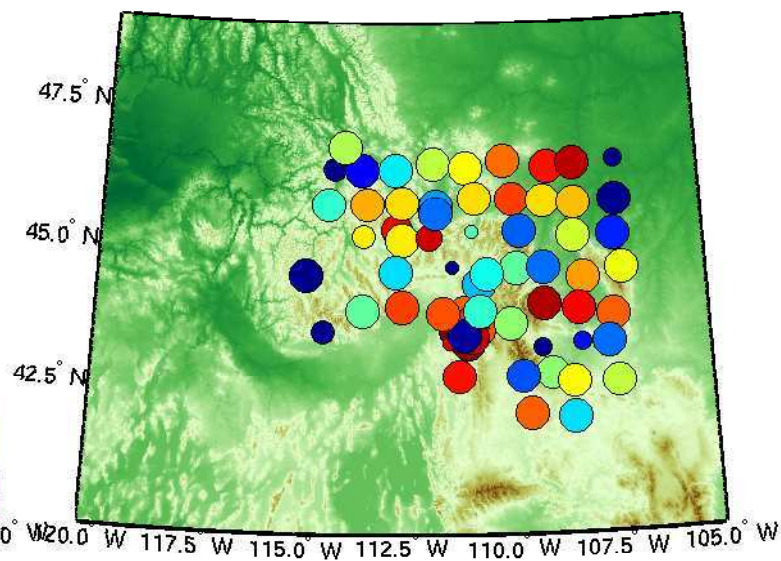
Baz = 310.7874  
Mean xcor value = 0.86385  
Range of  $t^*$  values is 2.0252  
Median  $t^*$  err is 0.15207

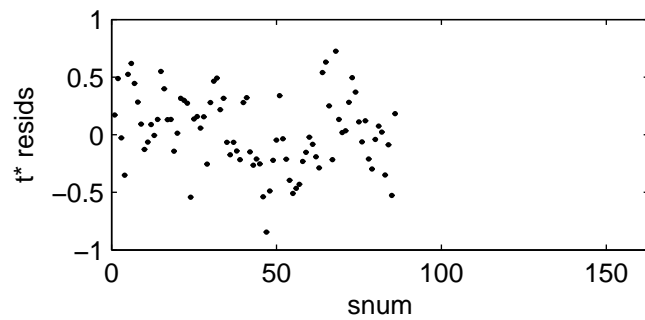
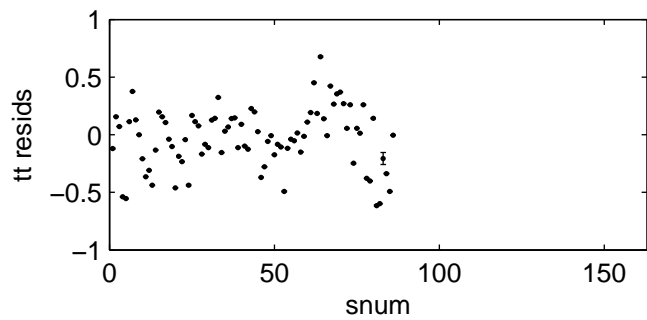
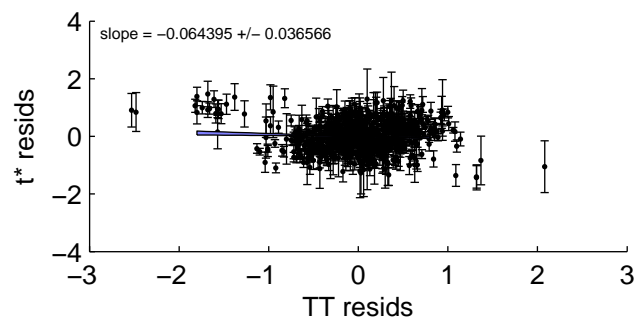
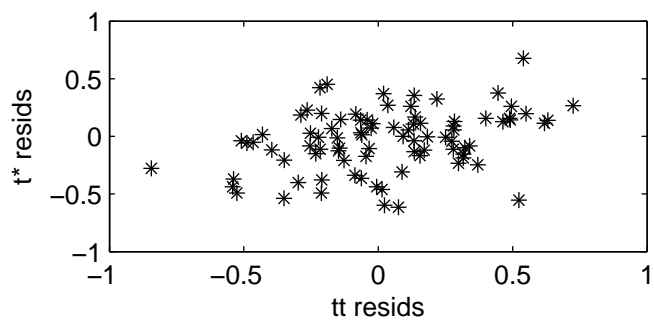


travel time residuals

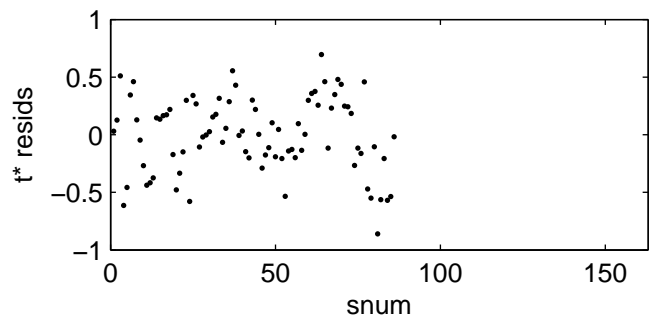
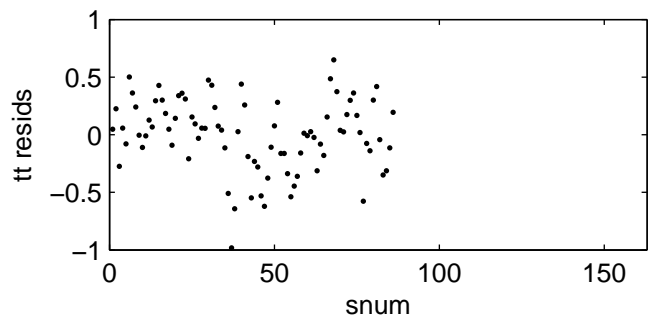
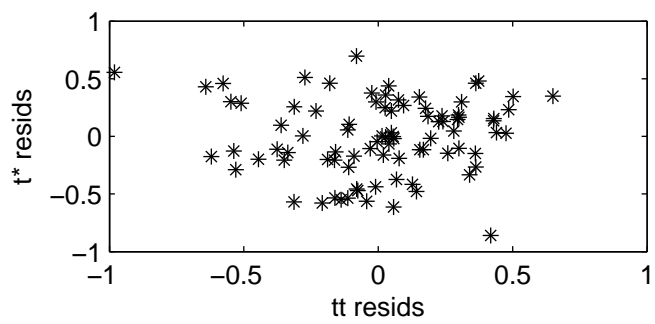


$t^*$  values

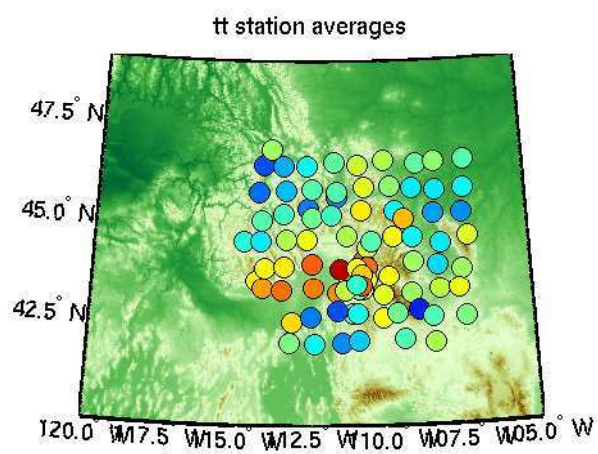
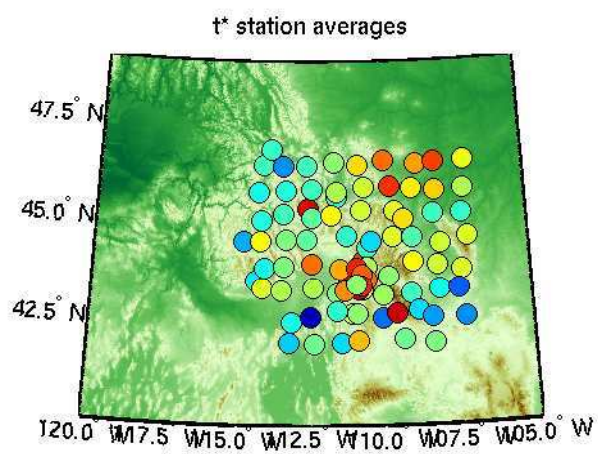
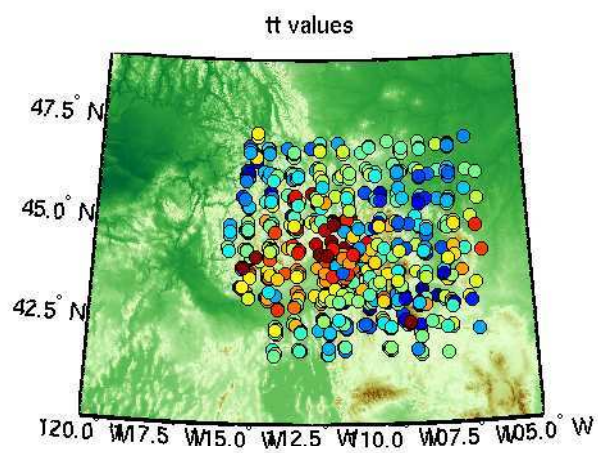
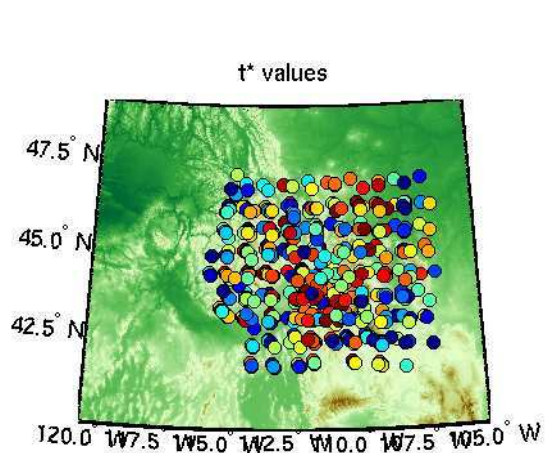








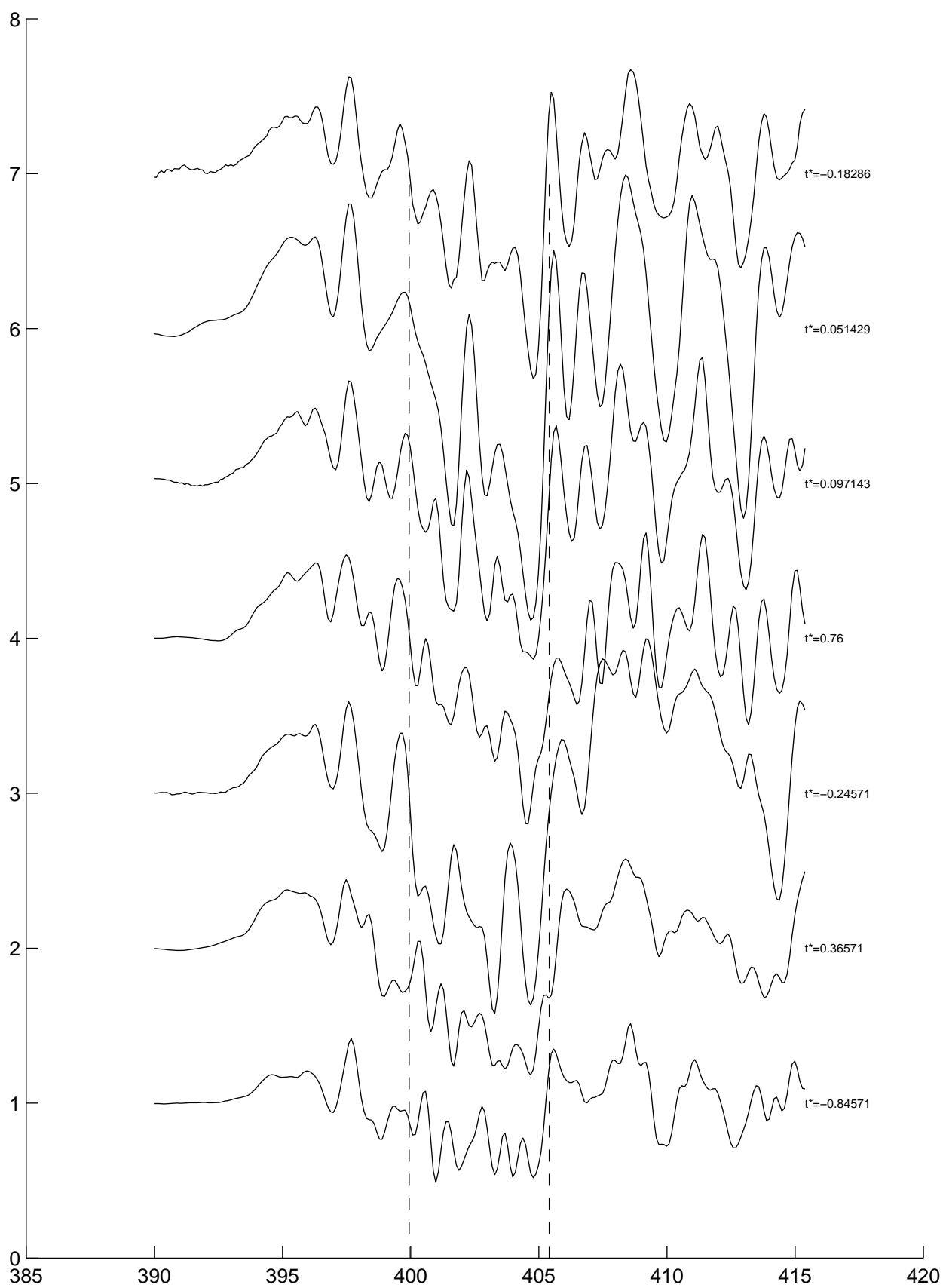
ALL DATA



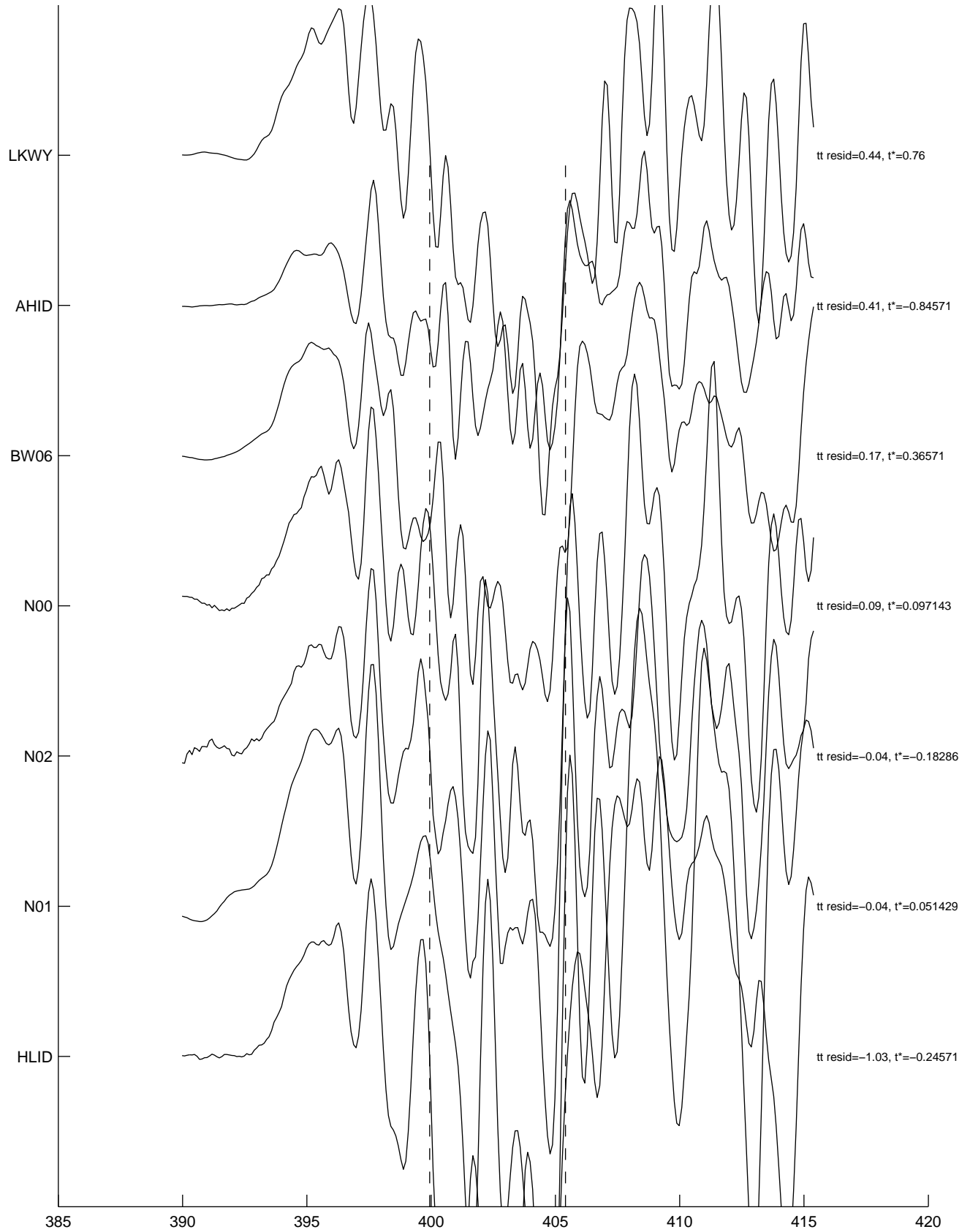
## Appendix VI

### INCLUSION OF CRATONIC STATIONS FFC AND CCM

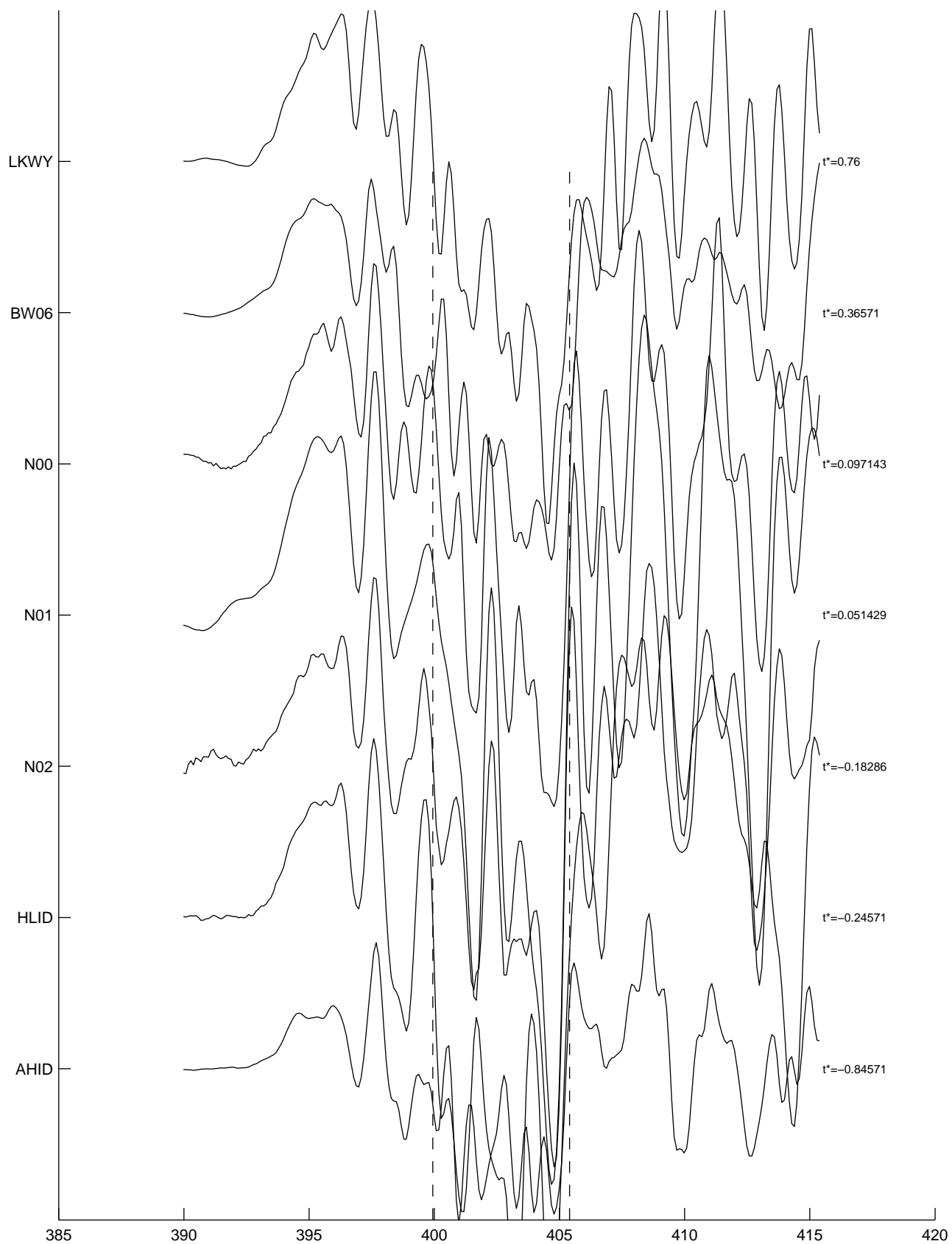
# Event\_1999\_192\_14\_14\_16



# Sorted by travel time:Event\_1999\_192\_14\_14\_16

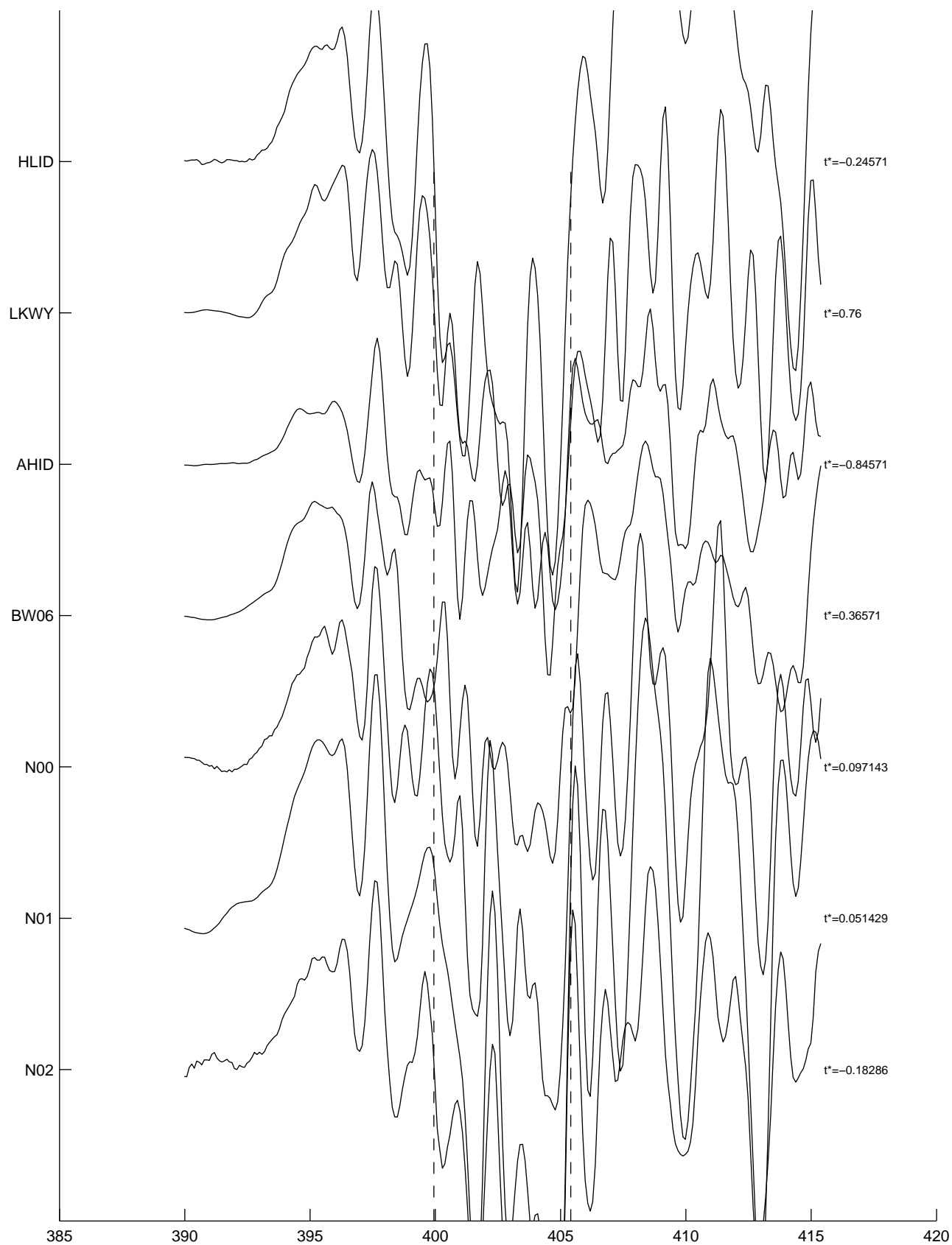


Sorted by  $t^*$ :Event\_1999\_192\_14\_14\_16

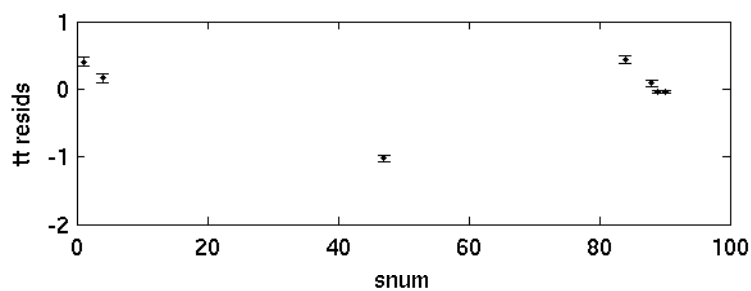
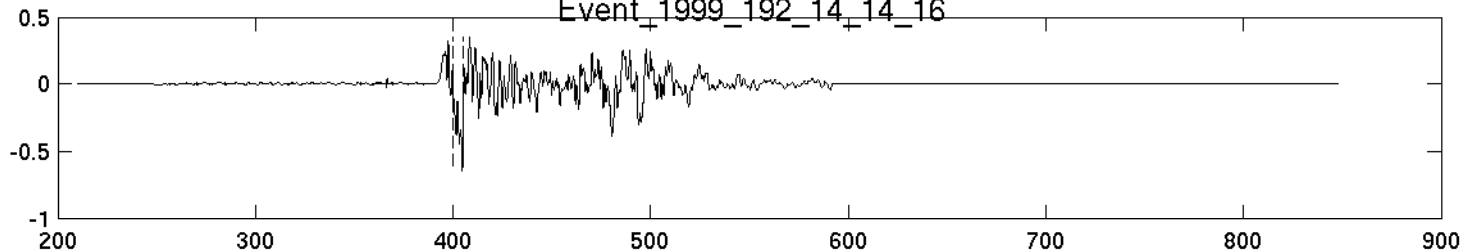




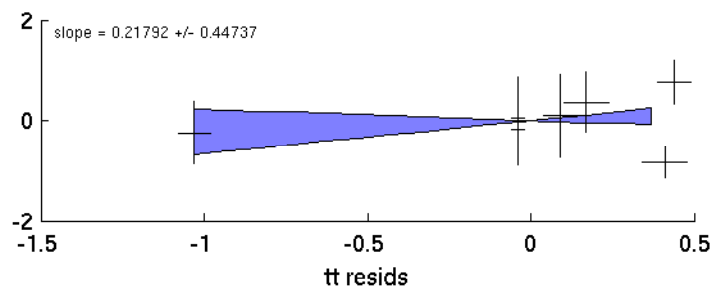
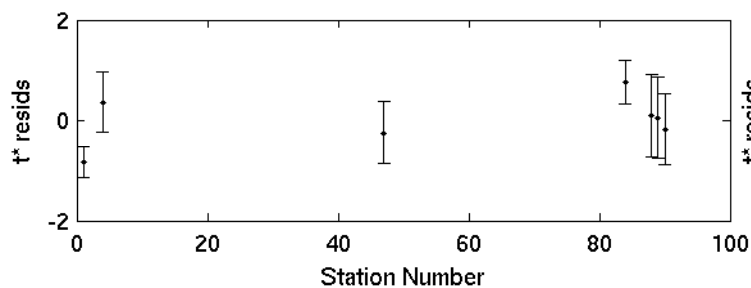
Sorted by Delta:Event\_1999\_192\_14\_14\_16



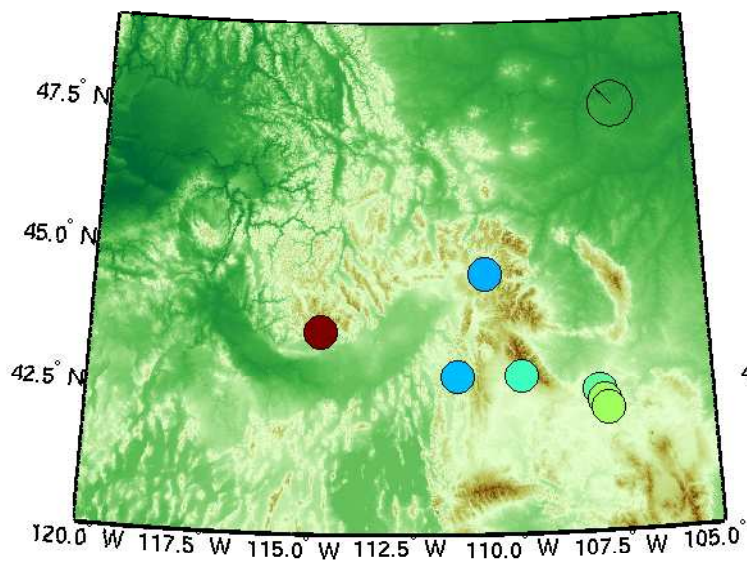
Stack  
Event\_1999\_12\_14\_14\_16



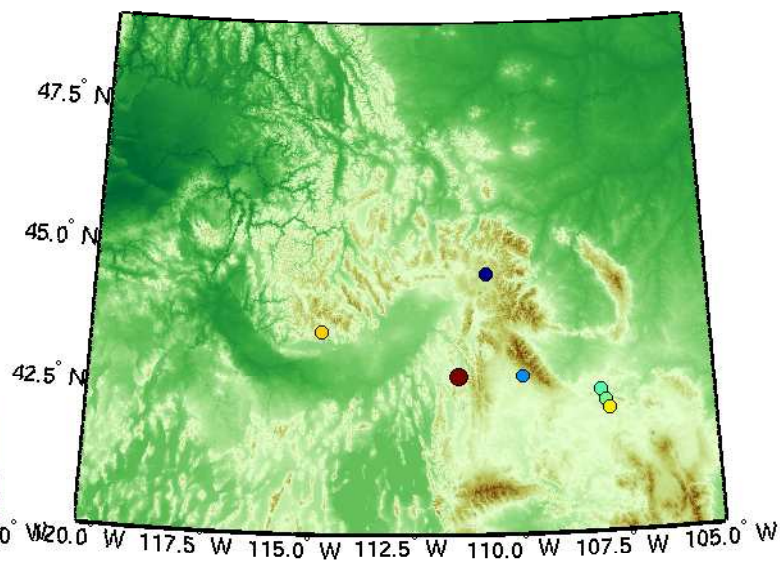
Baz = 139.8991  
Mean xcor value = 0.73143  
Range of  $t^*$  values is 1.6057  
Median  $t^*$  err is 0.62421  
Slope = 0.21792 +/- 0.44737



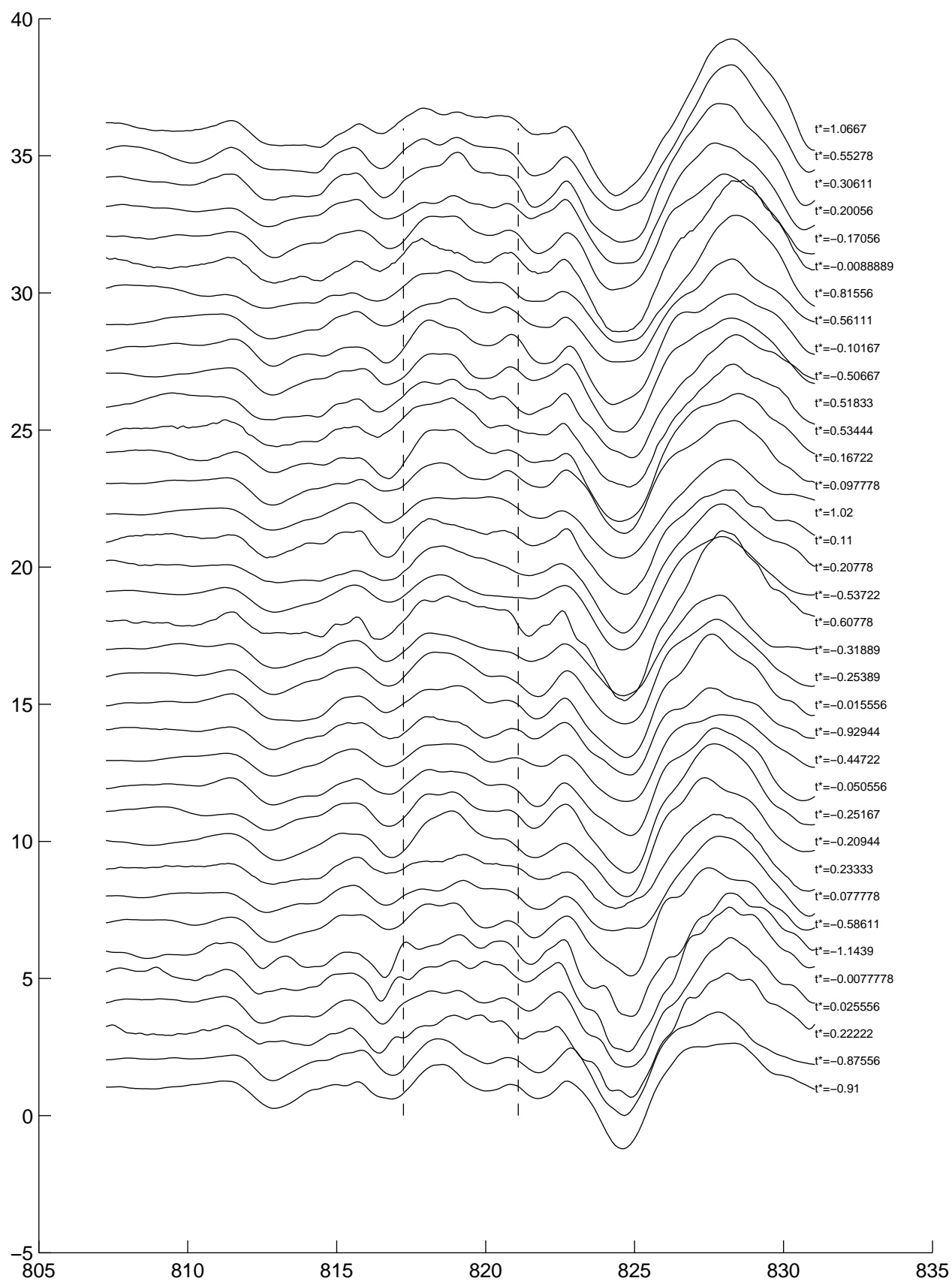
travel time residuals



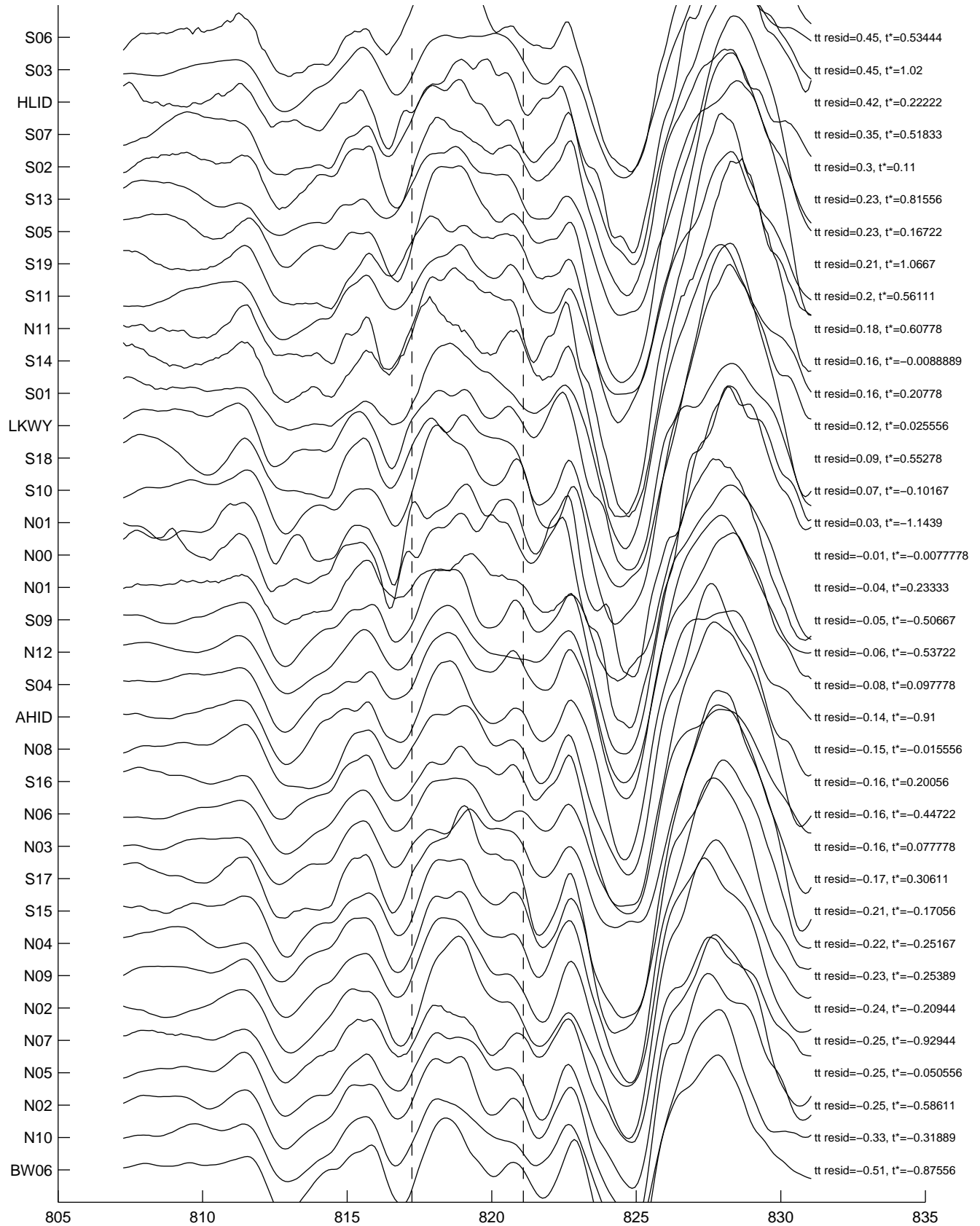
$t^*$  values



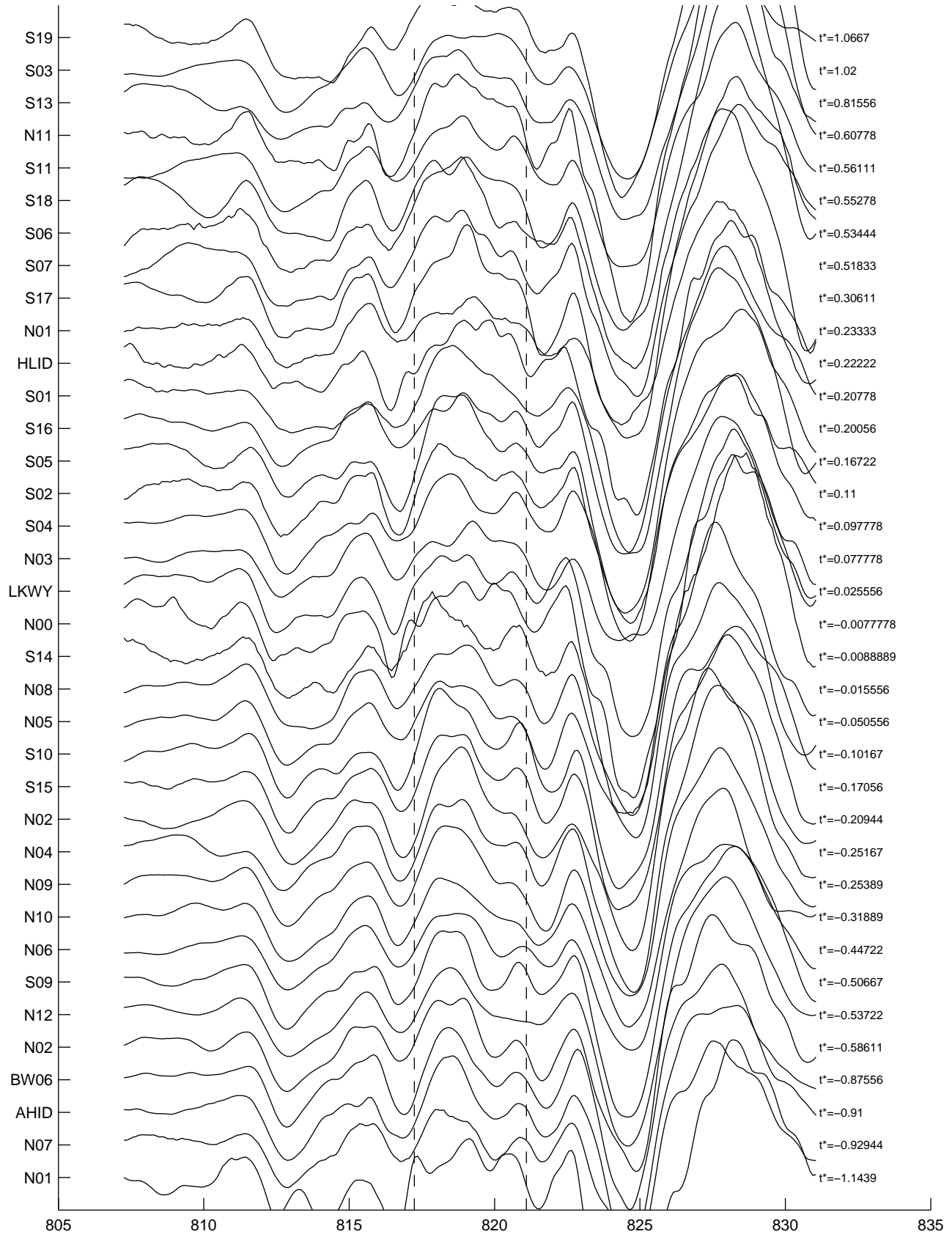
# Event\_1999\_330\_13\_21\_15



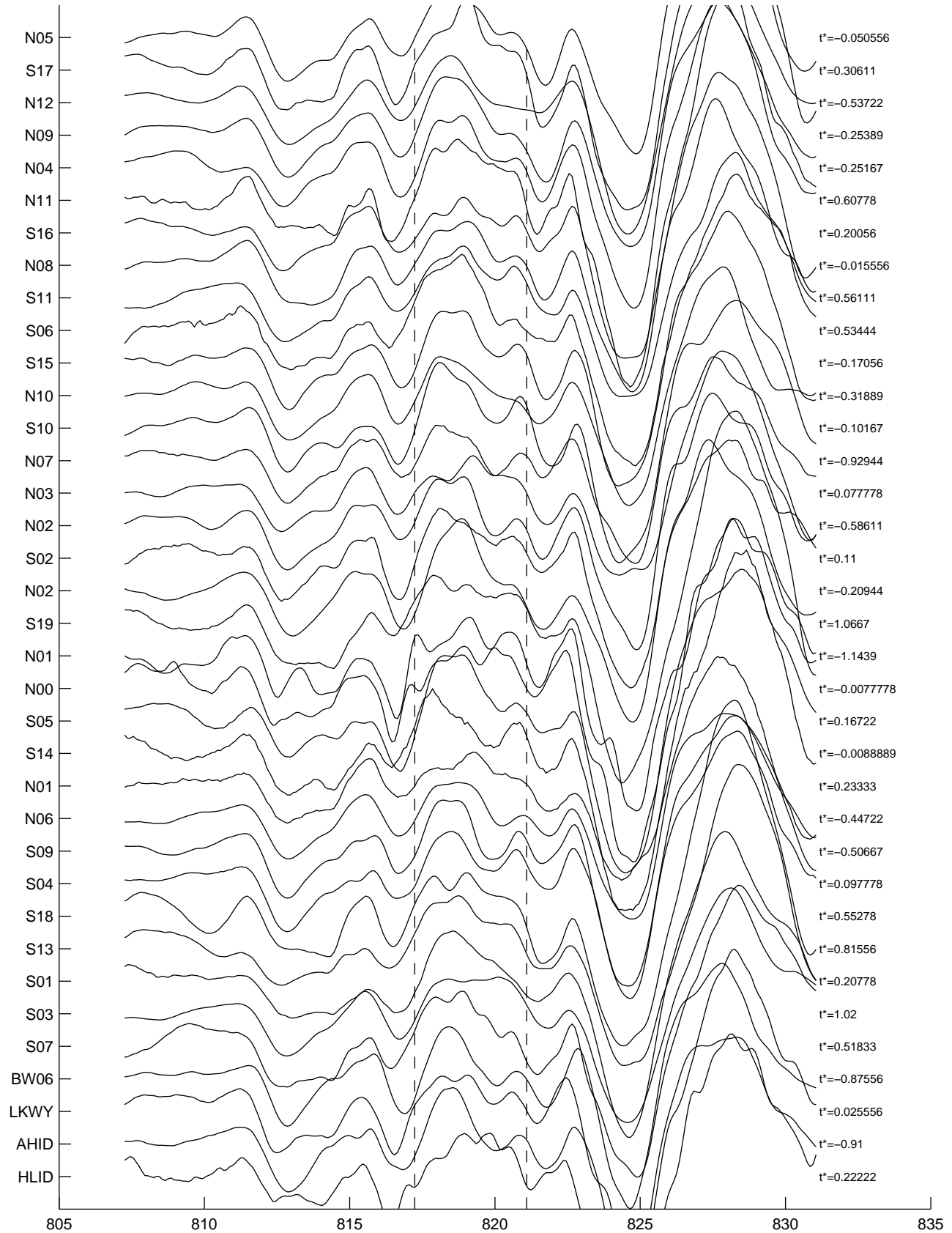
# Sorted by travel time:Event\_1999\_330\_13\_21\_15



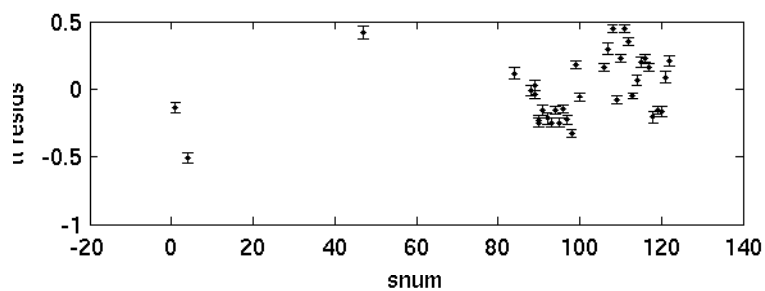
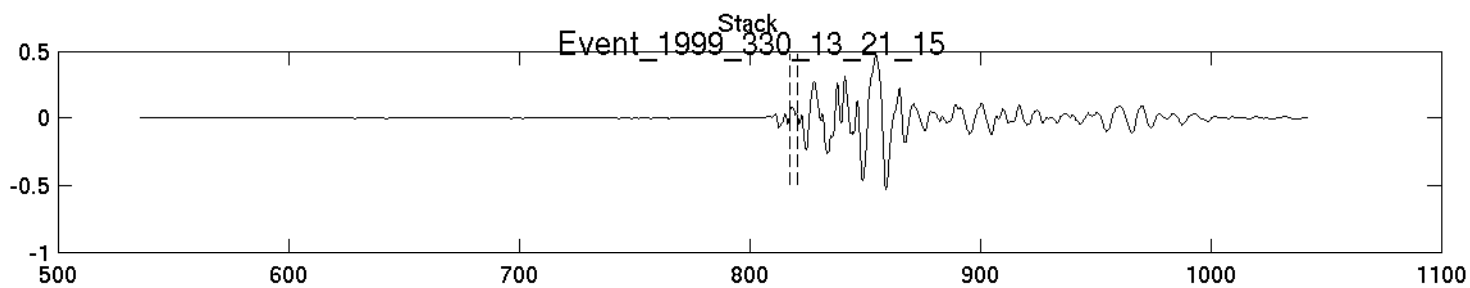
# Sorted by t\*:Event\_1999\_330\_13\_21\_15



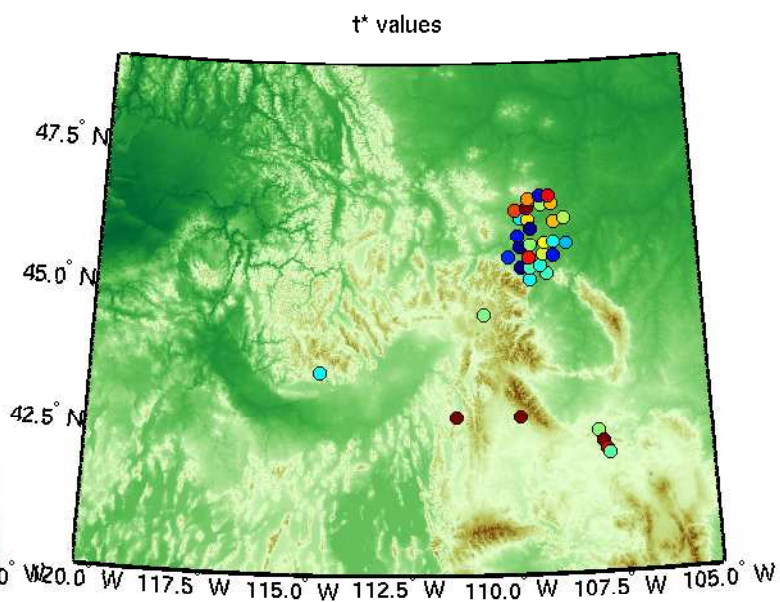
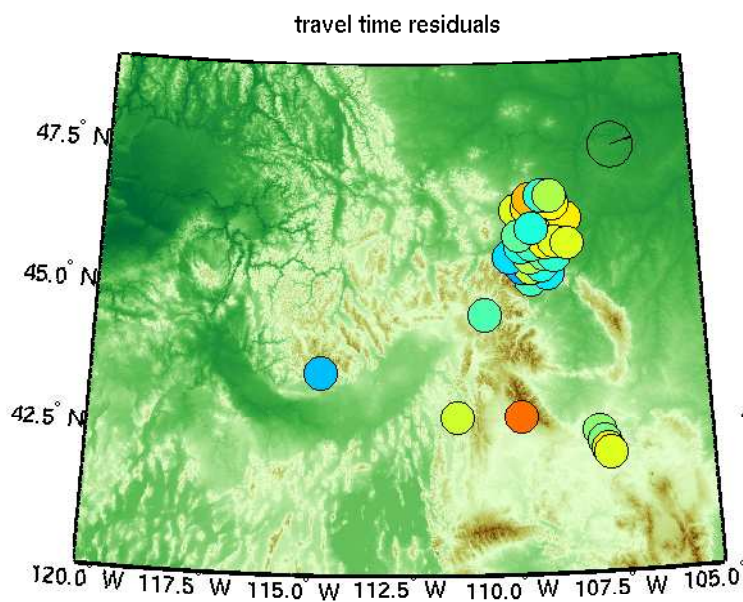
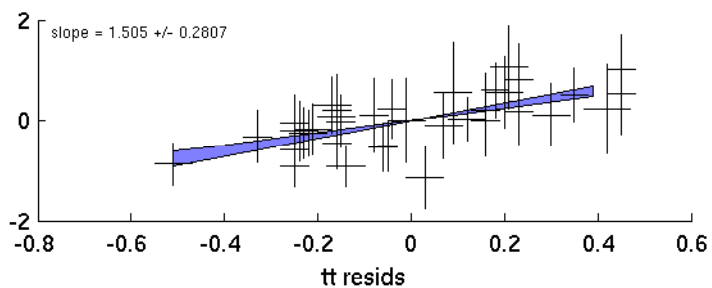
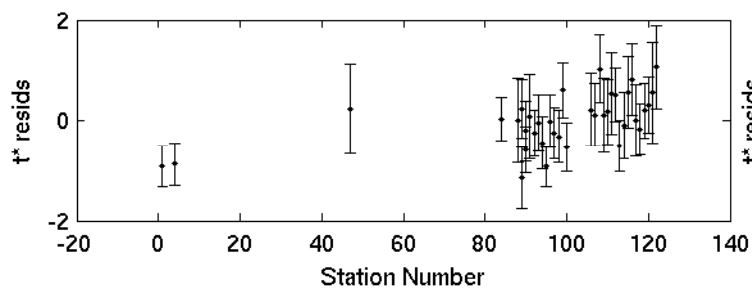
# Sorted by Delta:Event\_1999\_330\_13\_21\_15



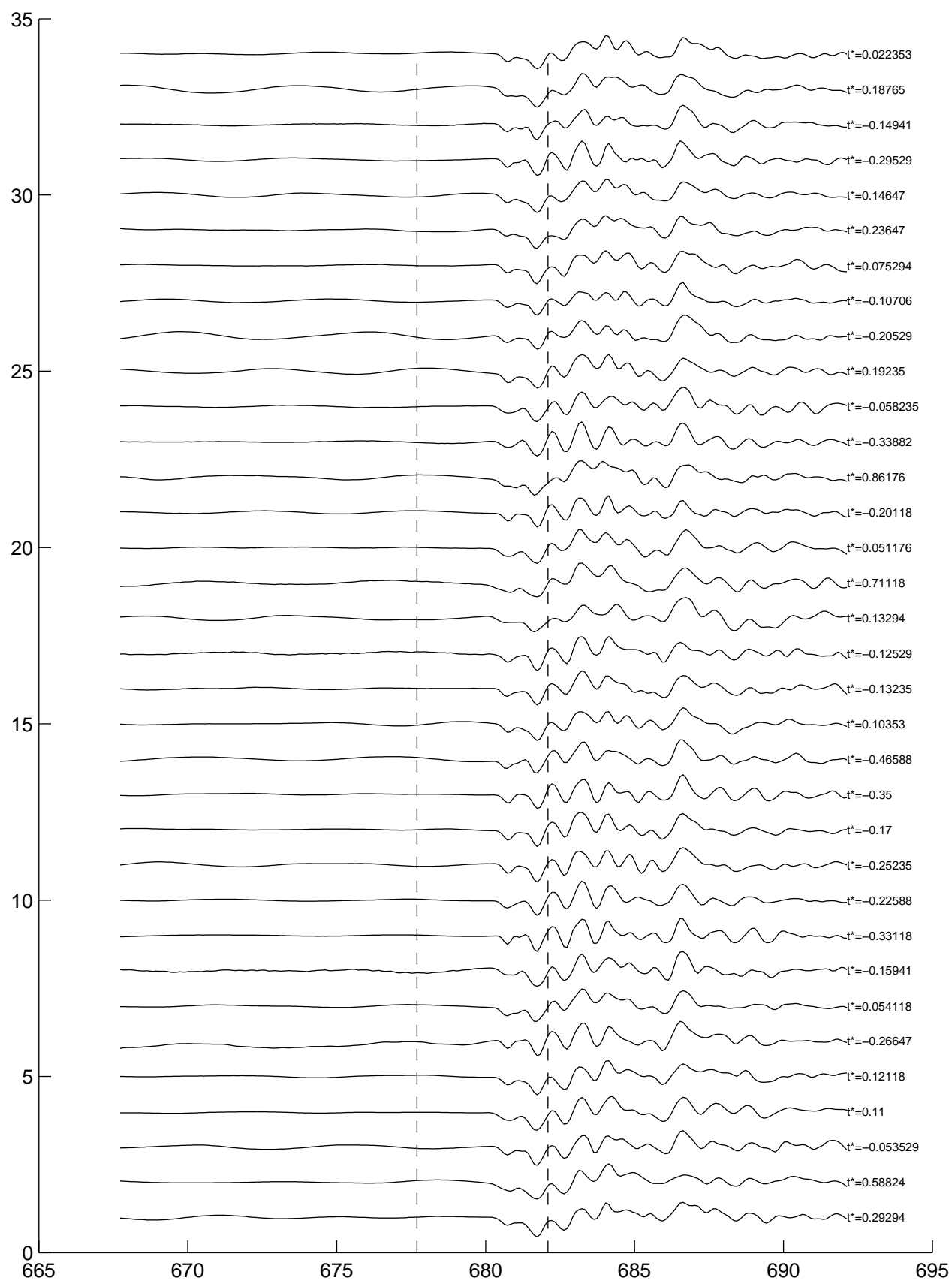




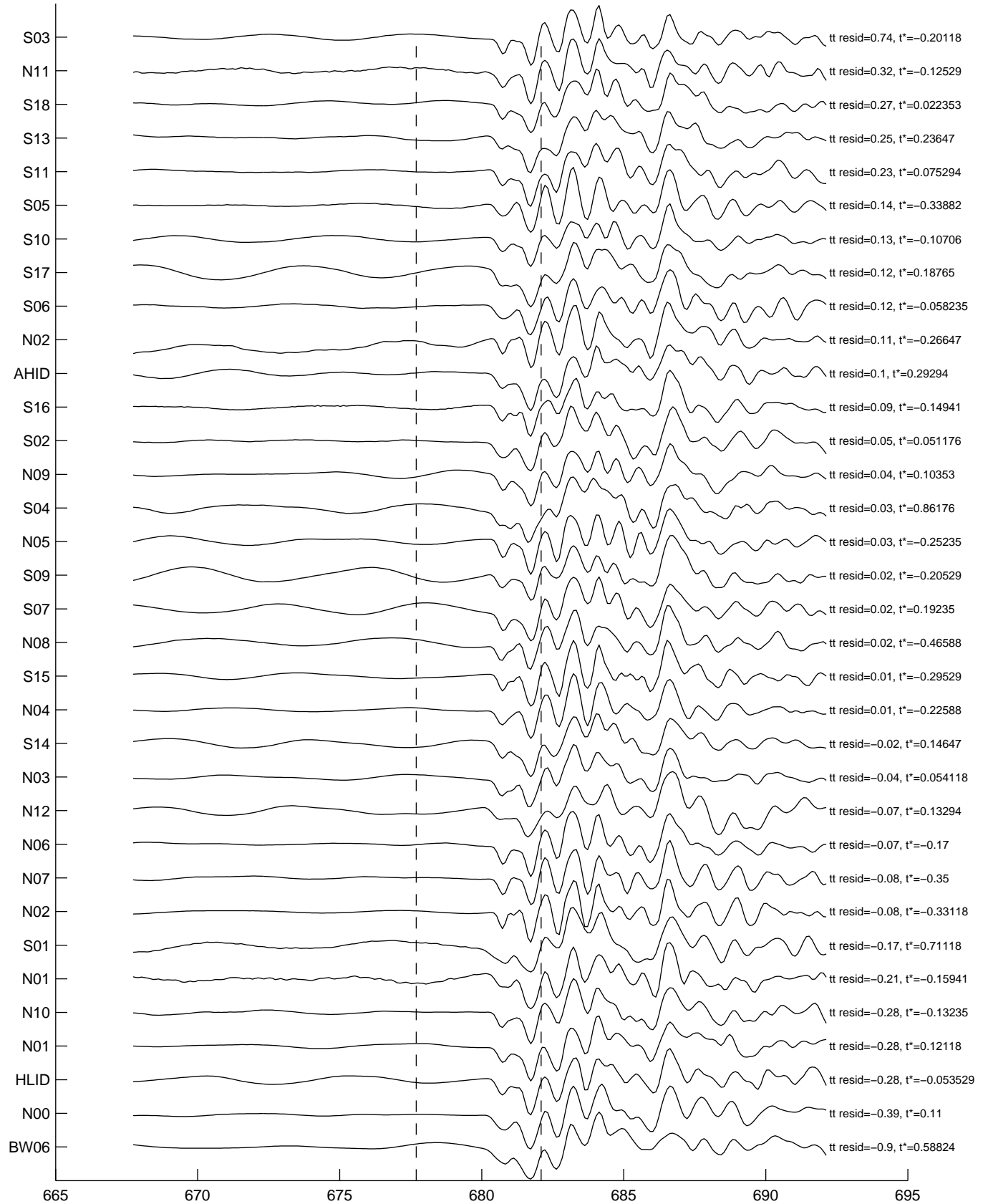
Baz = 253.3172  
Mean xcor value = 0.88139  
Range of  $t^*$  values is 2.2106  
Median  $t^*$  err is 0.57499  
Slope = 1.505 +/- 0.2807



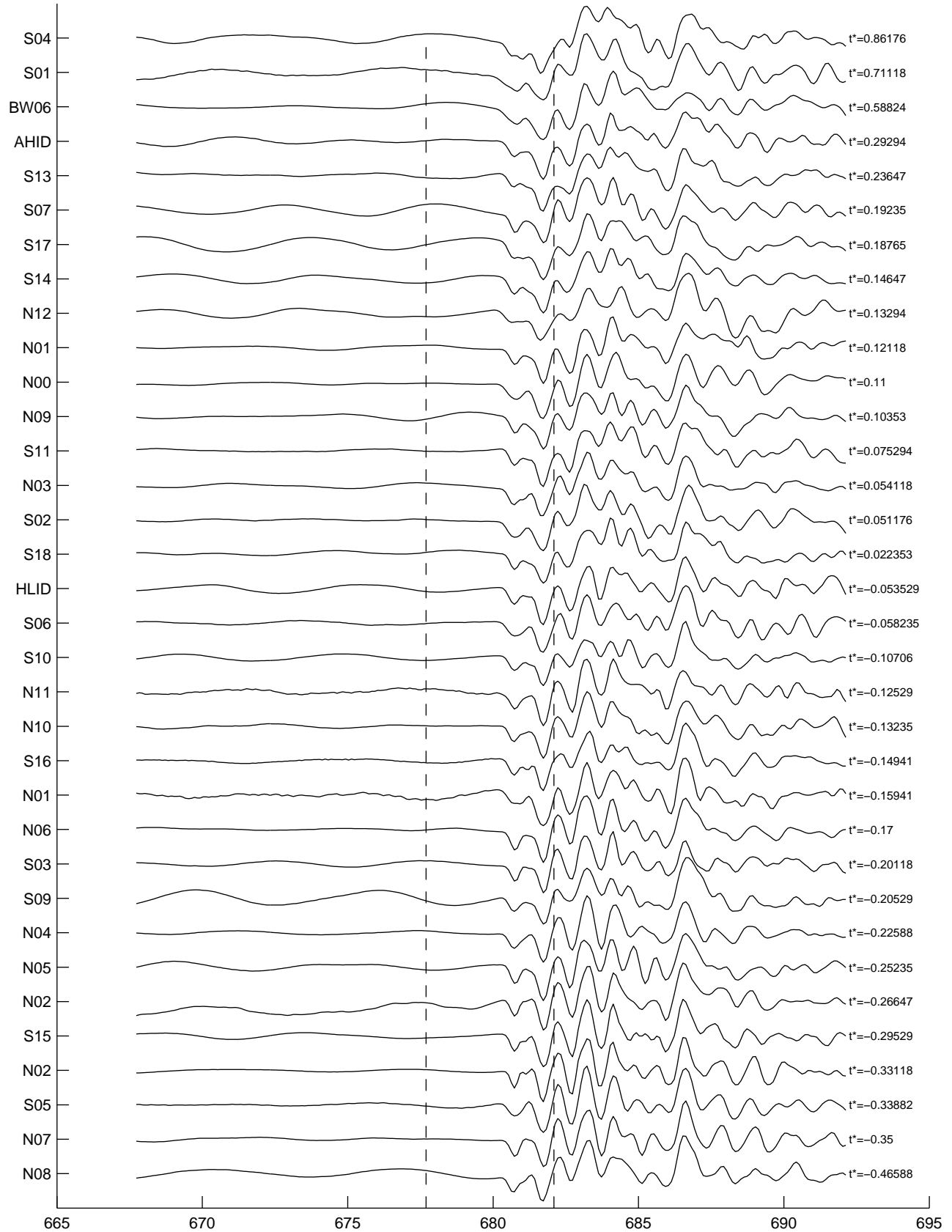
# Event\_1999\_334\_04\_01\_53



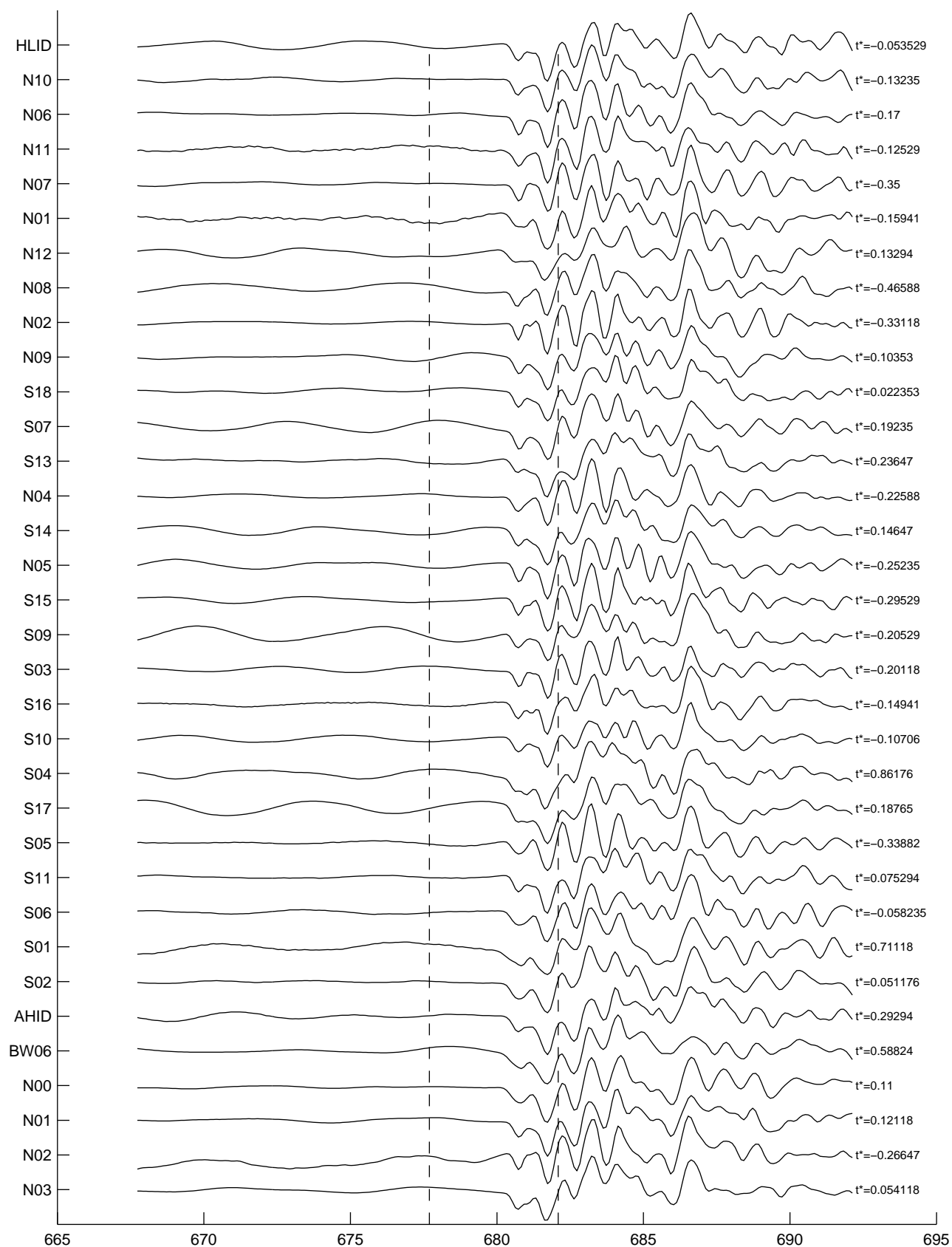
# Sorted by travel time:Event\_1999\_334\_04\_01\_53



Sorted by  $t^*$ :Event\_1999\_334\_04\_01\_53

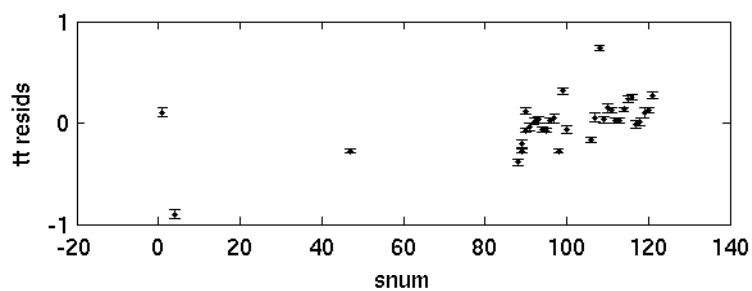
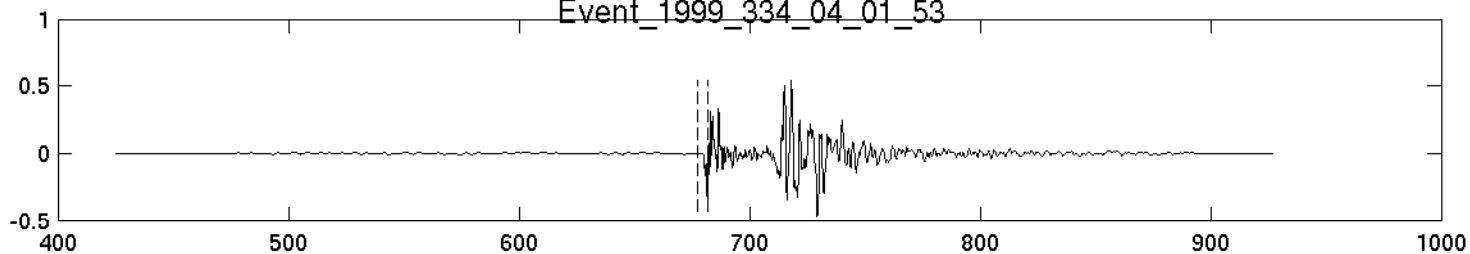


# Sorted by Delta:Event\_1999\_334\_04\_01\_53

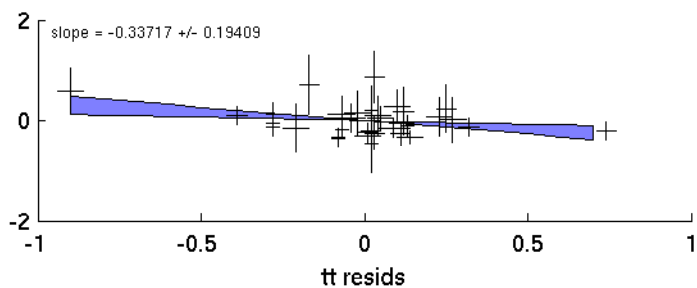
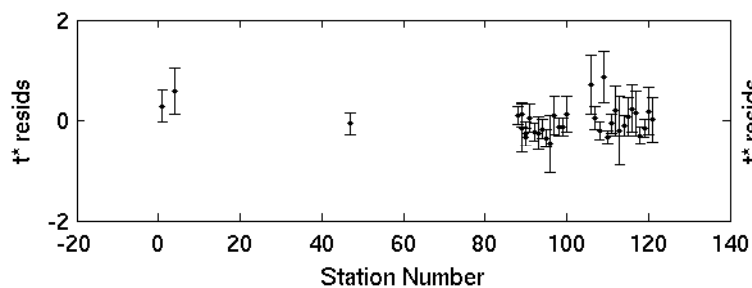


# Event\_1999\_334\_04\_01\_53

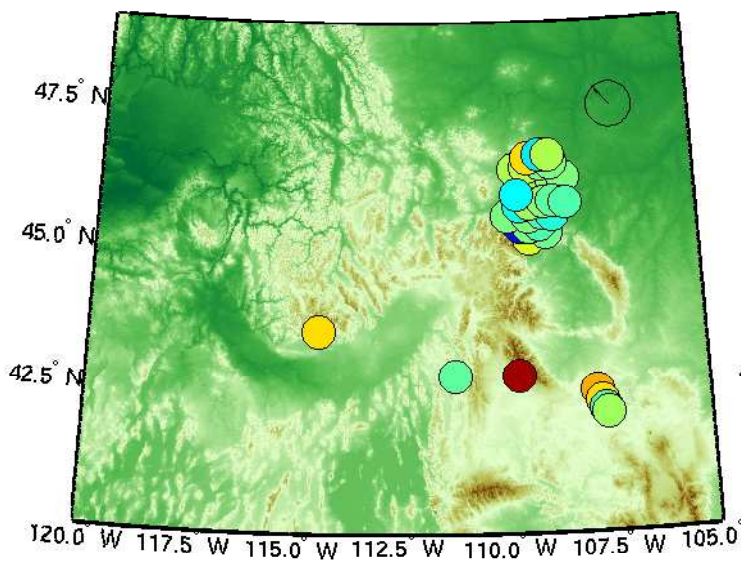
Stack



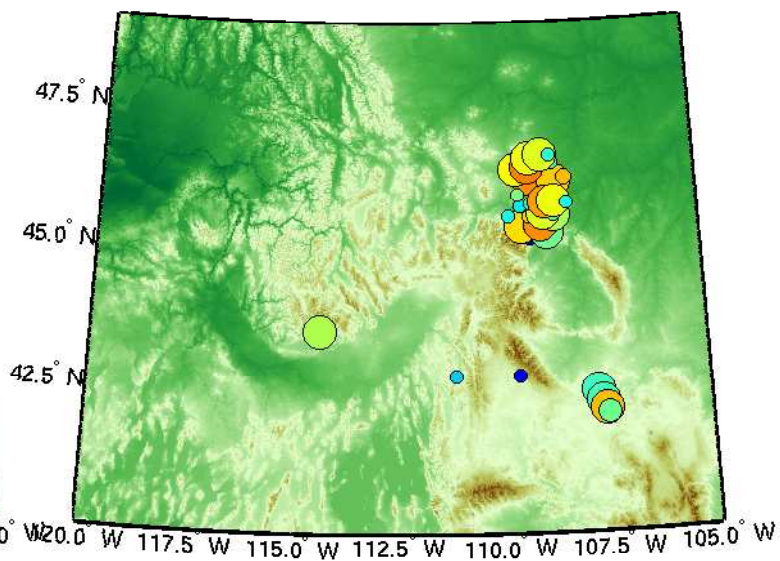
Baz = 140.825  
Mean xcor value = 0.71265  
Range of t\* values is 1.3276  
Median t\* err is 0.26139  
Slope = -0.33717 +/- 0.19409



travel time residuals

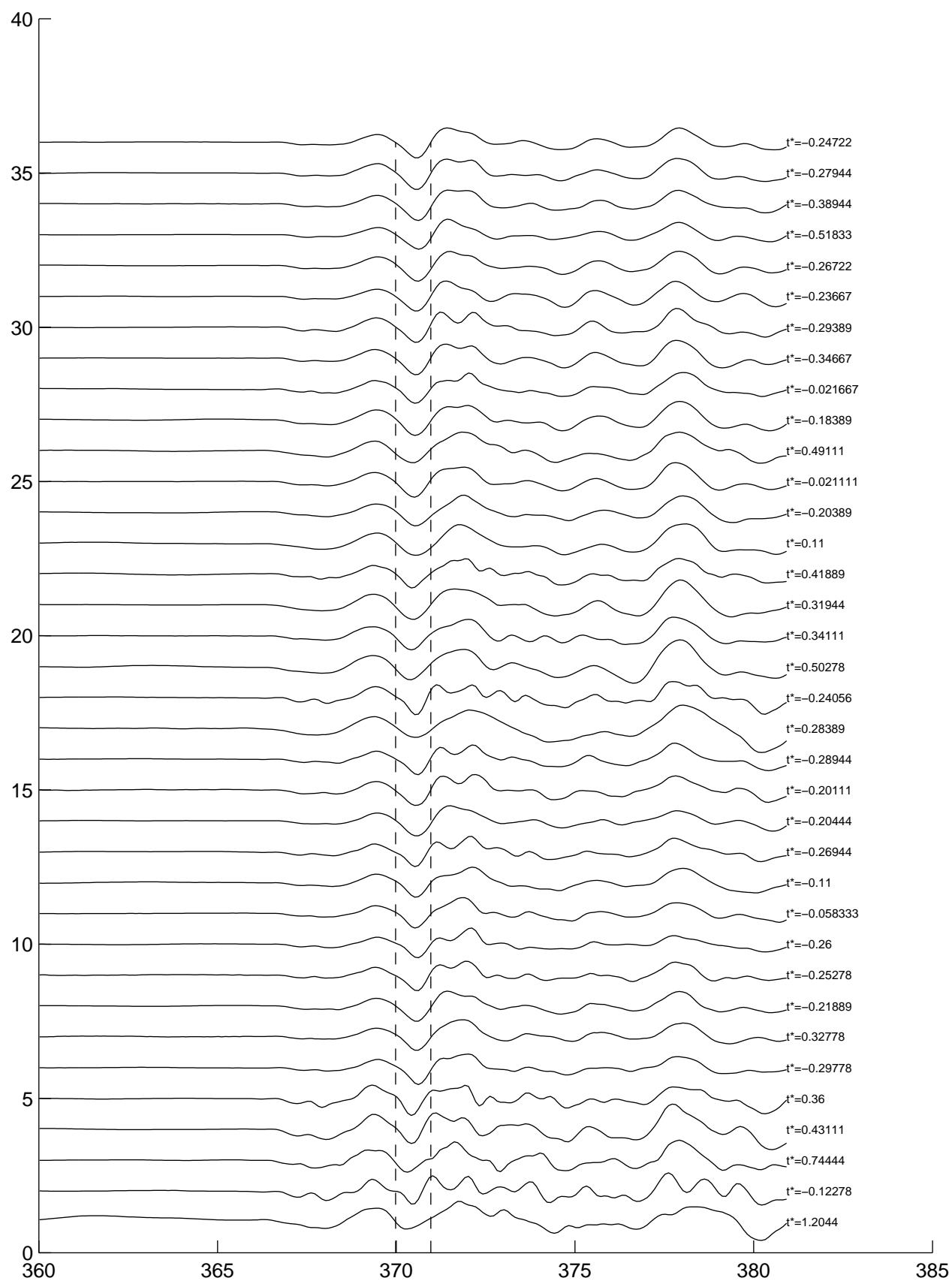


t\* values

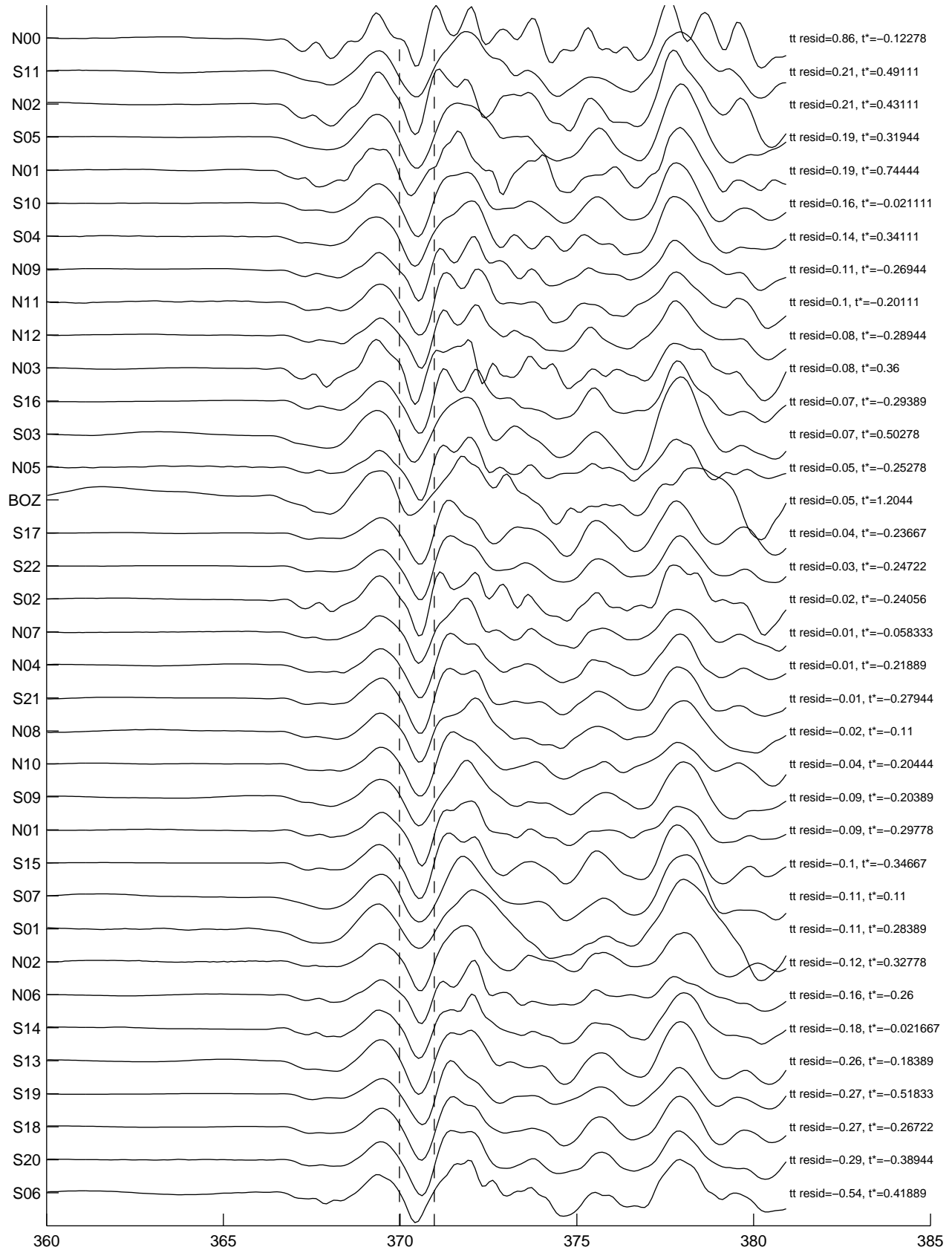




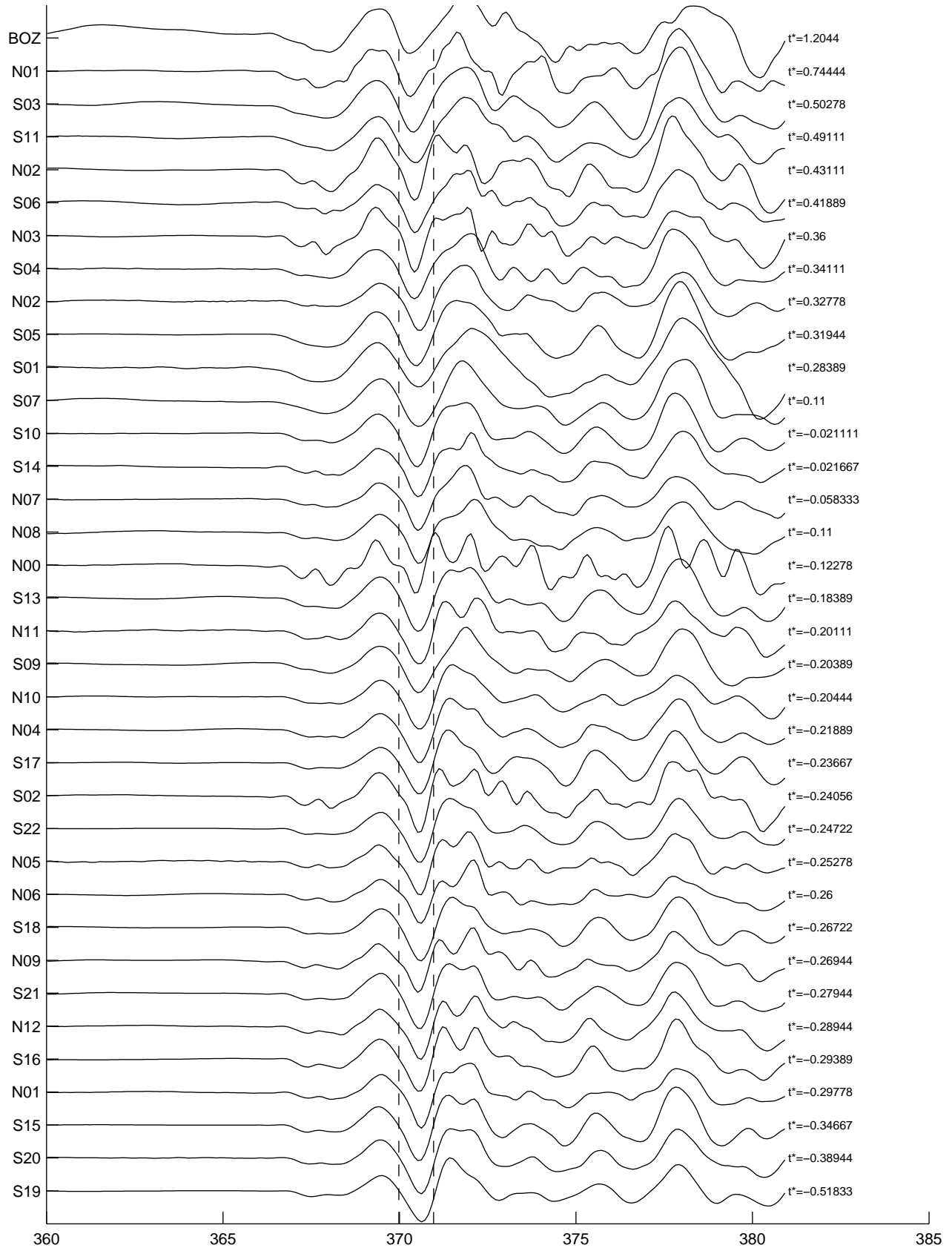
# Event\_1999\_340\_23\_12\_33



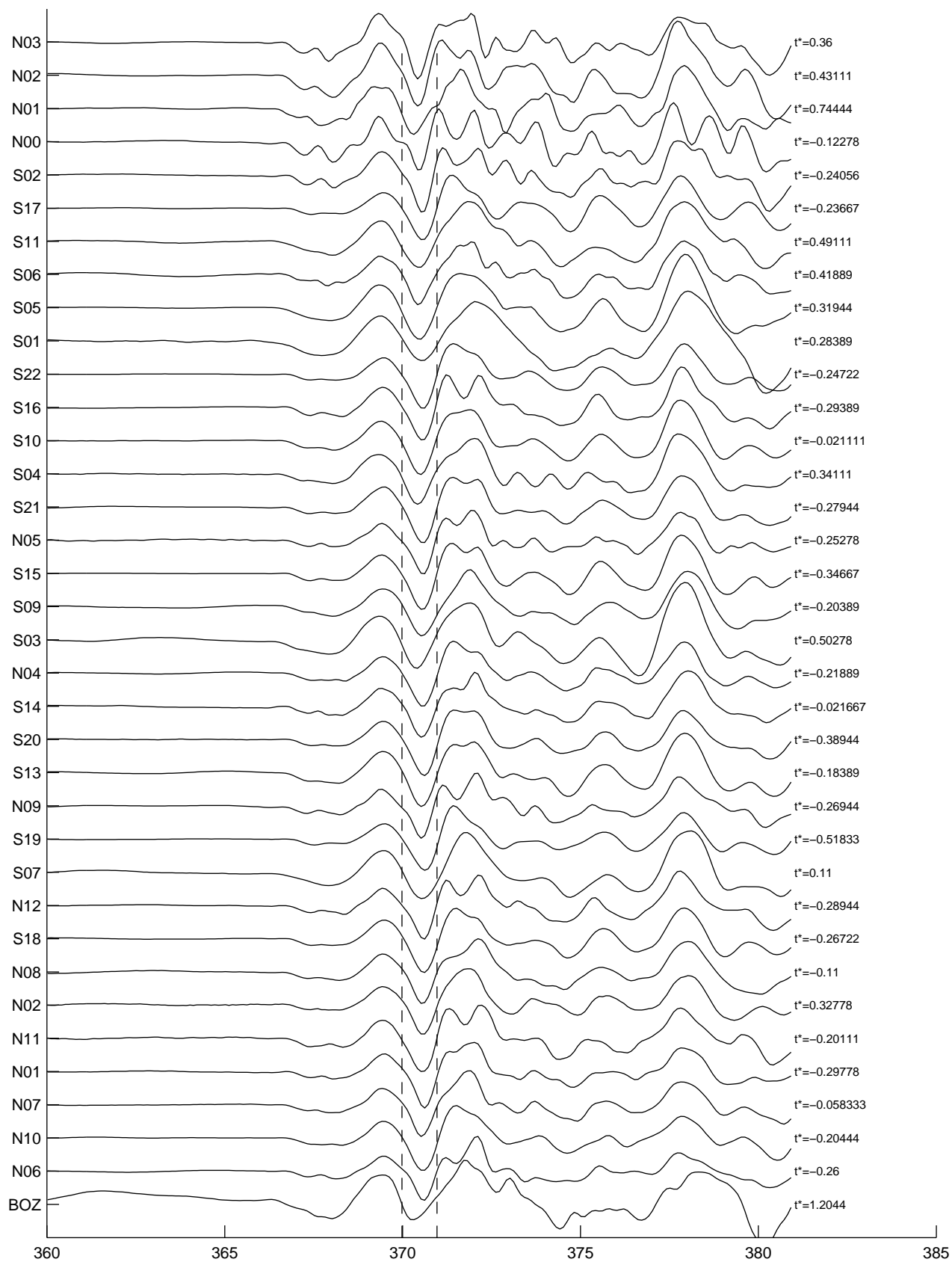
# Sorted by travel time:Event\_1999\_340\_23\_12\_33



# Sorted by $t^*$ :Event\_1999\_340\_23\_12\_33

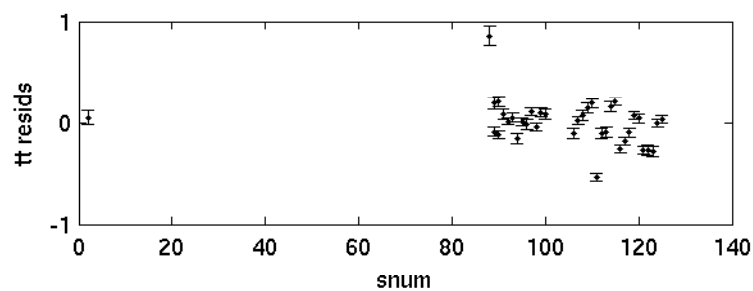
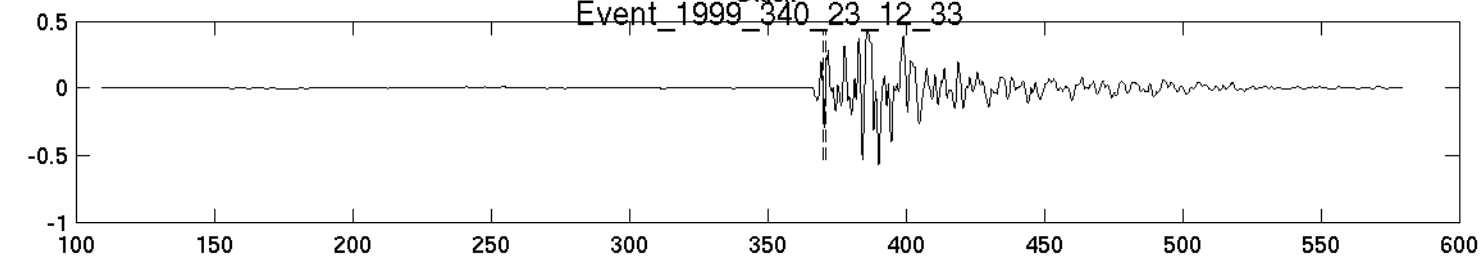


# Sorted by Delta:Event\_1999\_340\_23\_12\_33

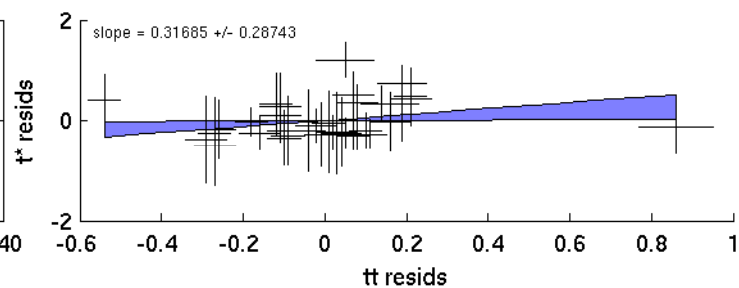
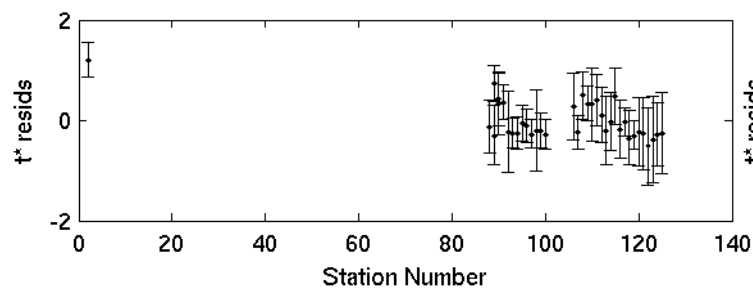


Event\_1999\_340\_23\_12\_33

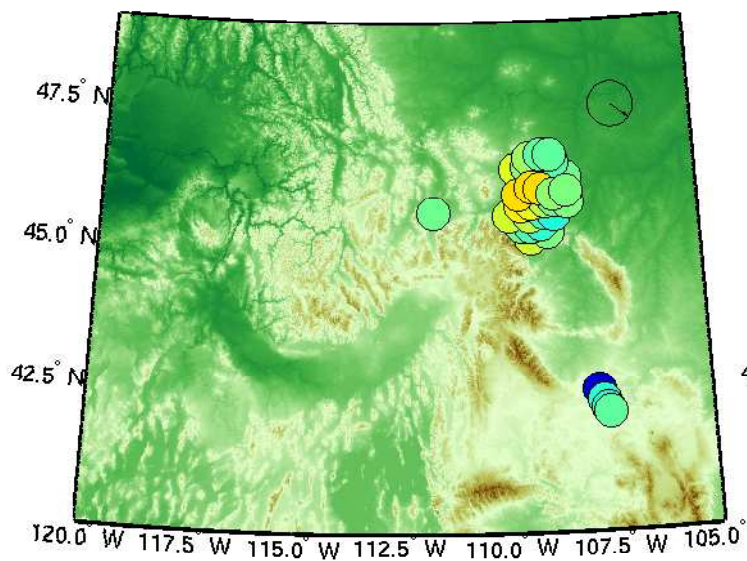
Stack



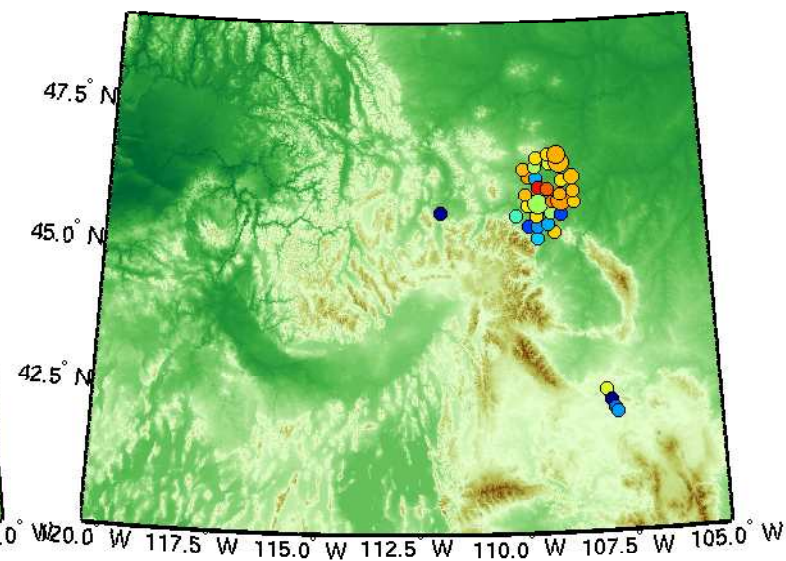
Baz = 309.817  
Mean xcor value = 0.84417  
Range of  $t^*$  values is 1.7228  
Median  $t^*$  err is 0.5379  
Slope = 0.31685 +/- 0.28743



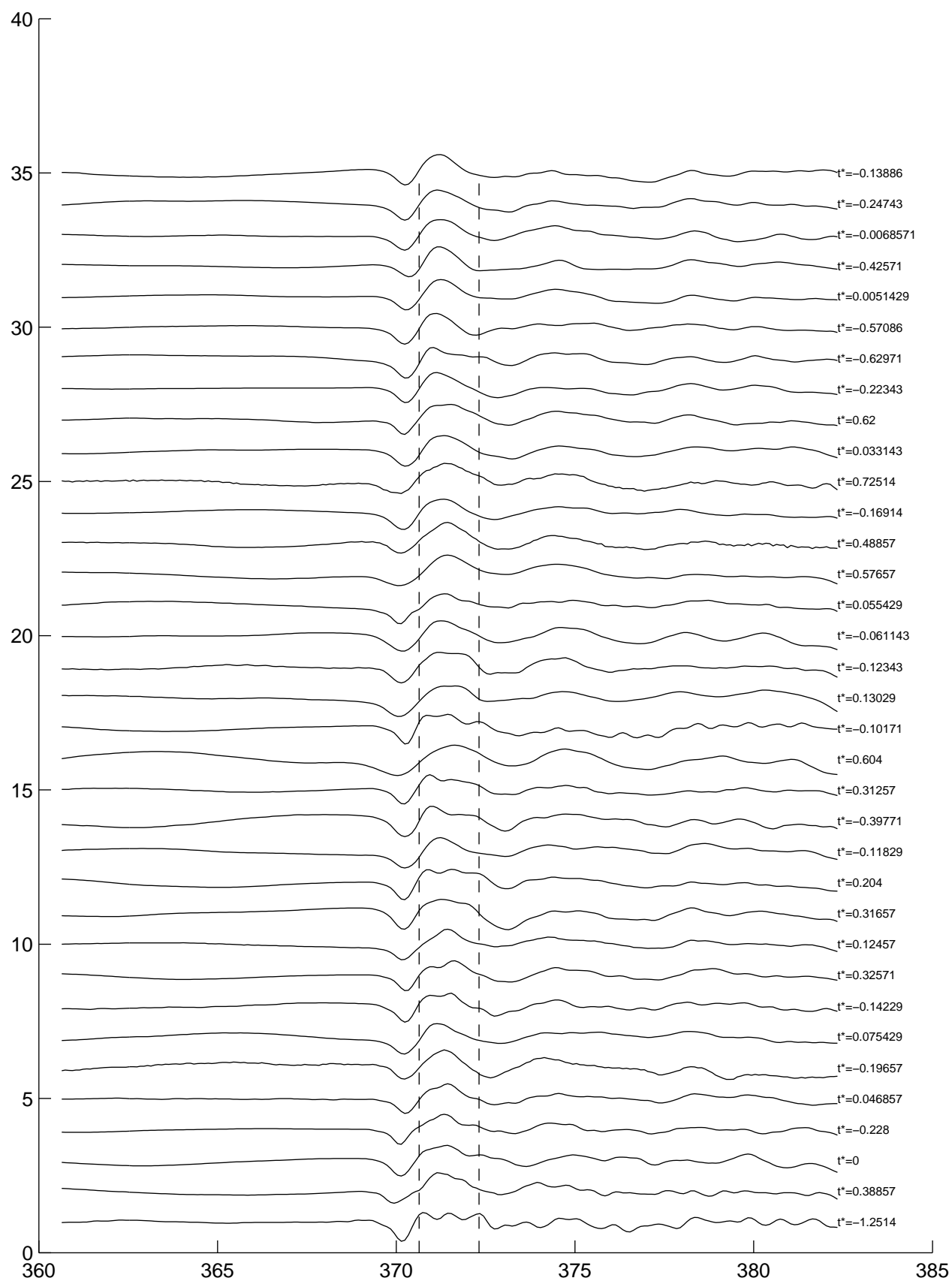
travel time residuals



$t^*$  values

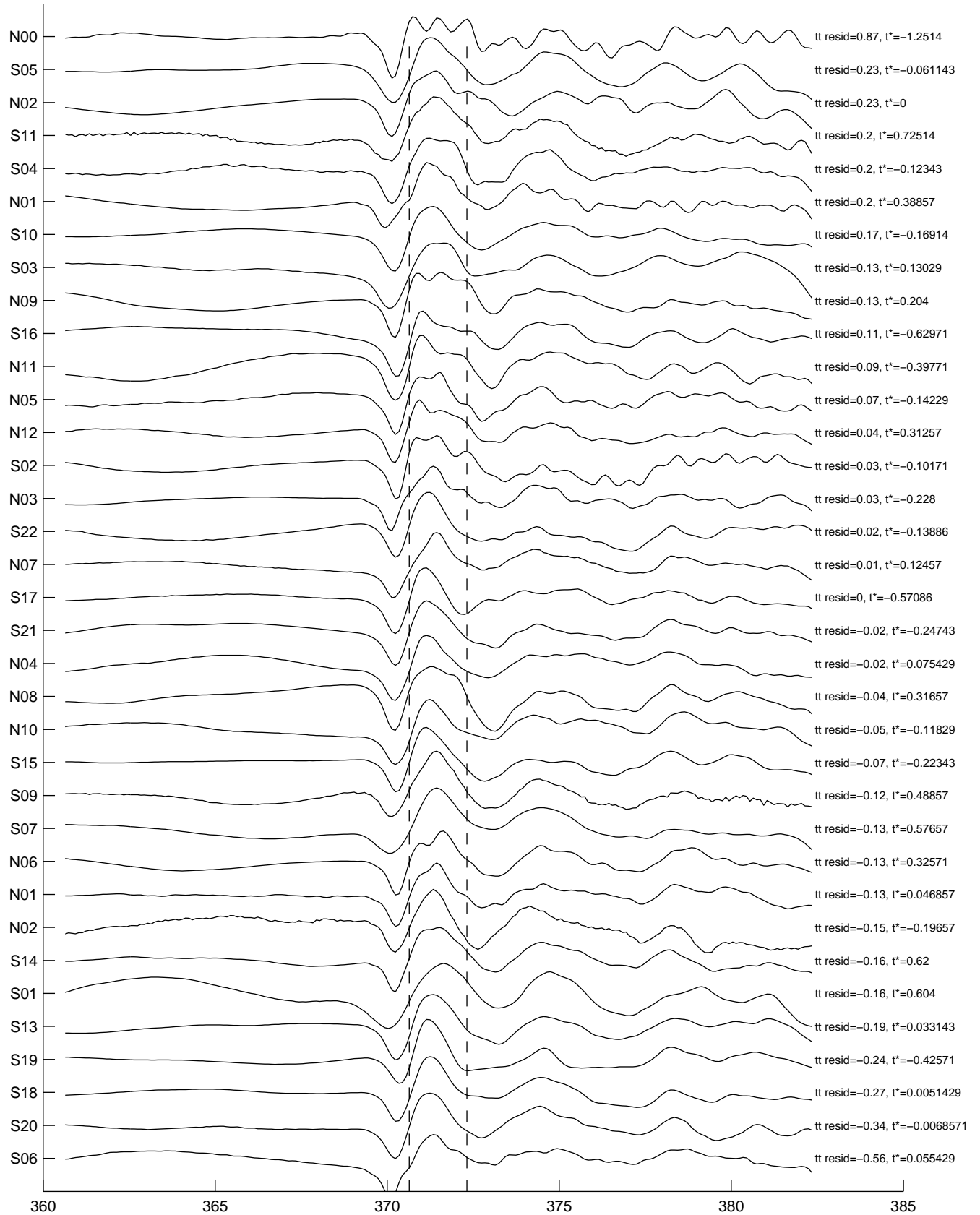


# Event\_1999\_341\_00\_19\_49

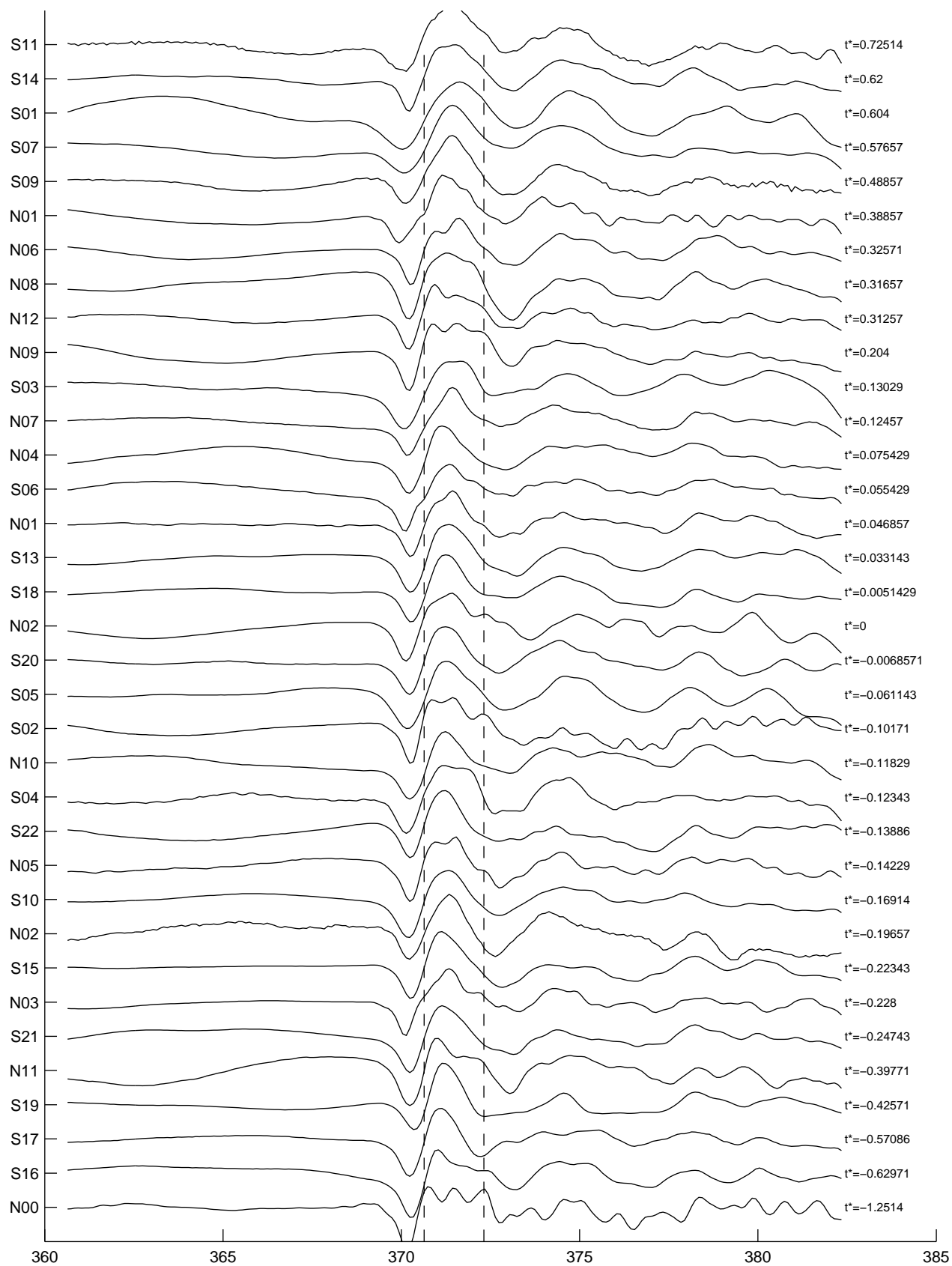




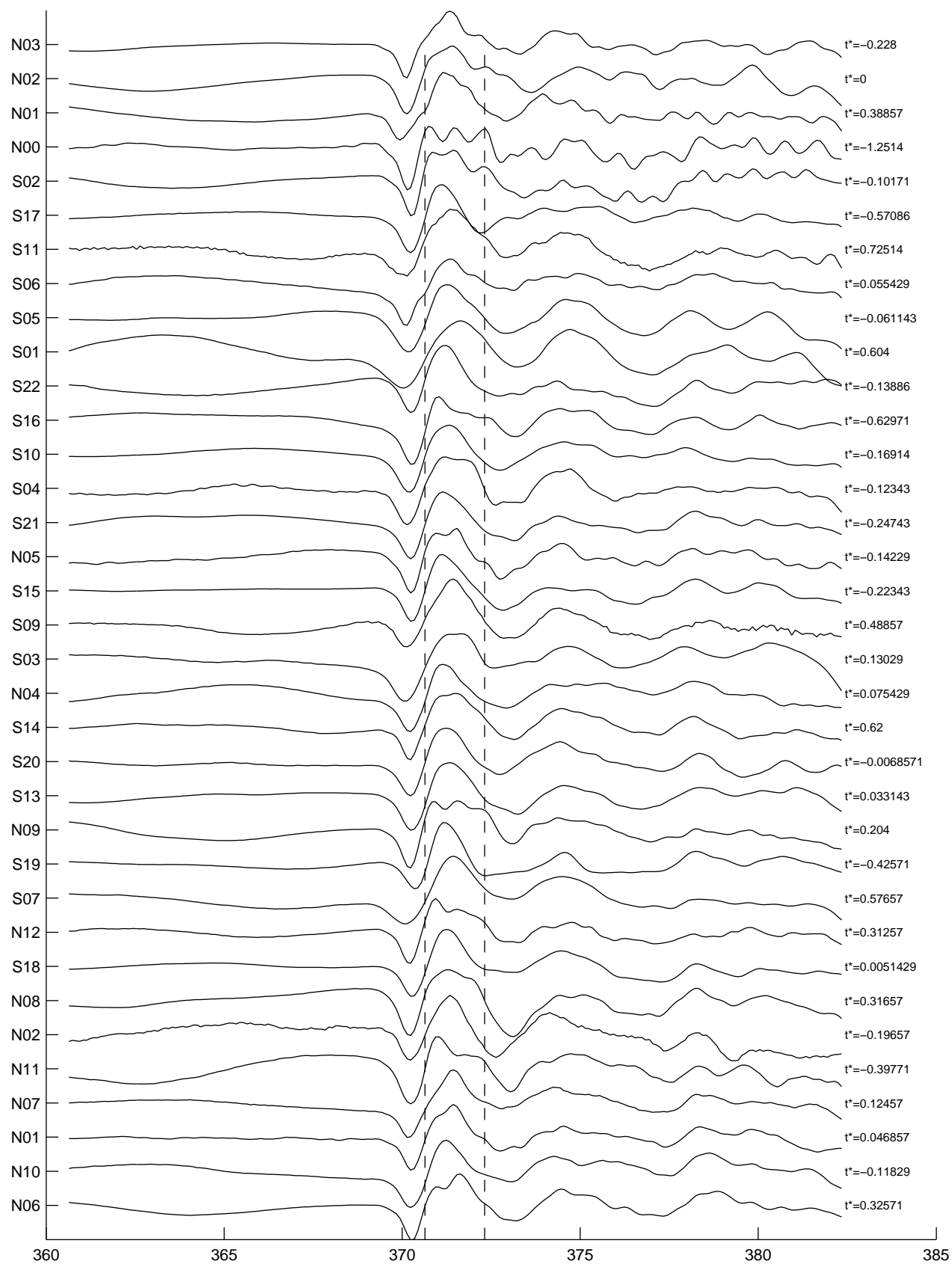
# Sorted by travel time:Event\_1999\_341\_00\_19\_49



Sorted by  $t^*$ :Event\_1999\_341\_00\_19\_49

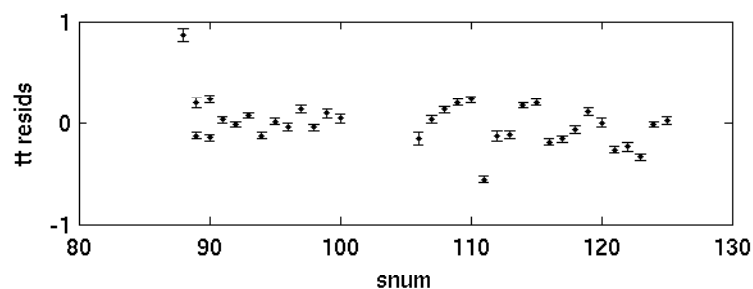
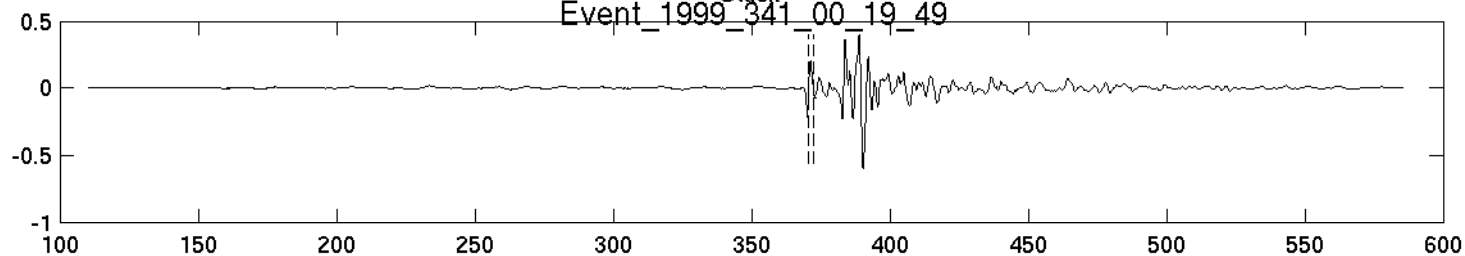


# Sorted by Delta:Event\_1999\_341\_00\_19\_49

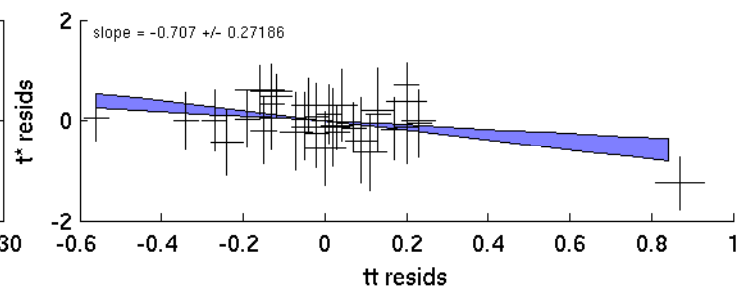
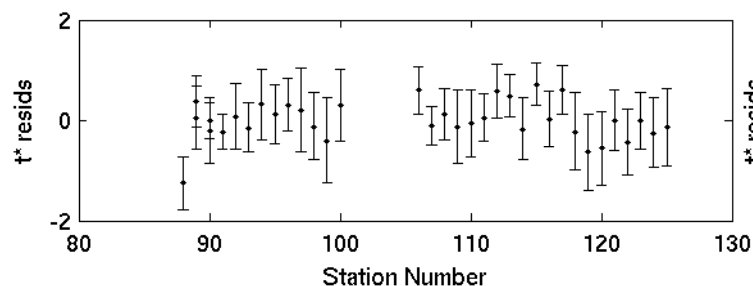


# Event\_1999\_341\_00\_19\_49

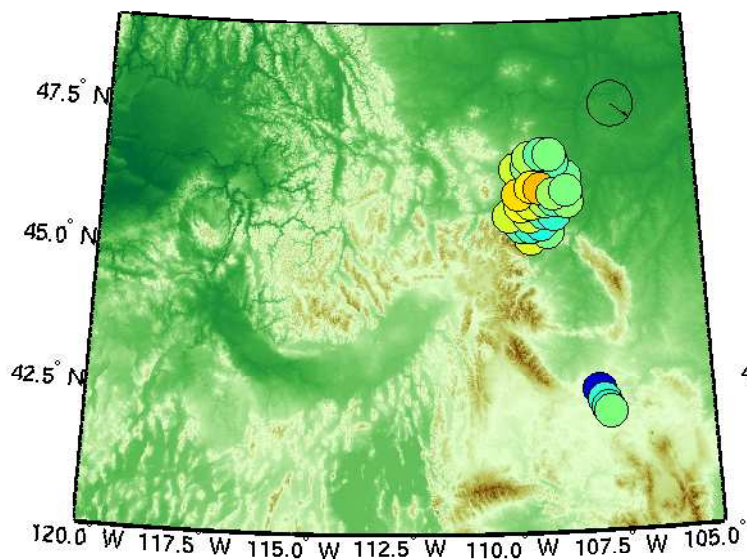
Stack



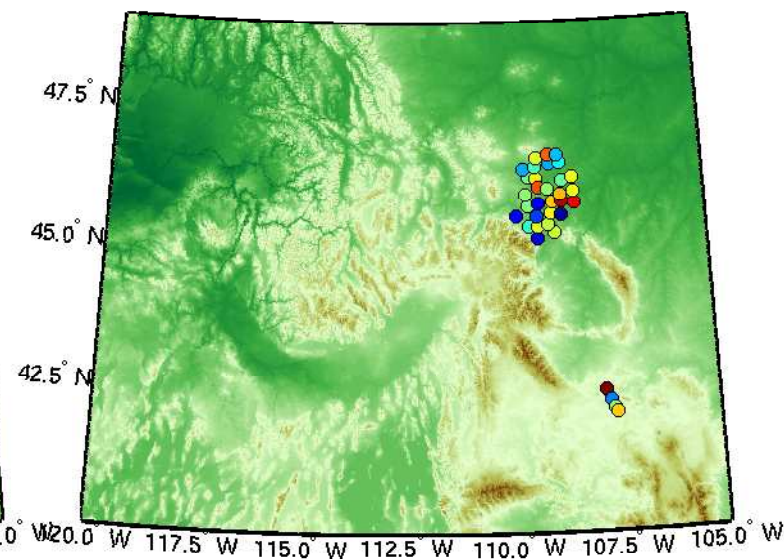
Baz = 309.7107  
Mean xcor value = 0.81286  
Range of t\* values is 1.9766  
Median t\* err is 0.60524  
Slope = -0.707 +/- 0.27186



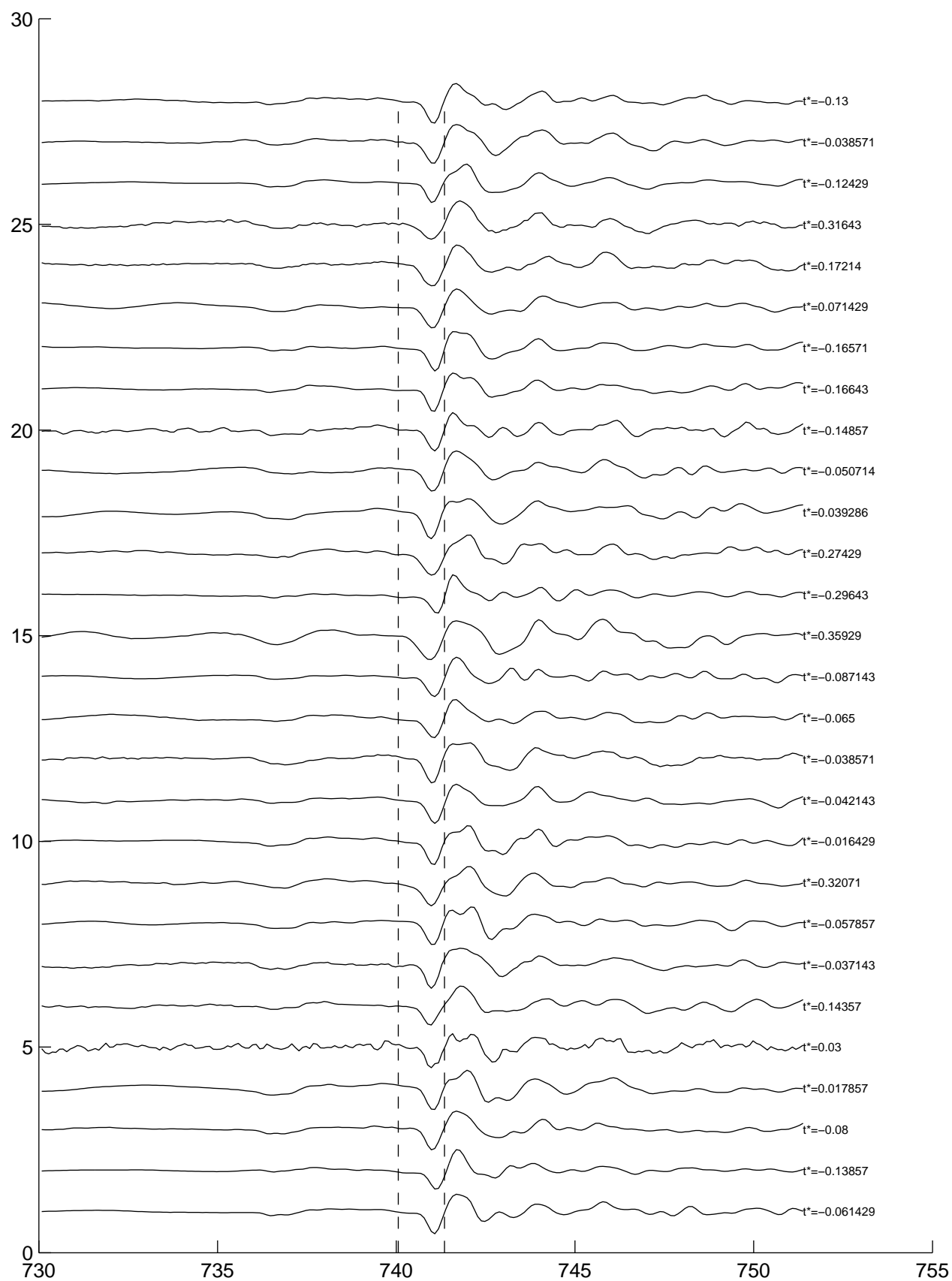
travel time residuals



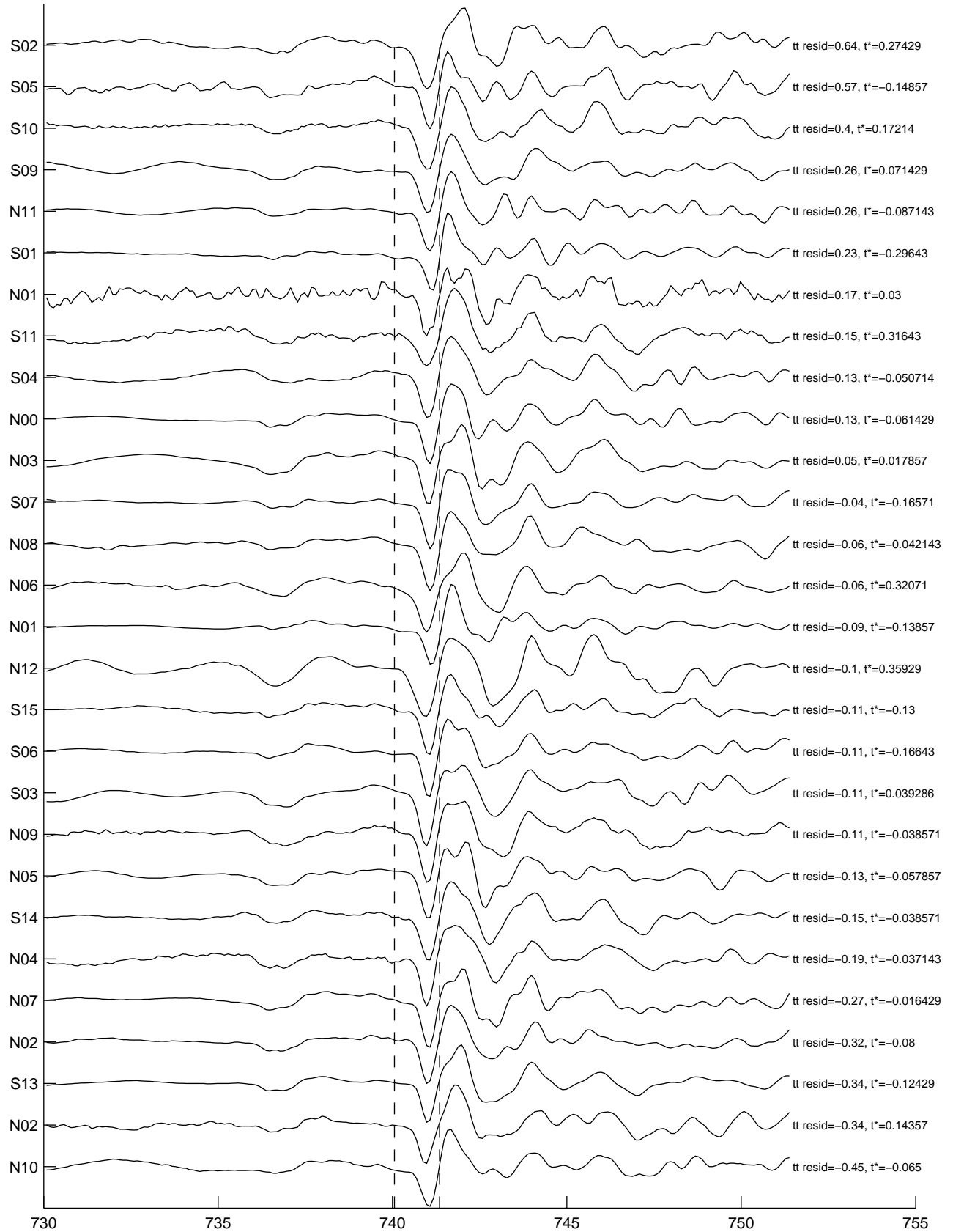
t\* values



# Event\_1999\_341\_21\_29\_49

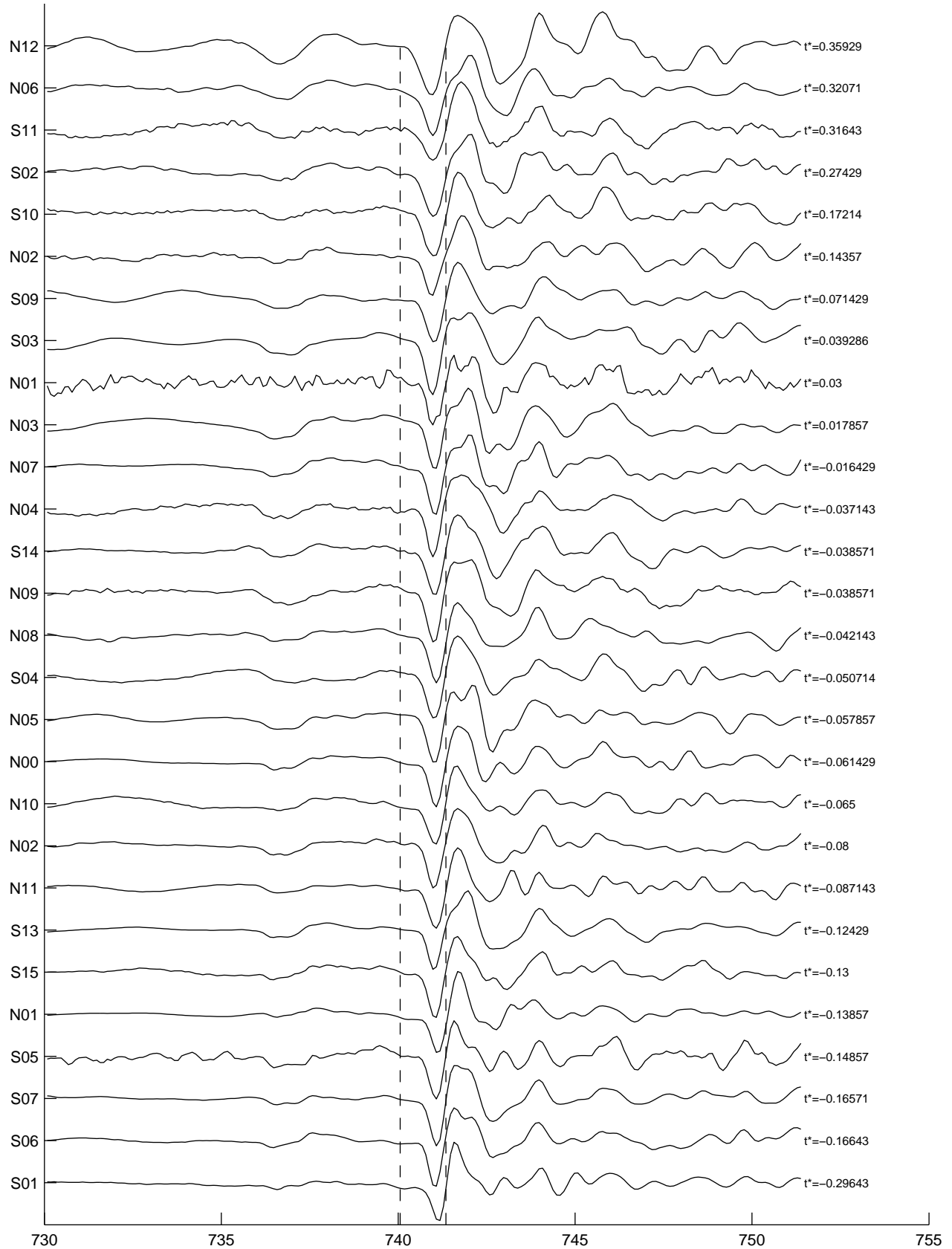


# Sorted by travel time: Event\_1999\_341\_21\_29\_49

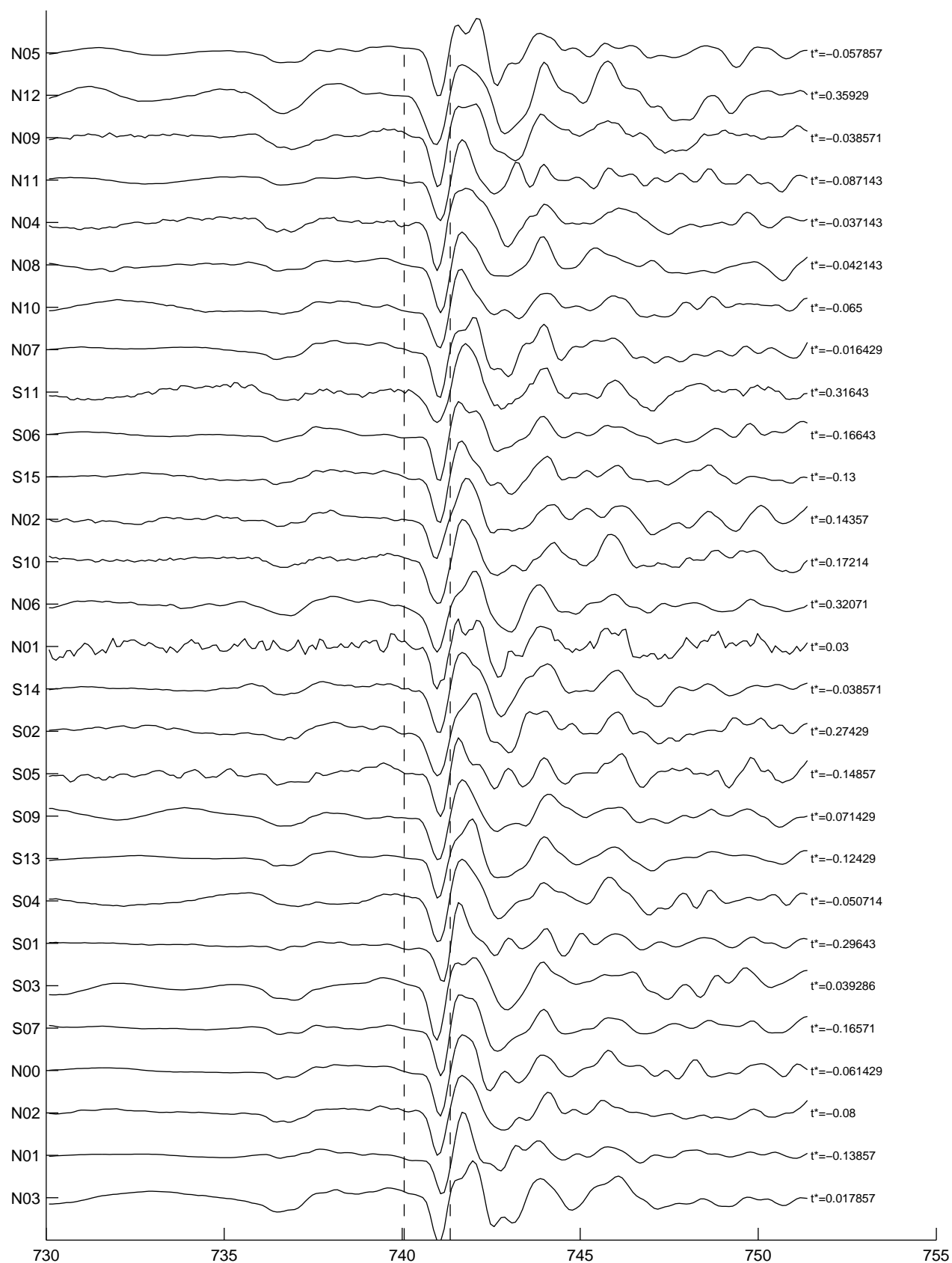


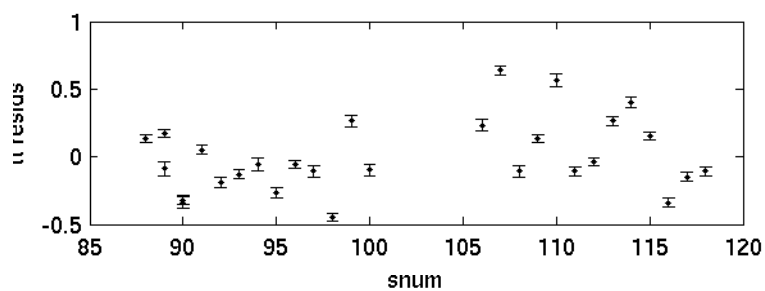
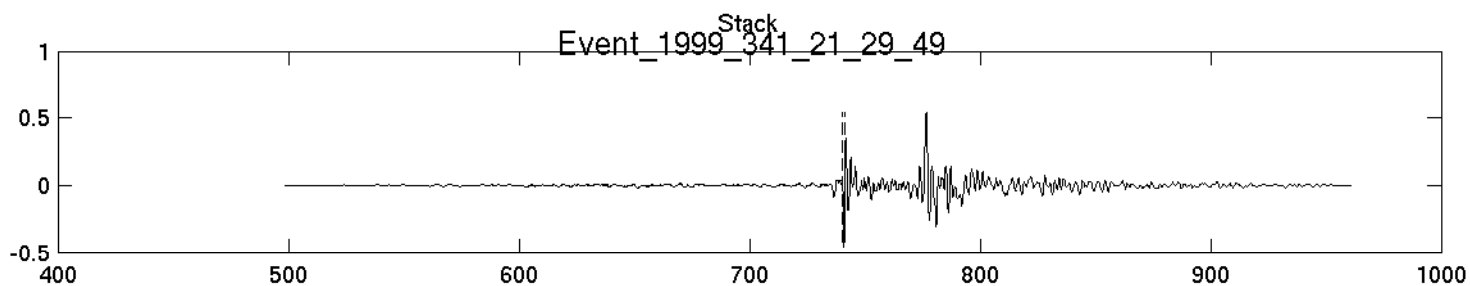


Sorted by  $t^*$ :Event\_1999\_341\_21\_29\_49

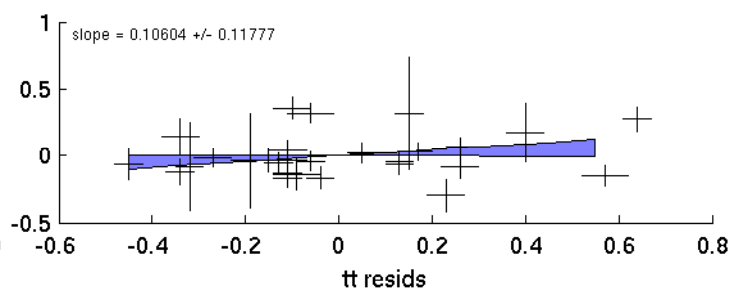
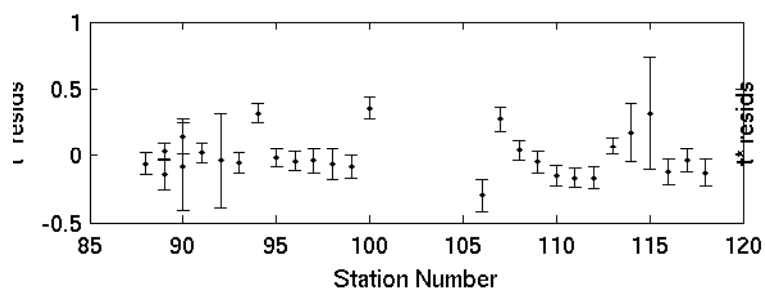


# Sorted by Delta:Event\_1999\_341\_21\_29\_49

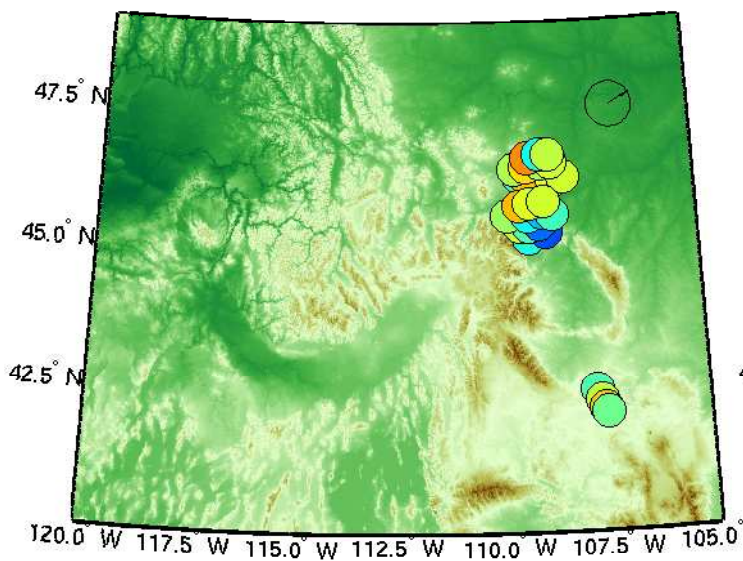




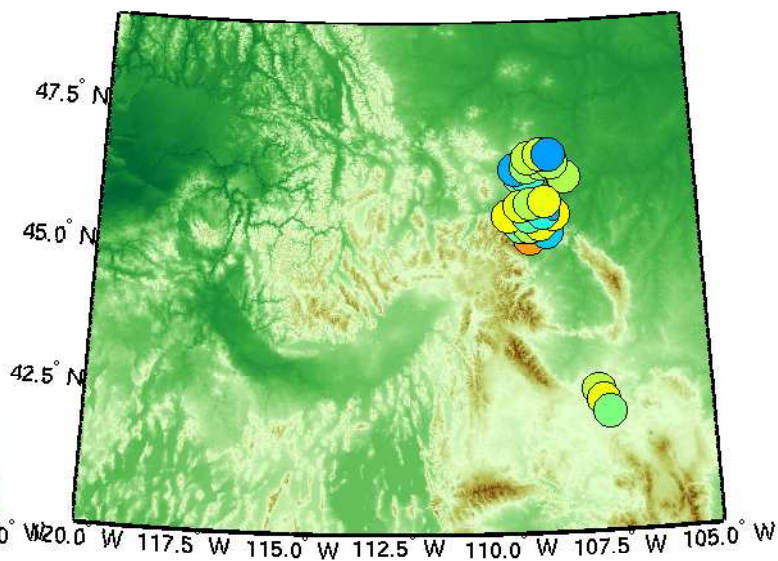
Baz = 241.191  
Mean xcor value = 0.6825  
Range of  $t^*$  values is 0.65571  
Median  $t^*$  err is 0.084266  
Slope = 0.10604 +/- 0.11777



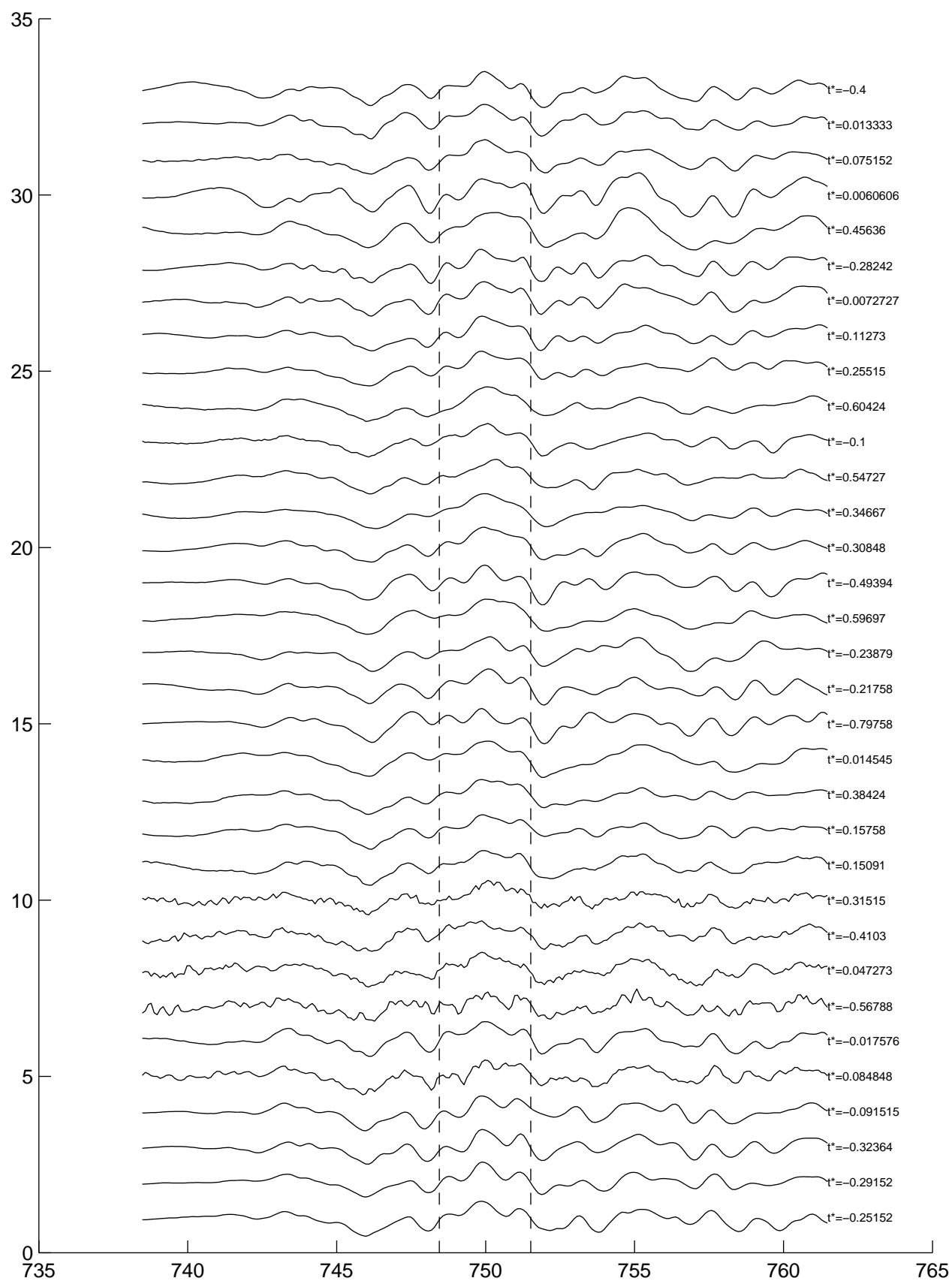
travel time residuals



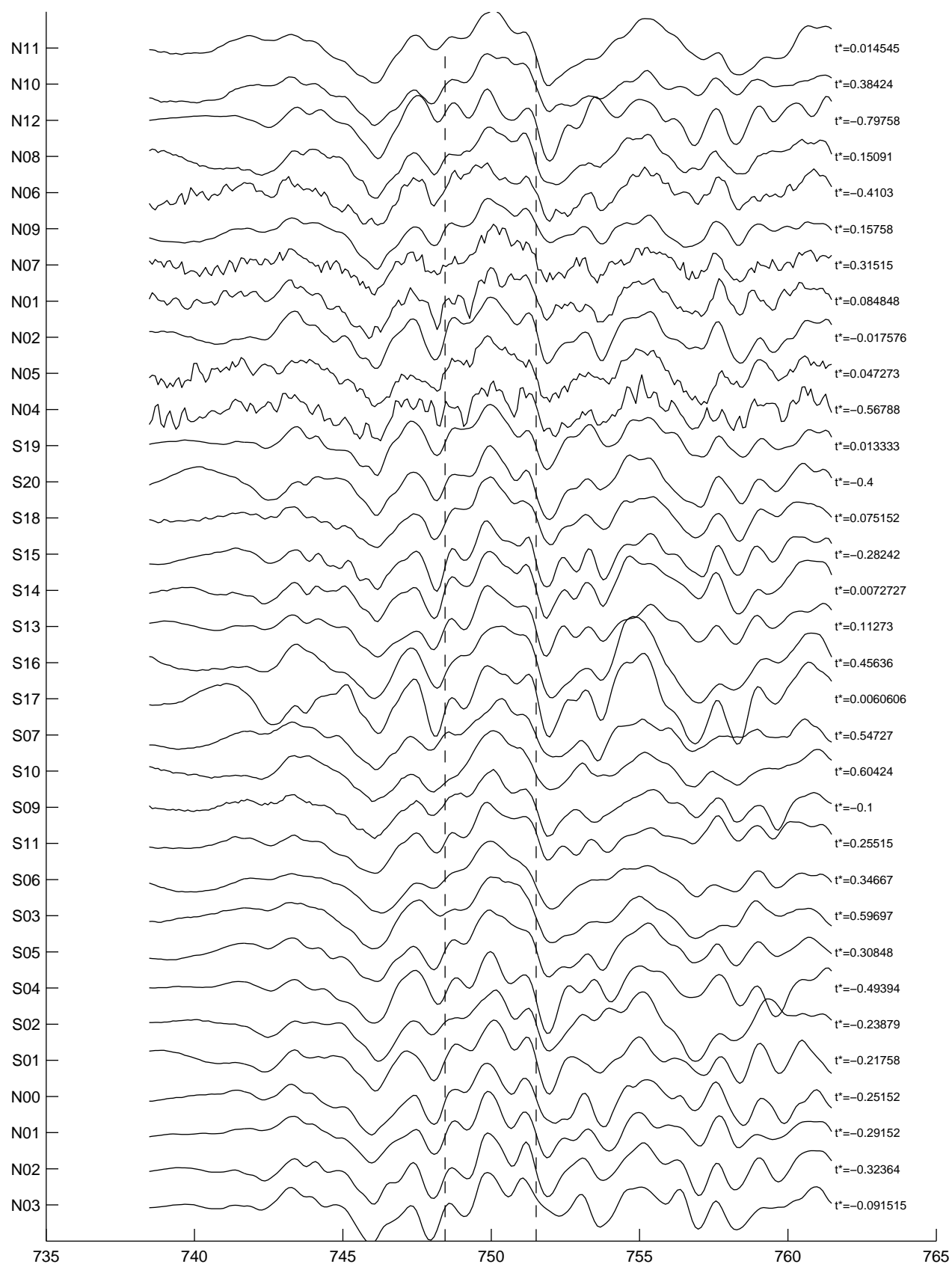
$t^*$  values



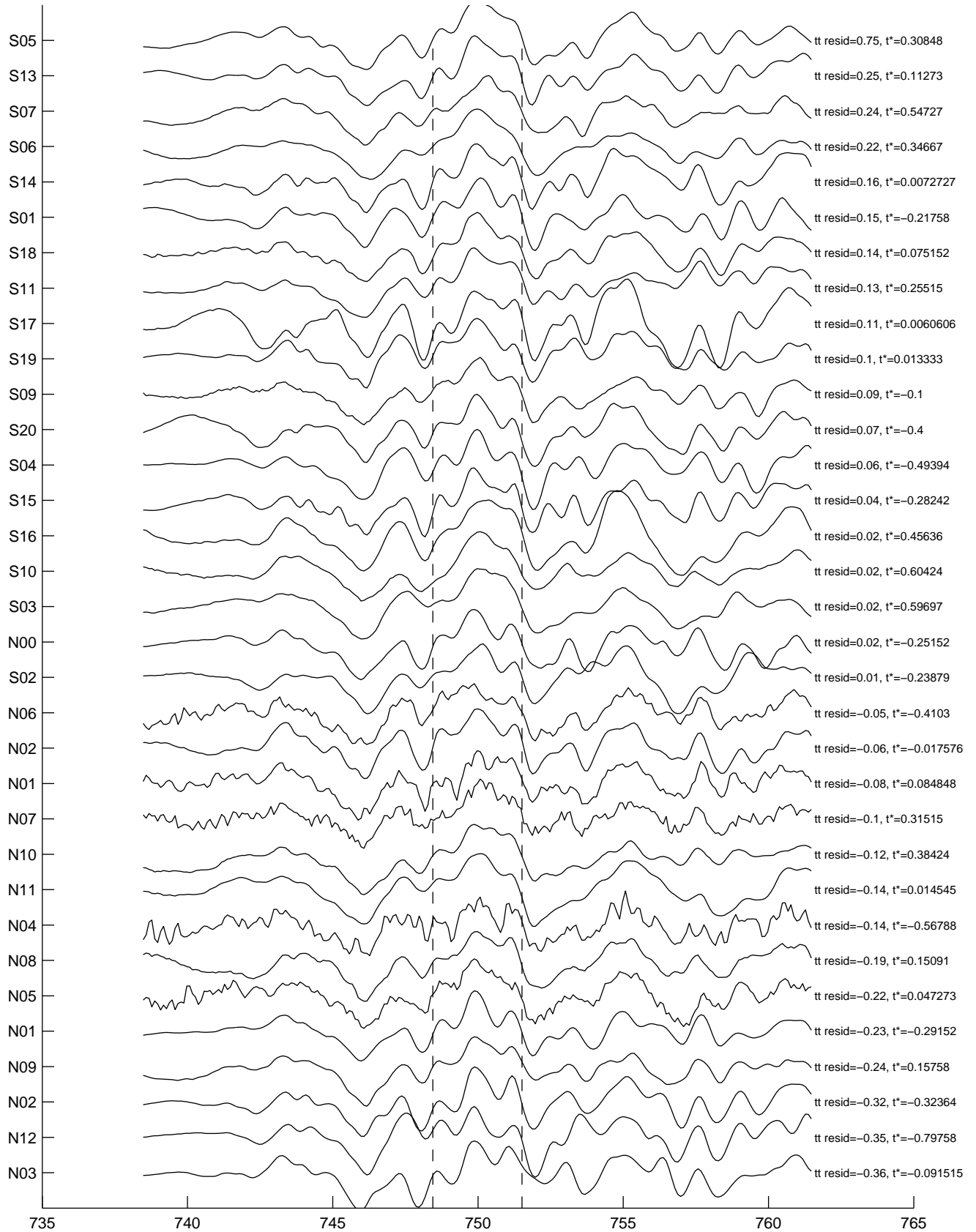
# Event\_1999\_344\_18\_38\_30



# Sorted by Delta:Event\_1999\_344\_18\_38\_30

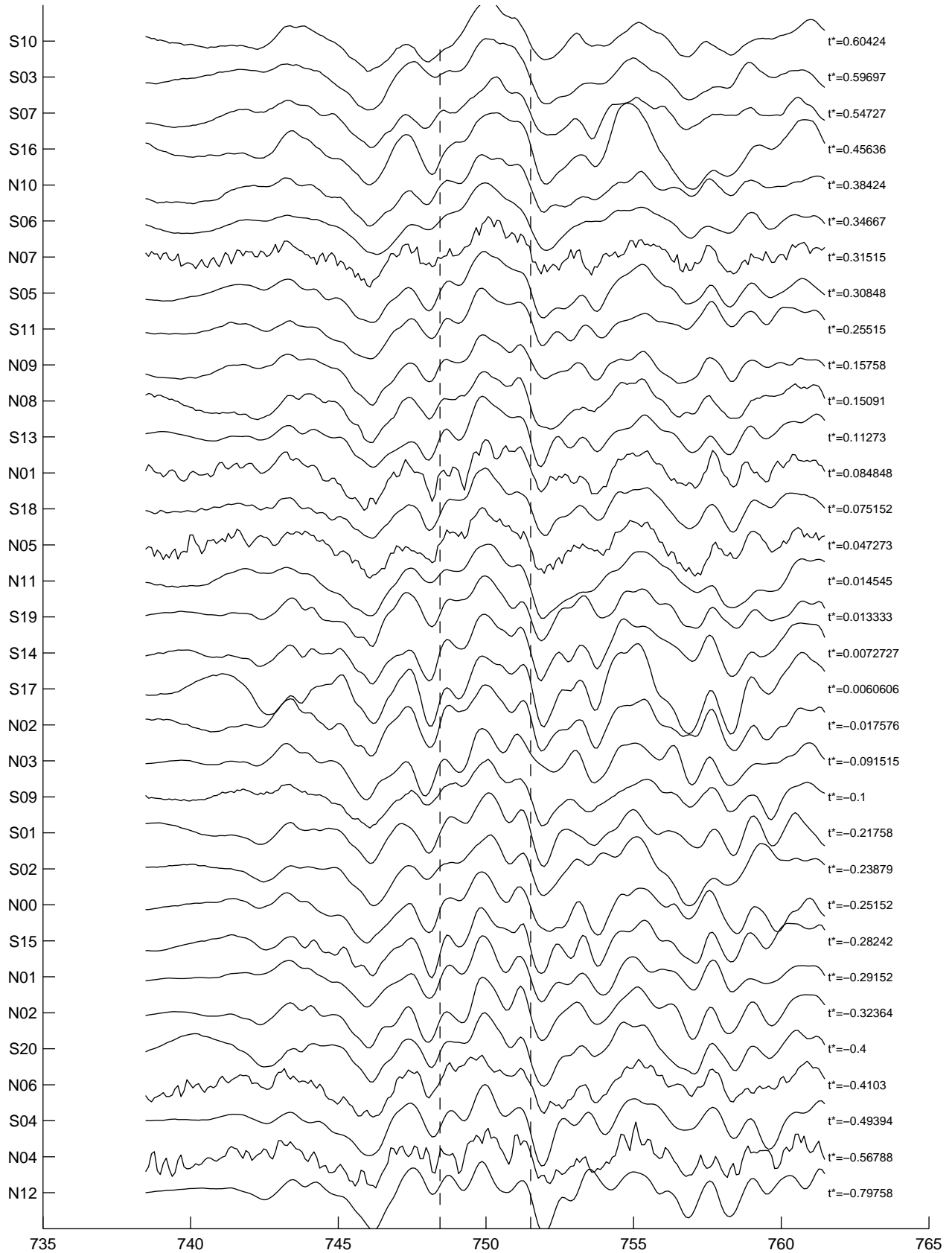


# Sorted by travel time: Event\_1999\_344\_18\_38\_30



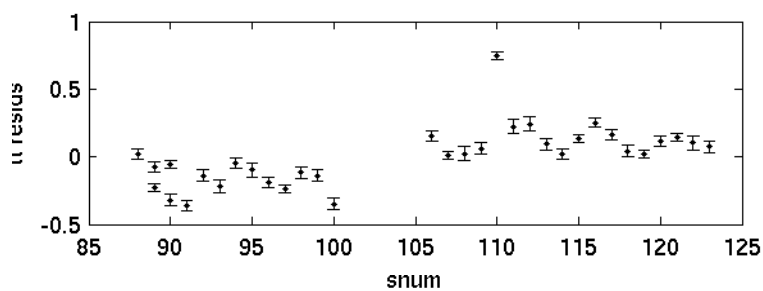
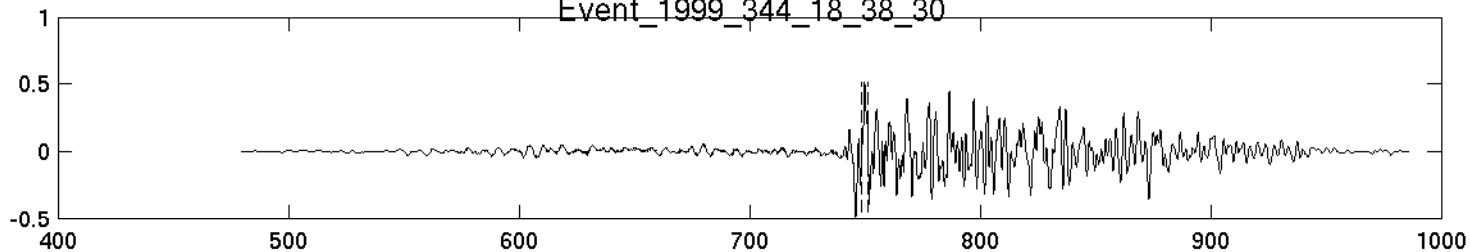


Sorted by  $t^*$ :Event\_1999\_344\_18\_38\_30

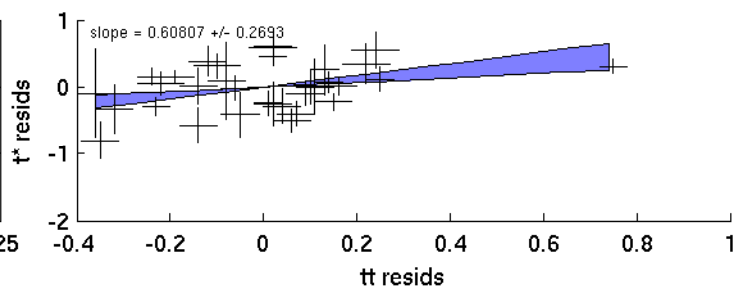
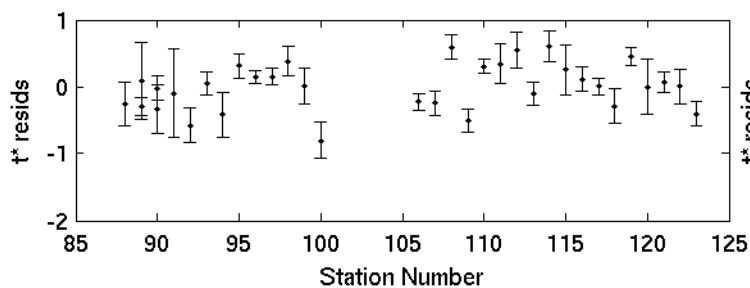


# Event\_1999\_344\_18\_38\_30

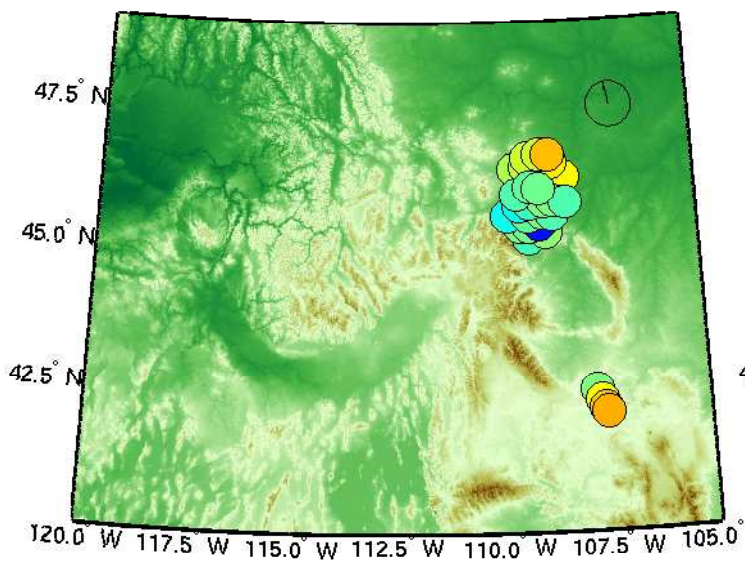
Stack



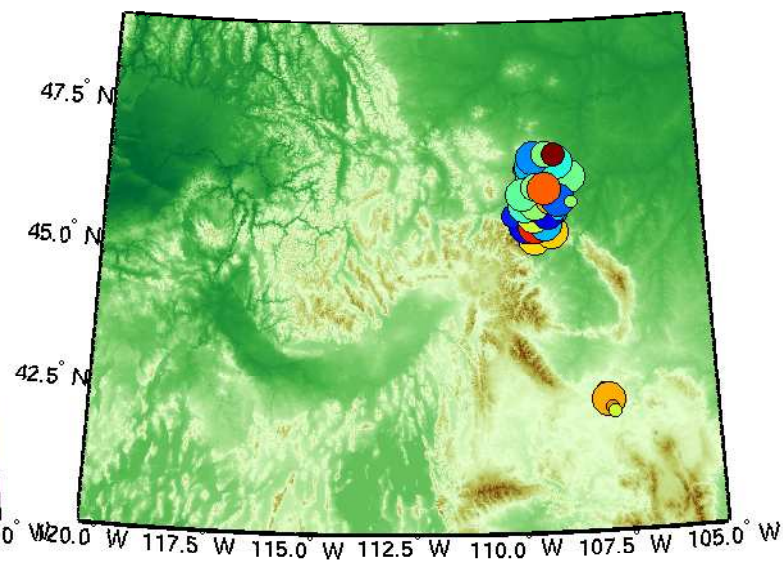
Baz = 170.672  
Mean xcor value = 0.71545  
Range of  $t^*$  values is 1.4018  
Median  $t^*$  err is 0.18612  
Slope = 0.60807 +/- 0.2693



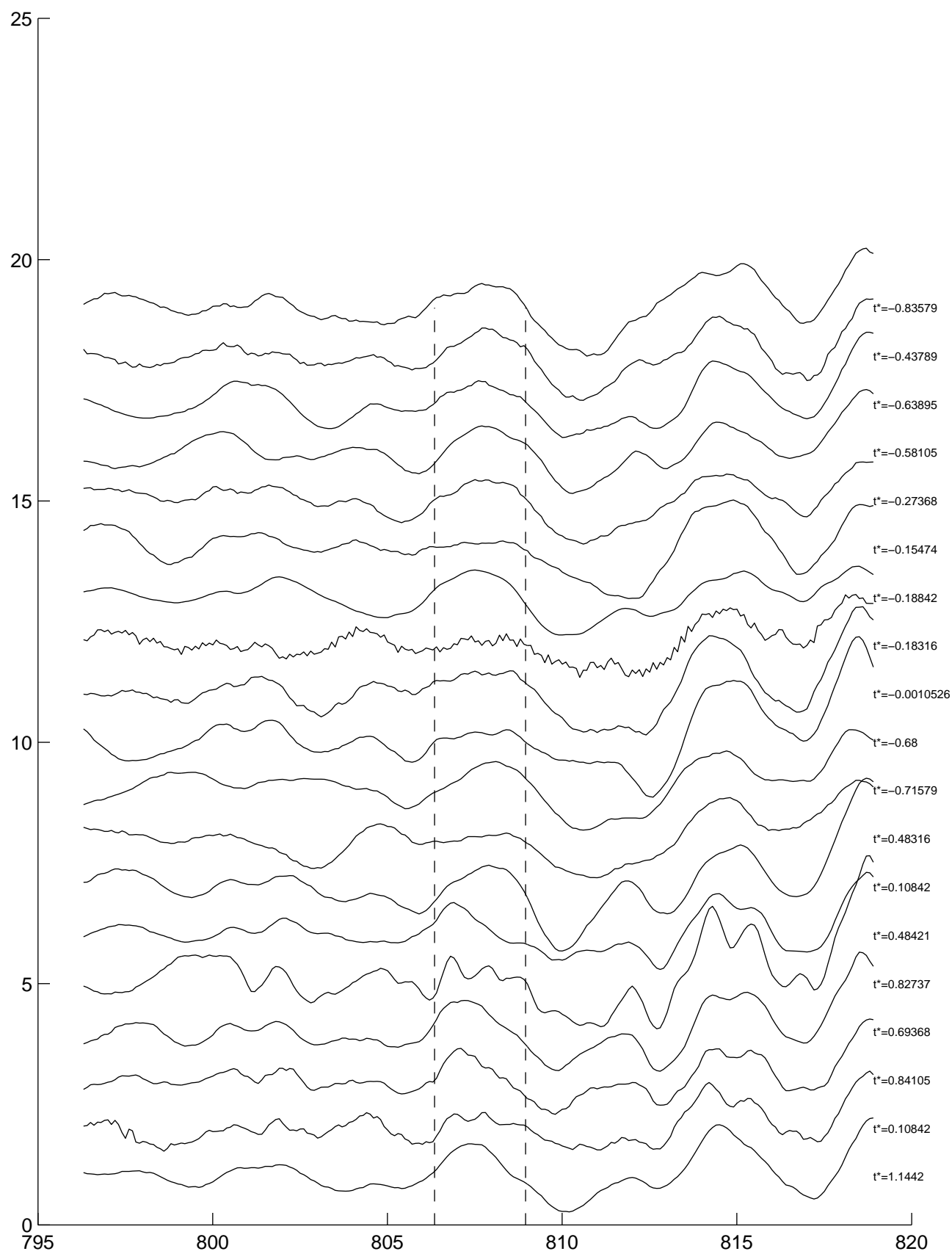
travel time residuals



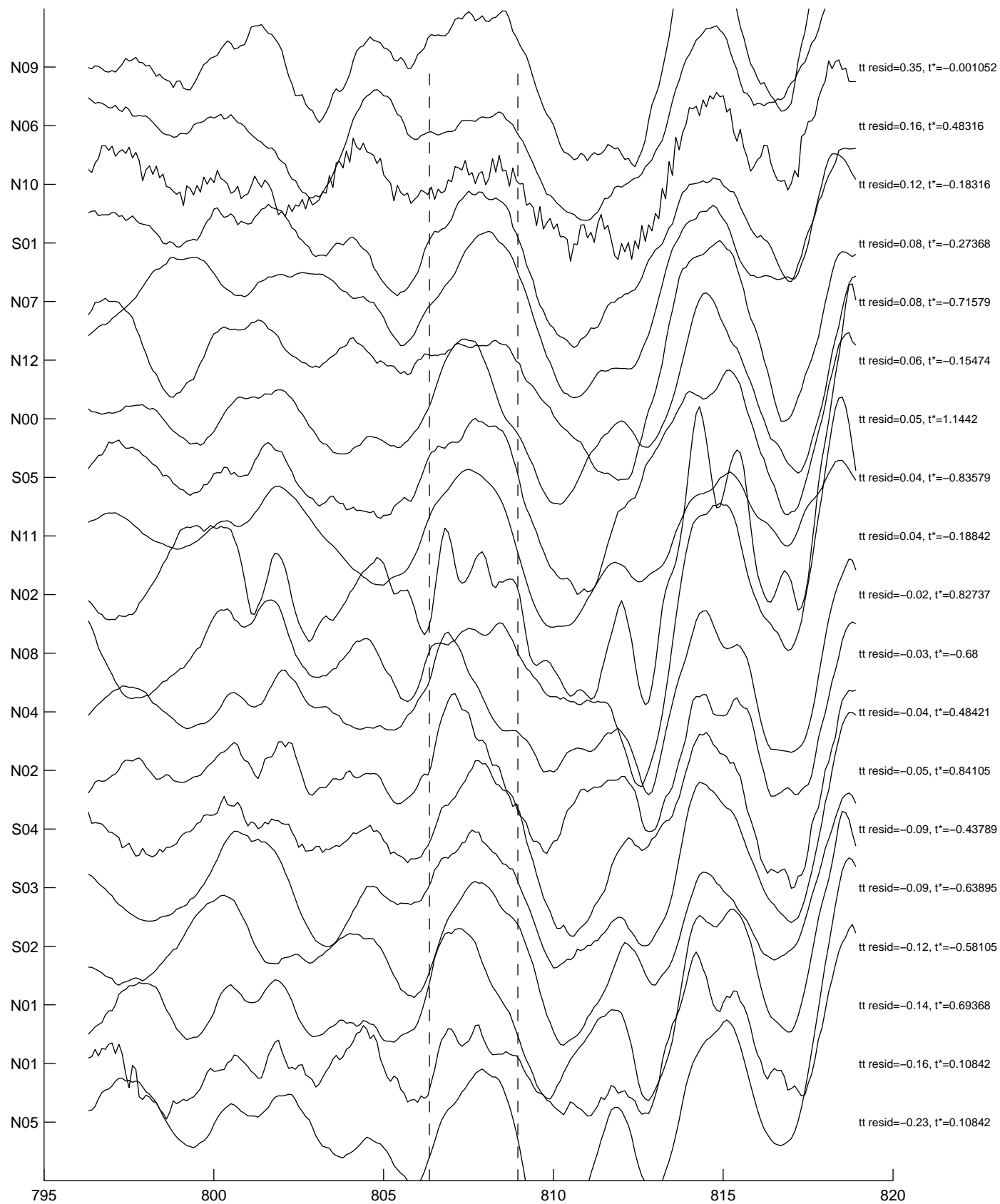
$t^*$  values



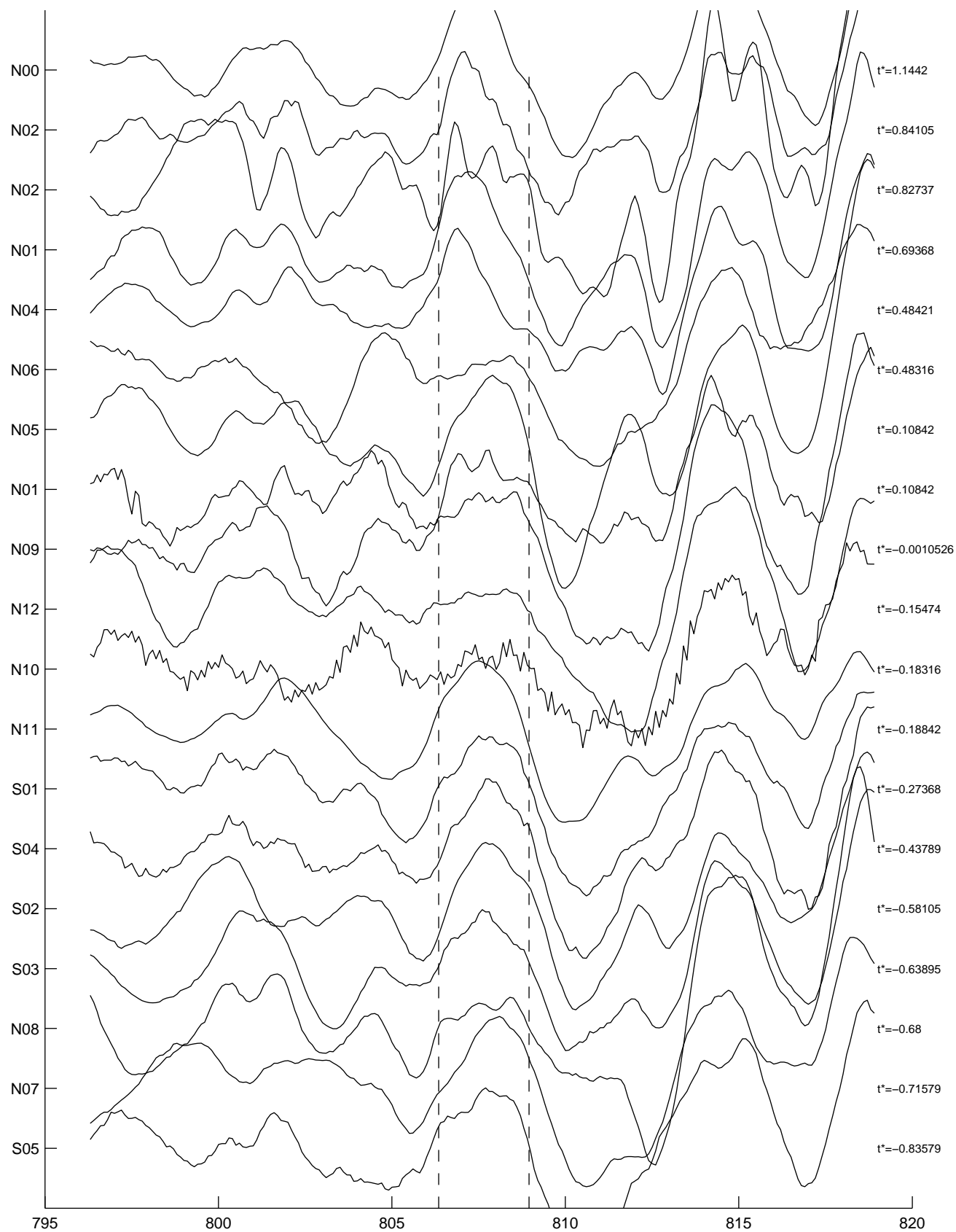
# Event\_1999\_363\_13\_29\_19



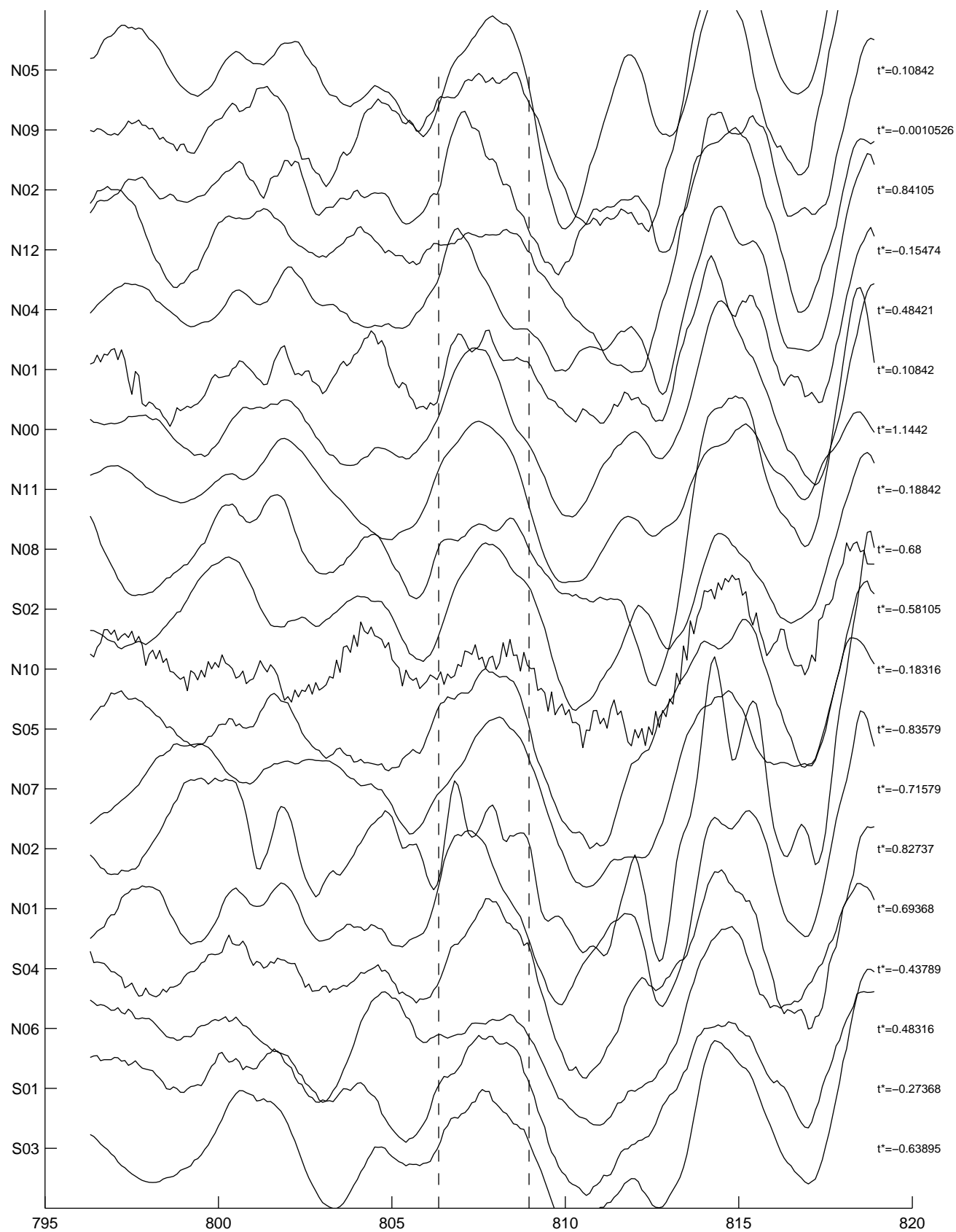
# Sorted by travel time:Event\_1999\_363\_13\_29\_19



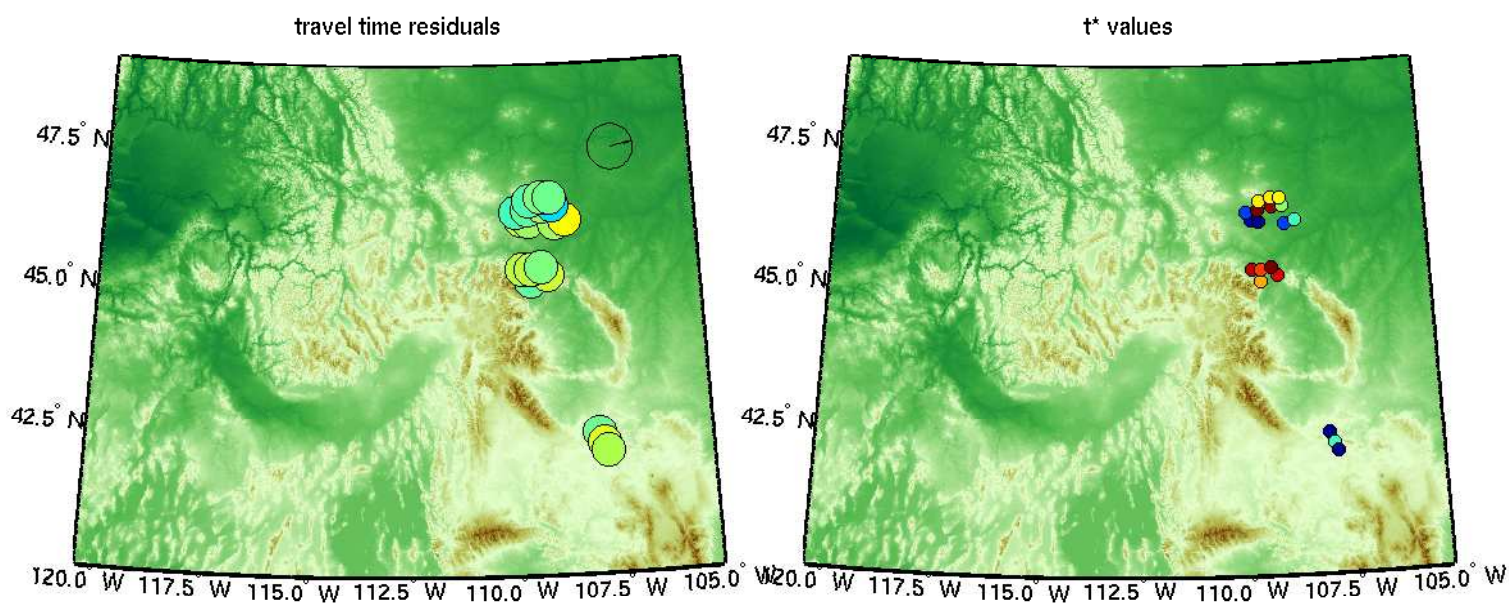
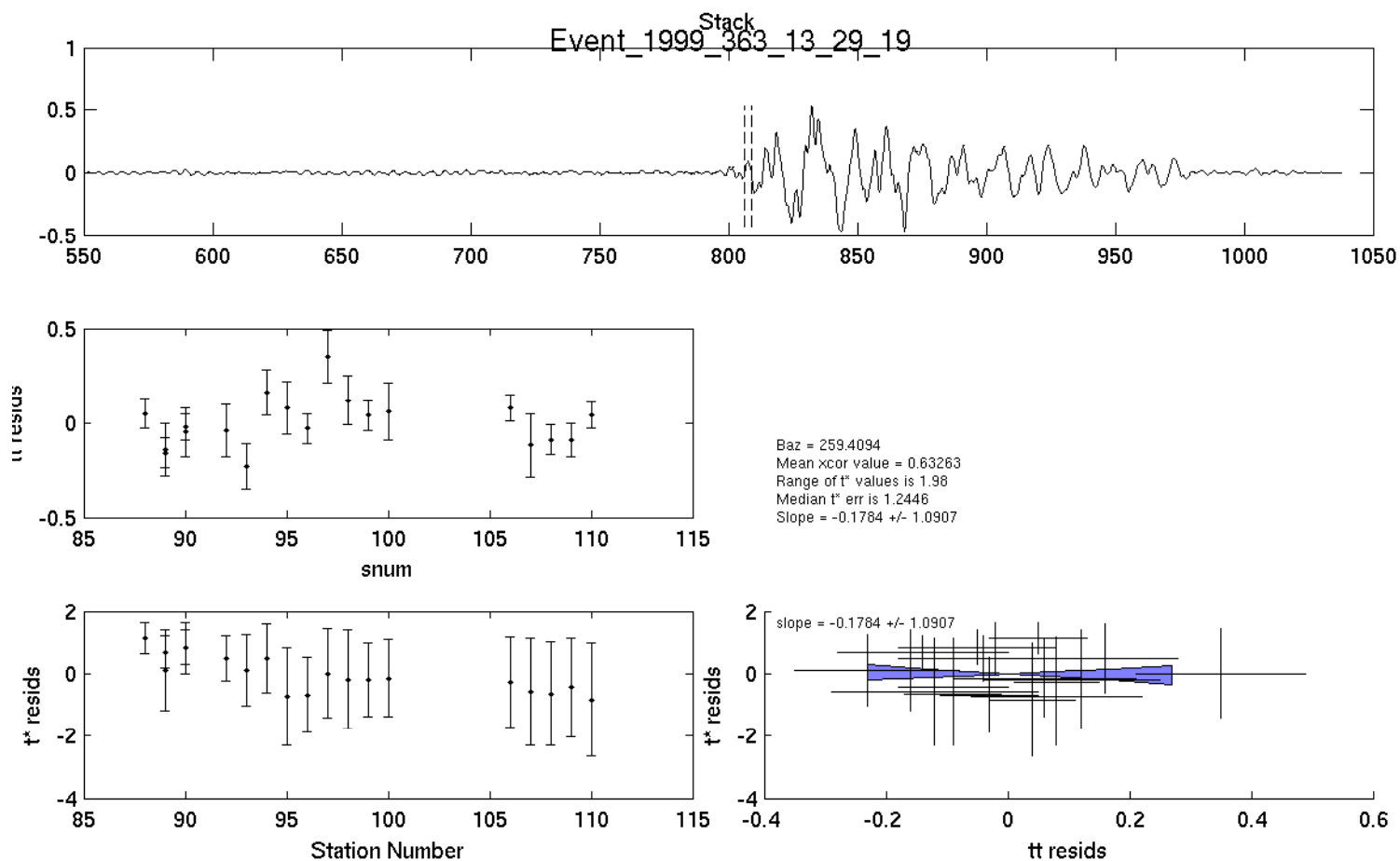
Sorted by  $t^*$ :Event\_1999\_363\_13\_29\_19



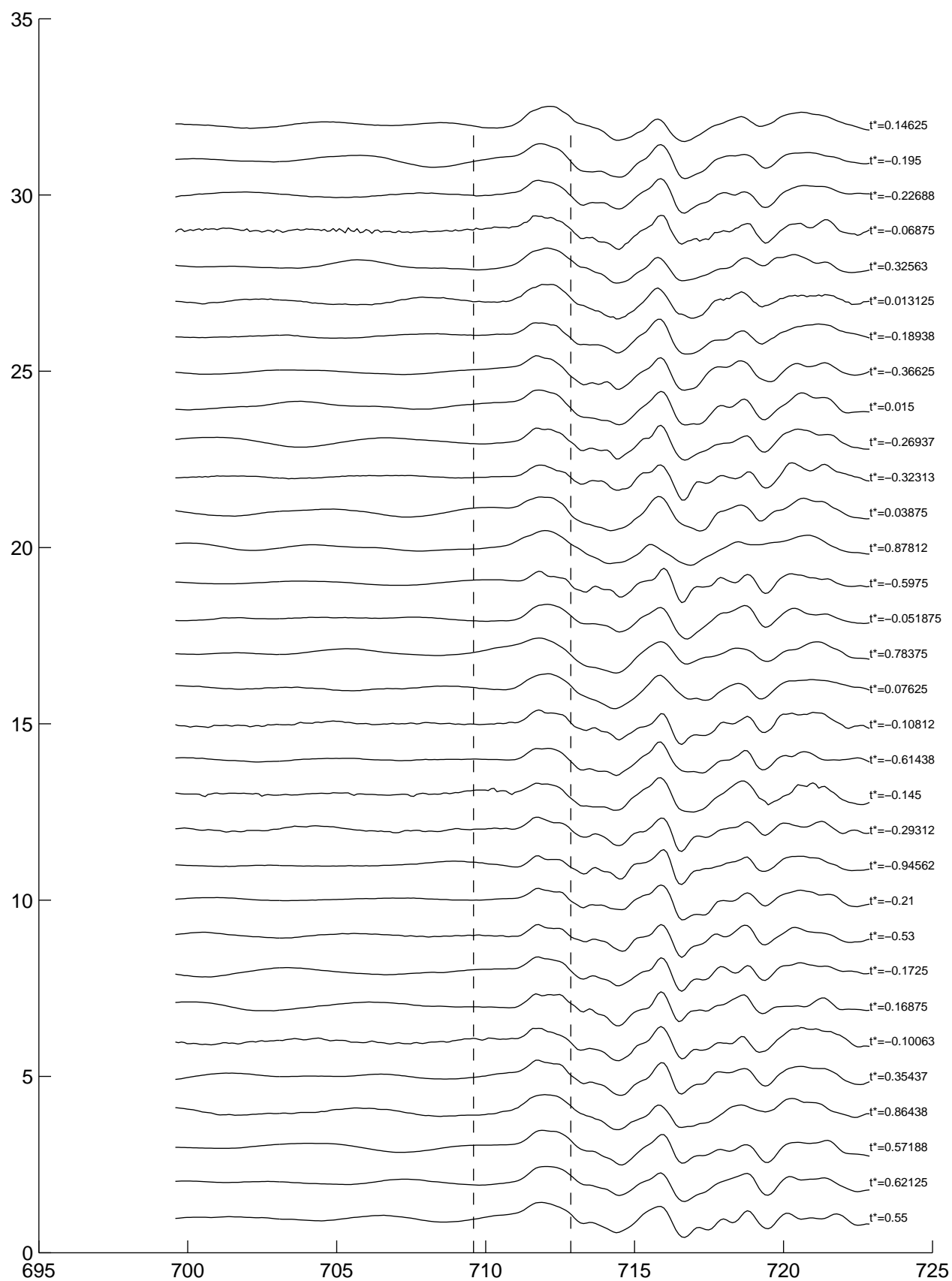
# Sorted by Delta:Event\_1999\_363\_13\_29\_19



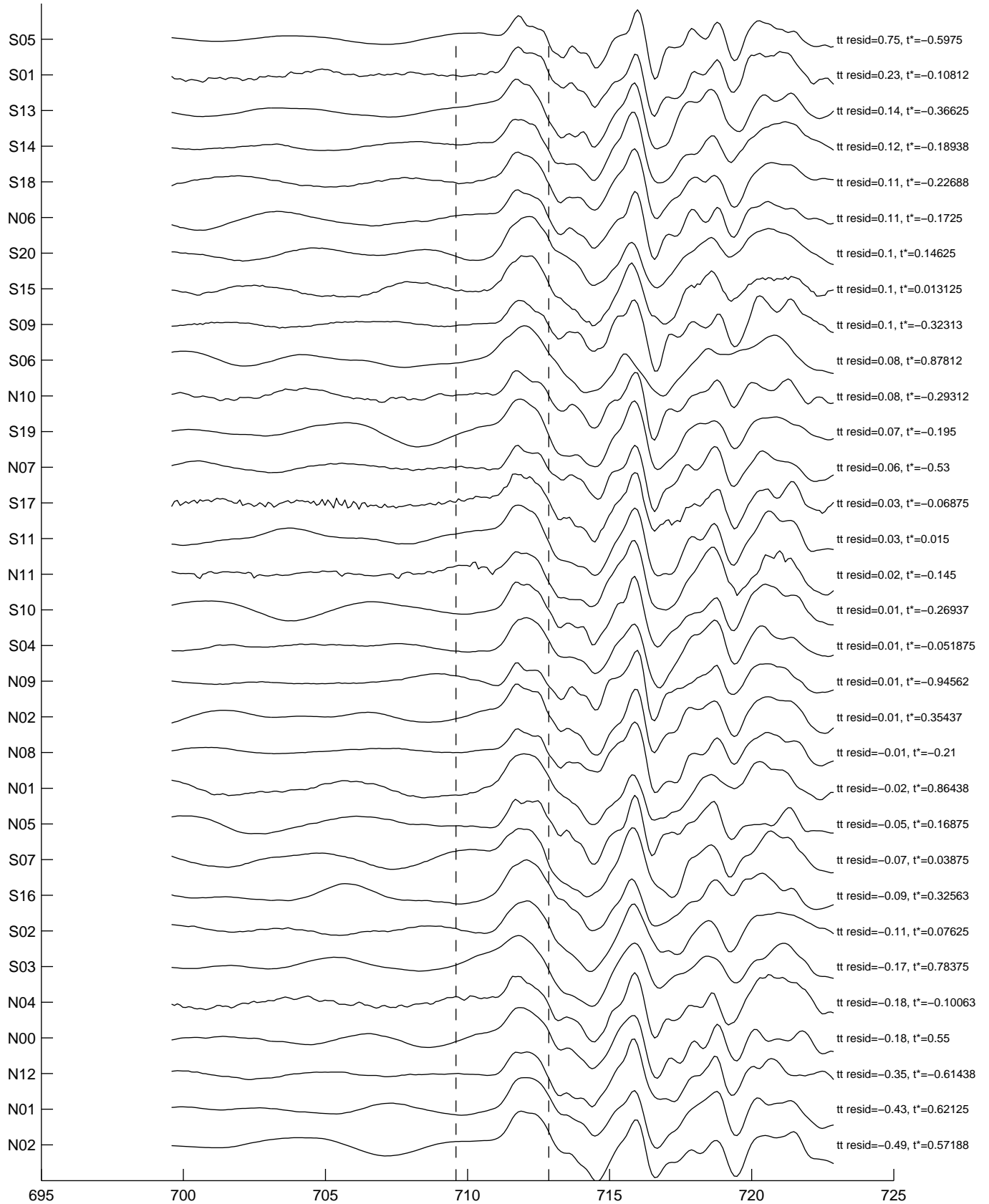




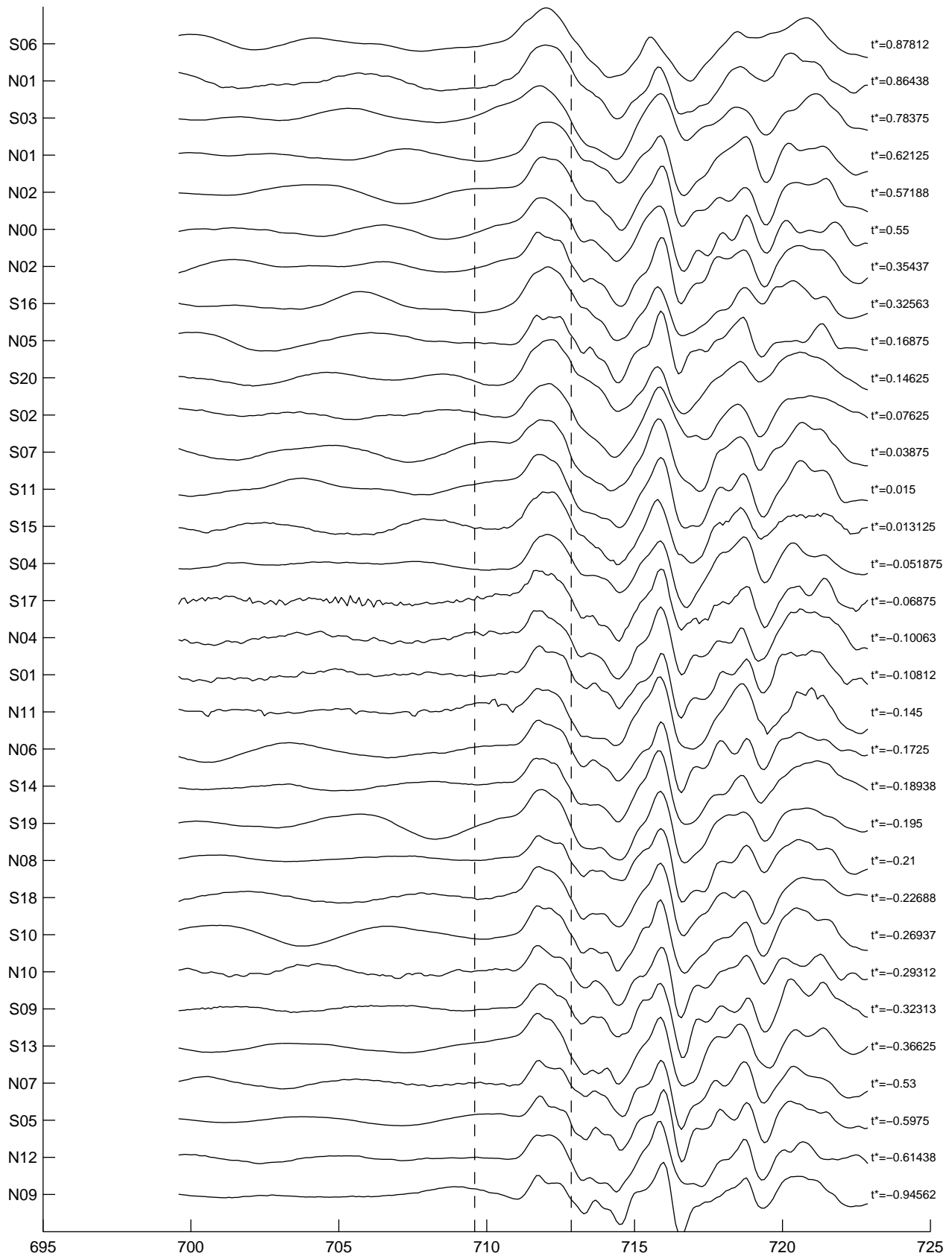
# Event\_2000\_008\_11\_59\_21



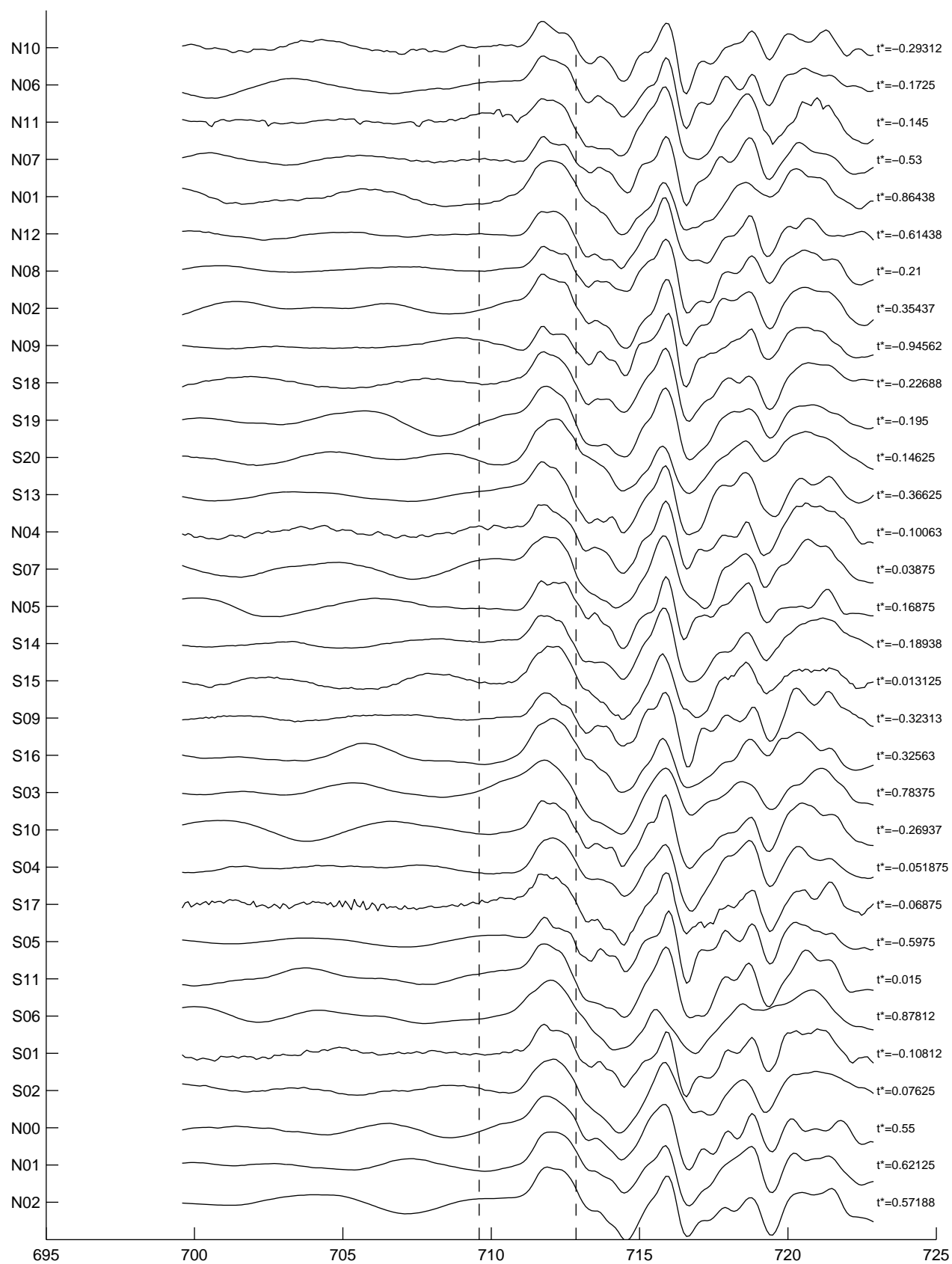
# Sorted by travel time:Event\_2000\_008\_11\_59\_21



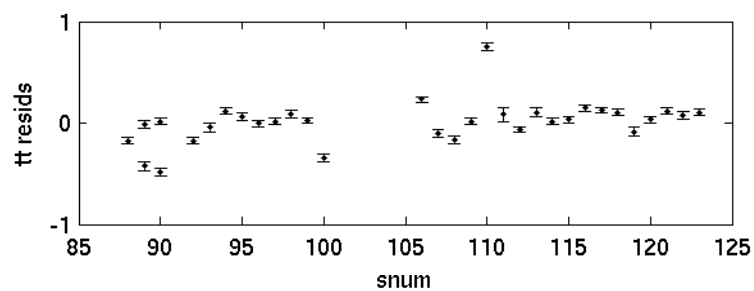
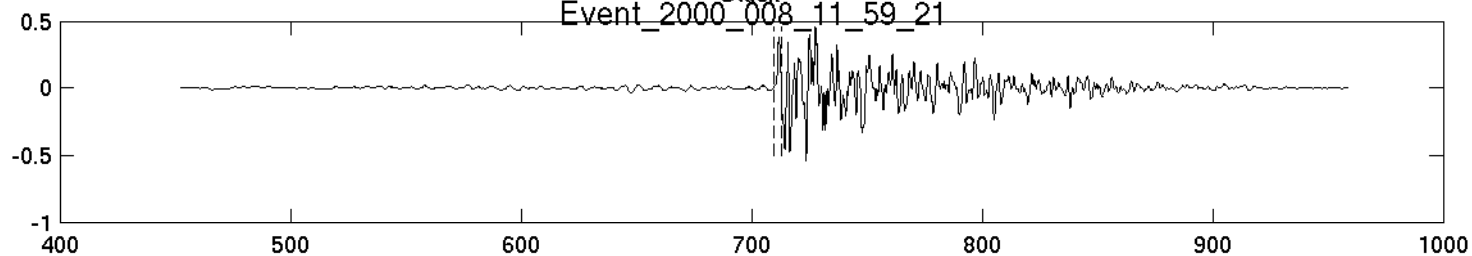
Sorted by  $t^*$ :Event\_2000\_008\_11\_59\_21



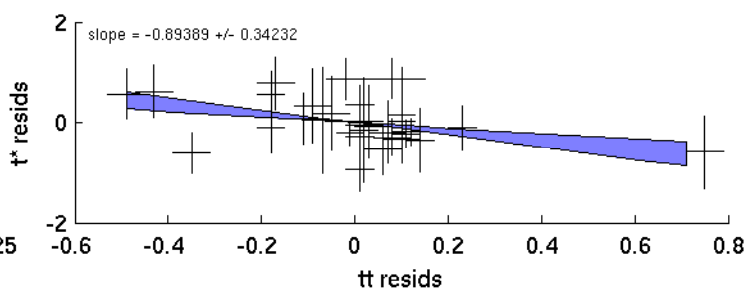
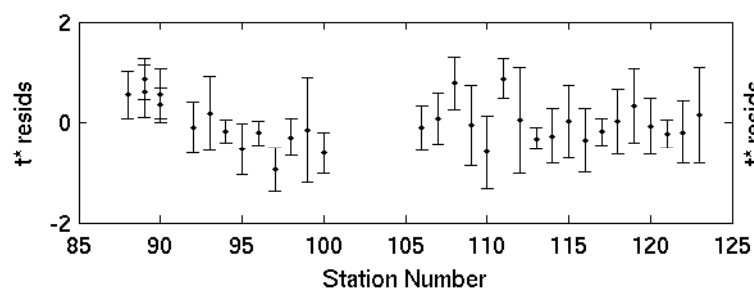
# Sorted by Delta:Event\_2000\_008\_11\_59\_21



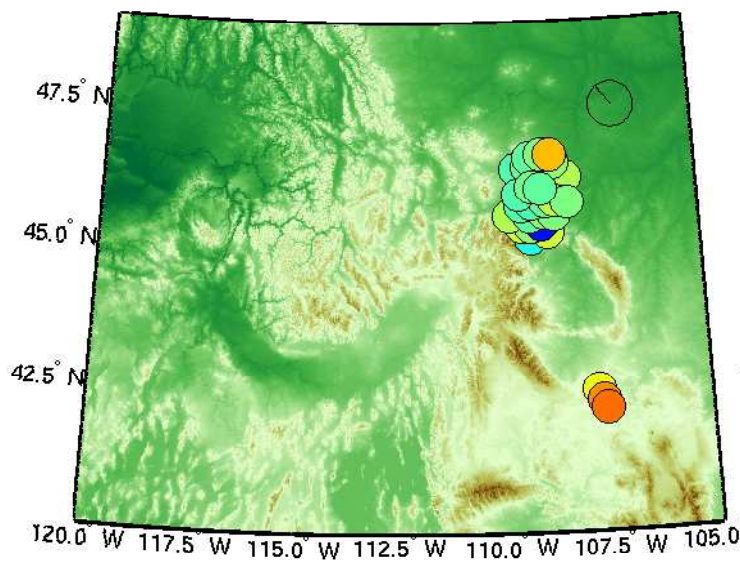
Stack  
Event\_2000\_008\_11\_59\_21



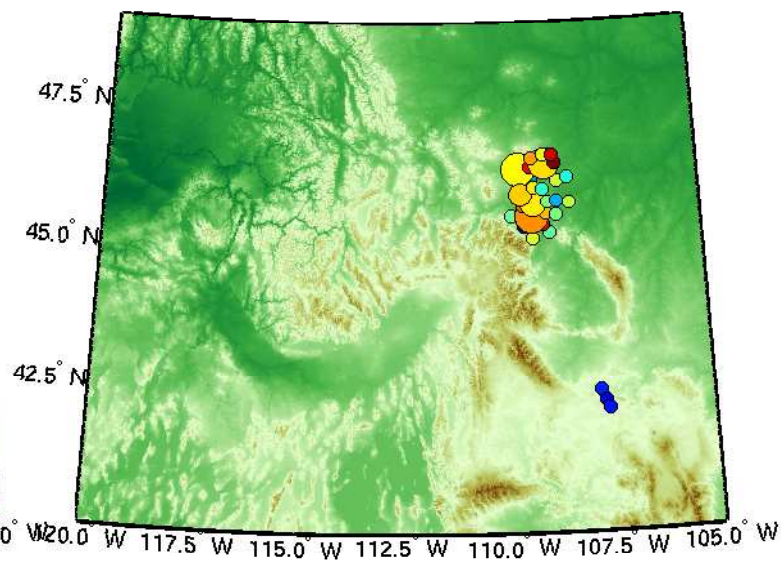
Baz = 143.8713  
Mean xcor value = 0.83219  
Range of  $t^*$  values is 1.8237  
Median  $t^*$  err is 0.51096  
Slope =  $-0.89389 \pm 0.34232$



travel time residuals

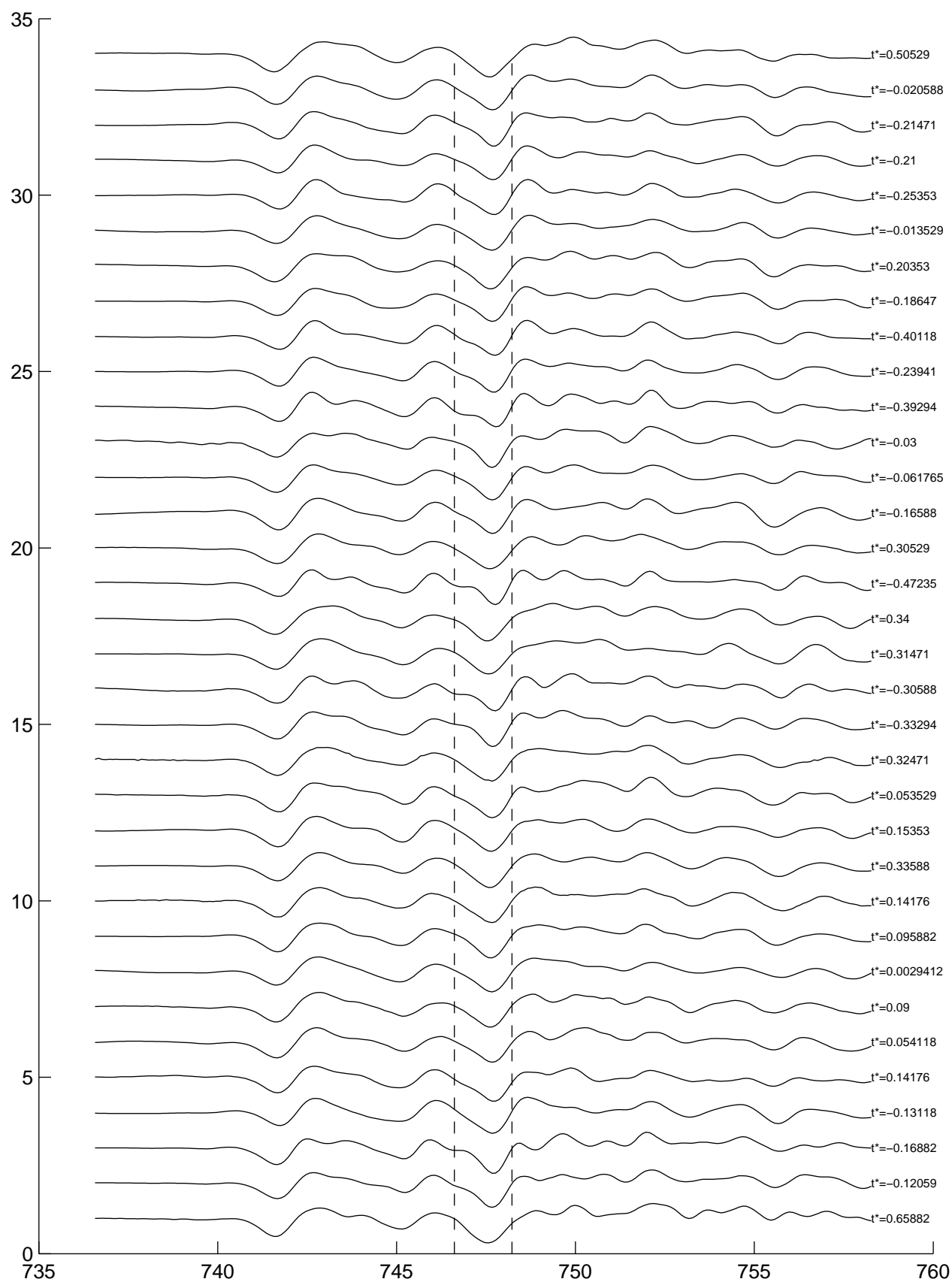


$t^*$  values

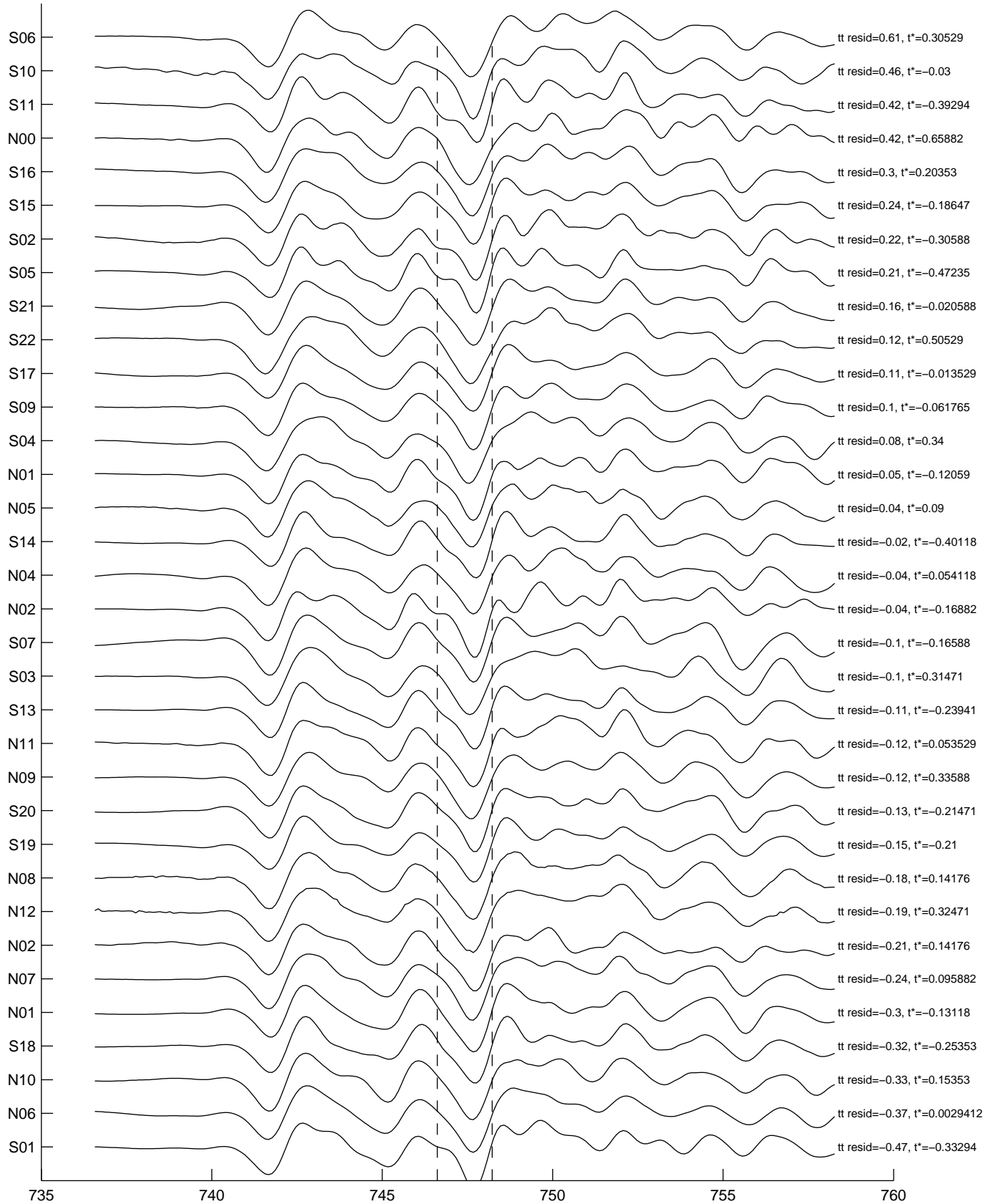




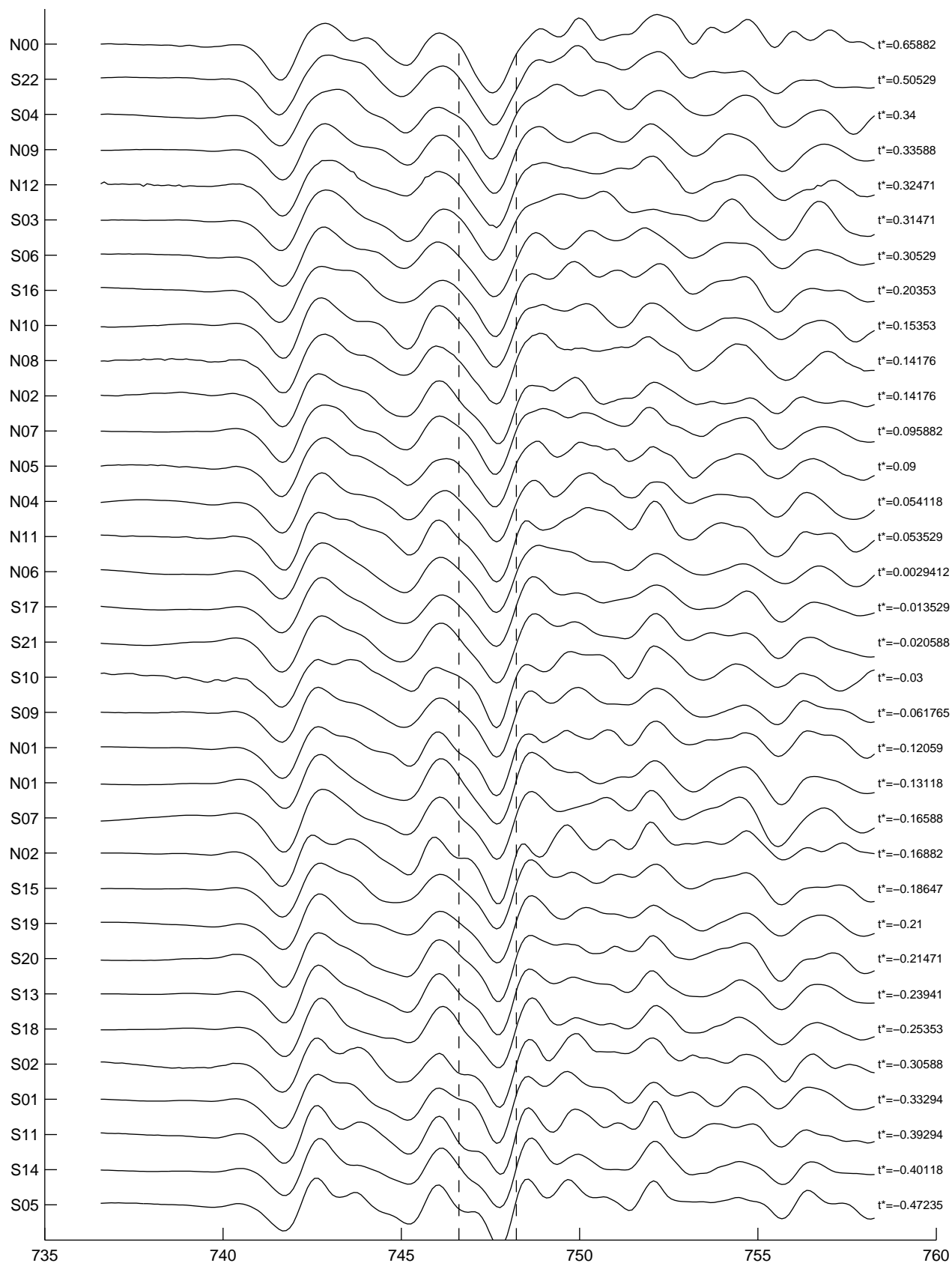
# Event\_2000\_008\_16\_47\_20



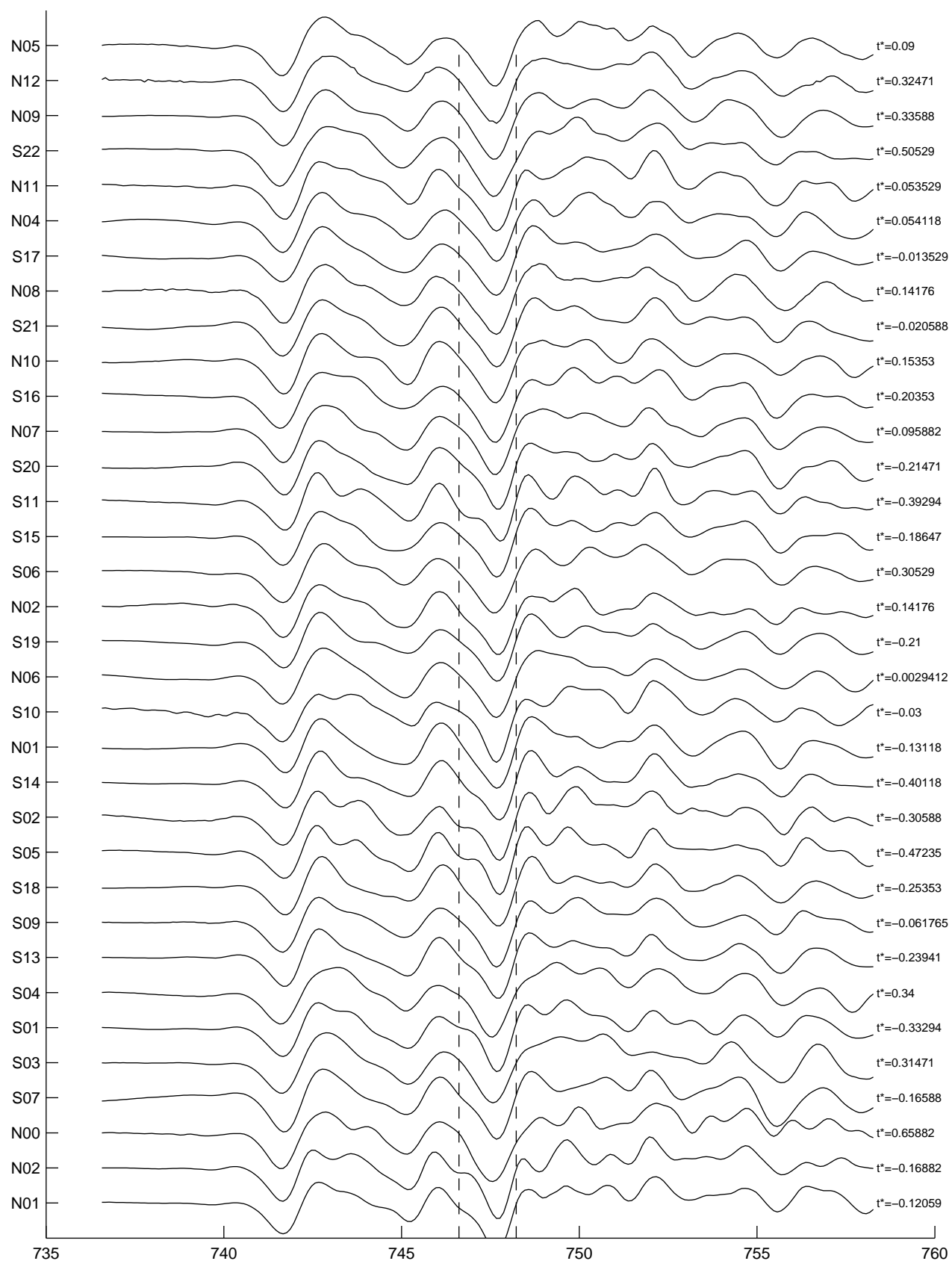
# Sorted by travel time:Event\_2000\_008\_16\_47\_20



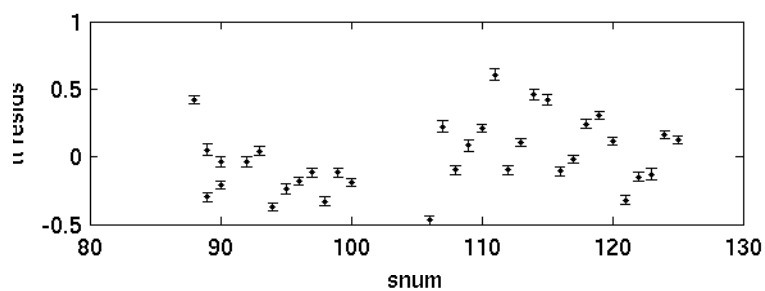
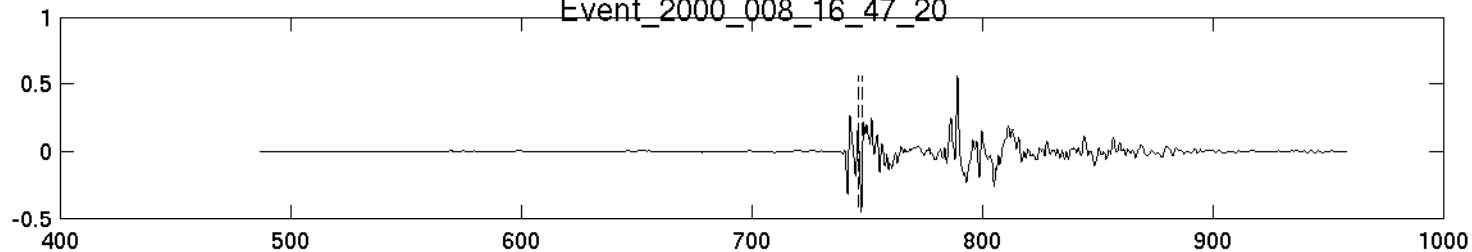
# Sorted by $t^*$ :Event\_2000\_008\_16\_47\_20



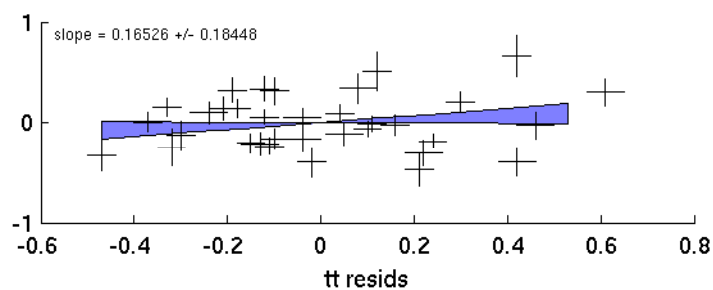
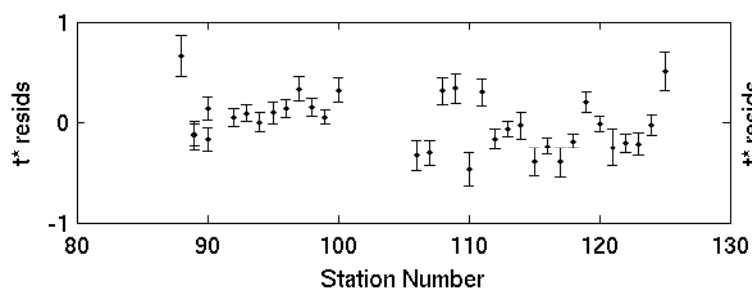
# Sorted by Delta:Event\_2000\_008\_16\_47\_20



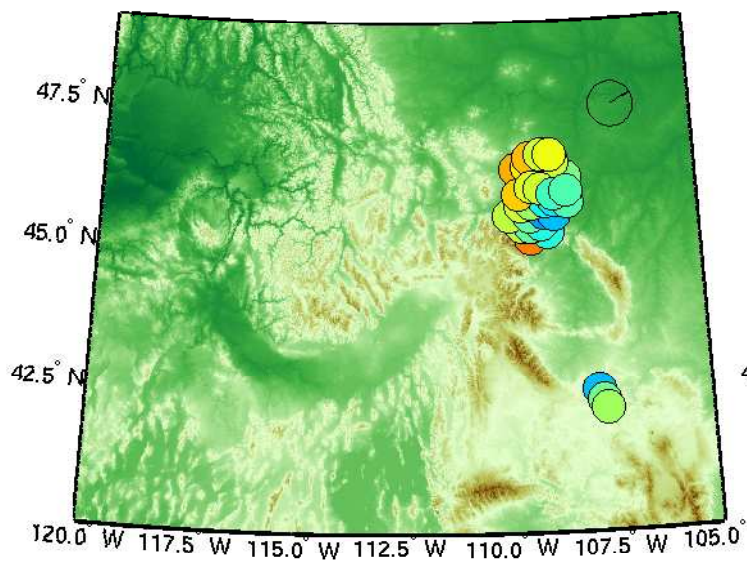
# Stack Event\_2000\_008\_16\_47\_20



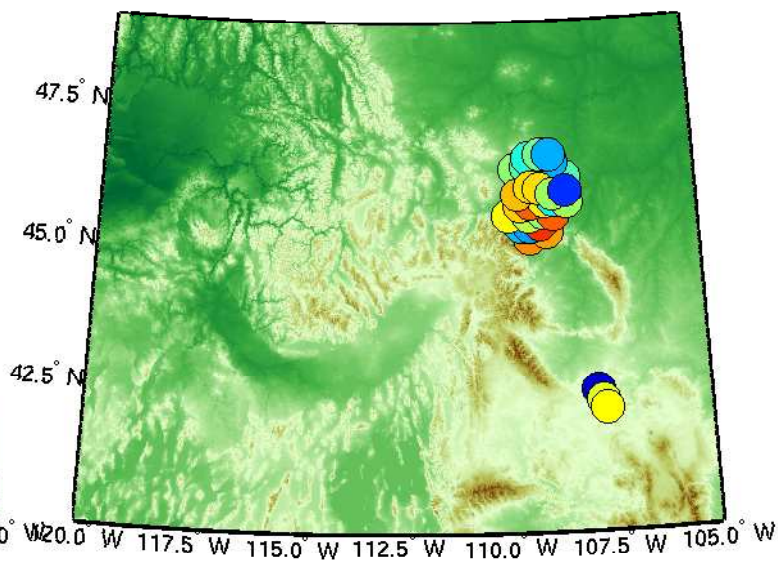
Baz = 240.7017  
Mean xcor value = 0.89912  
Range of  $t^*$  values is 1.1312  
Median  $t^*$  err is 0.11522  
Slope = 0.16526 +/- 0.18448



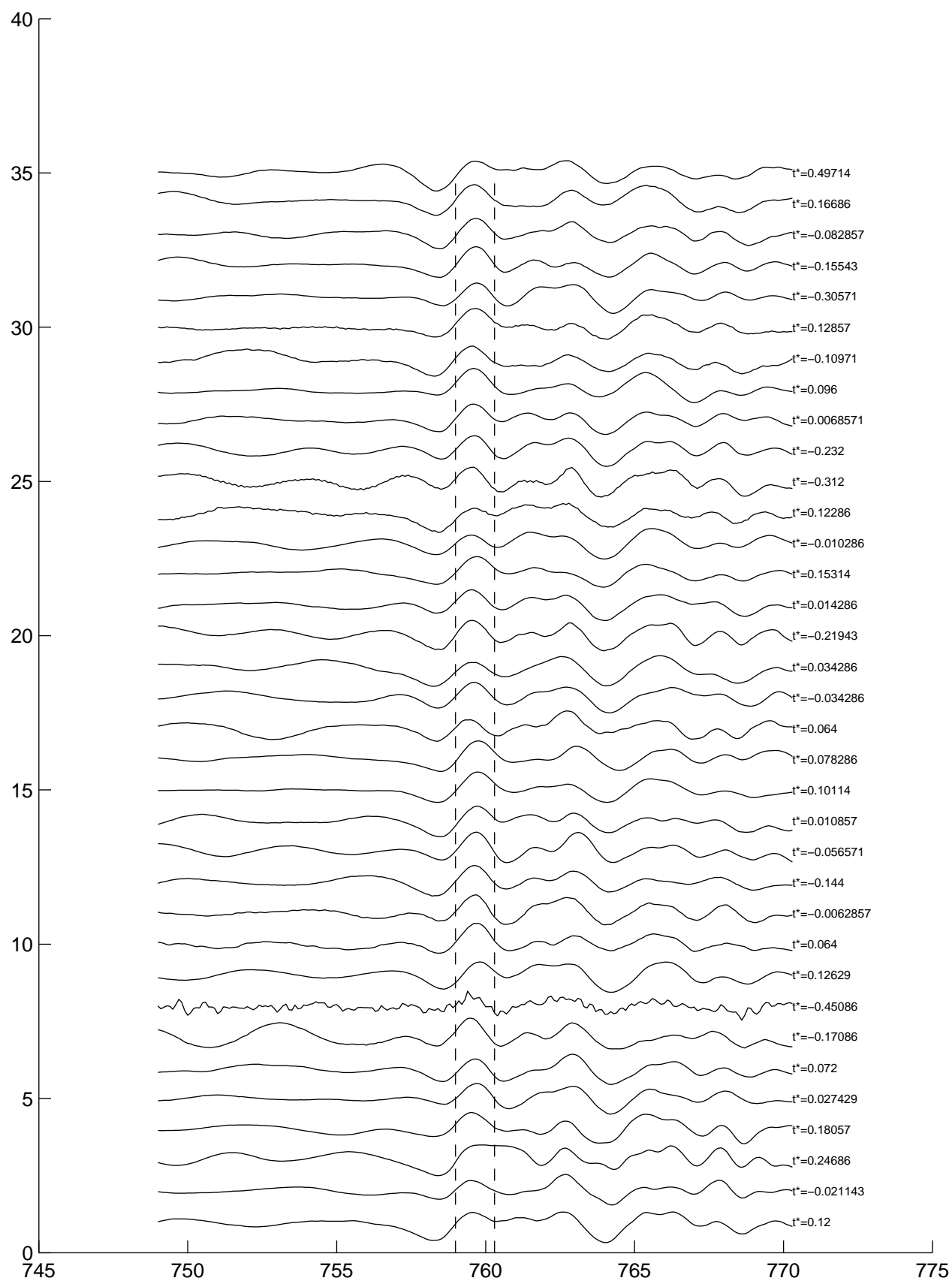
travel time residuals



$t^*$  values

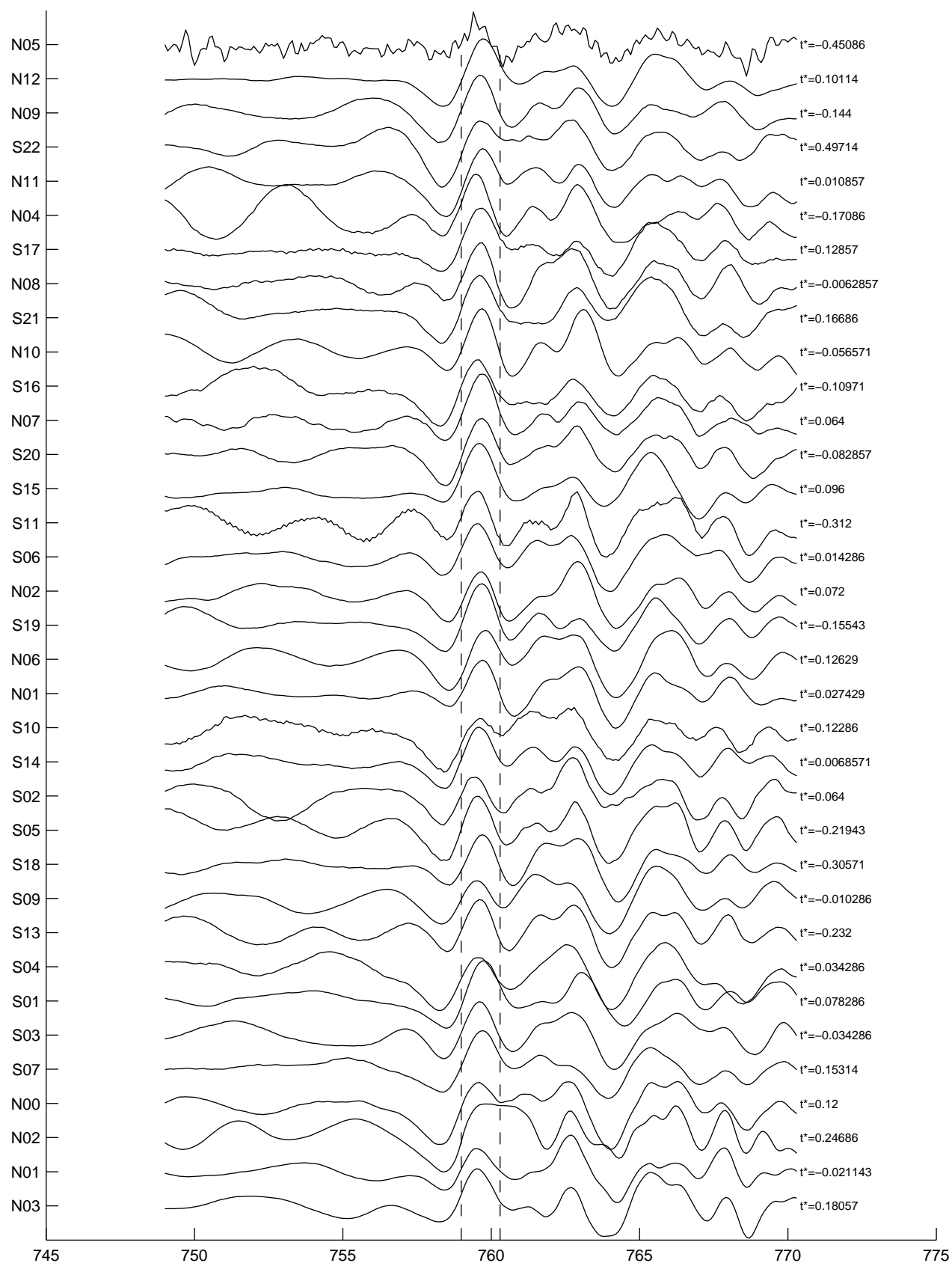


# Event\_2000\_026\_13\_26\_50

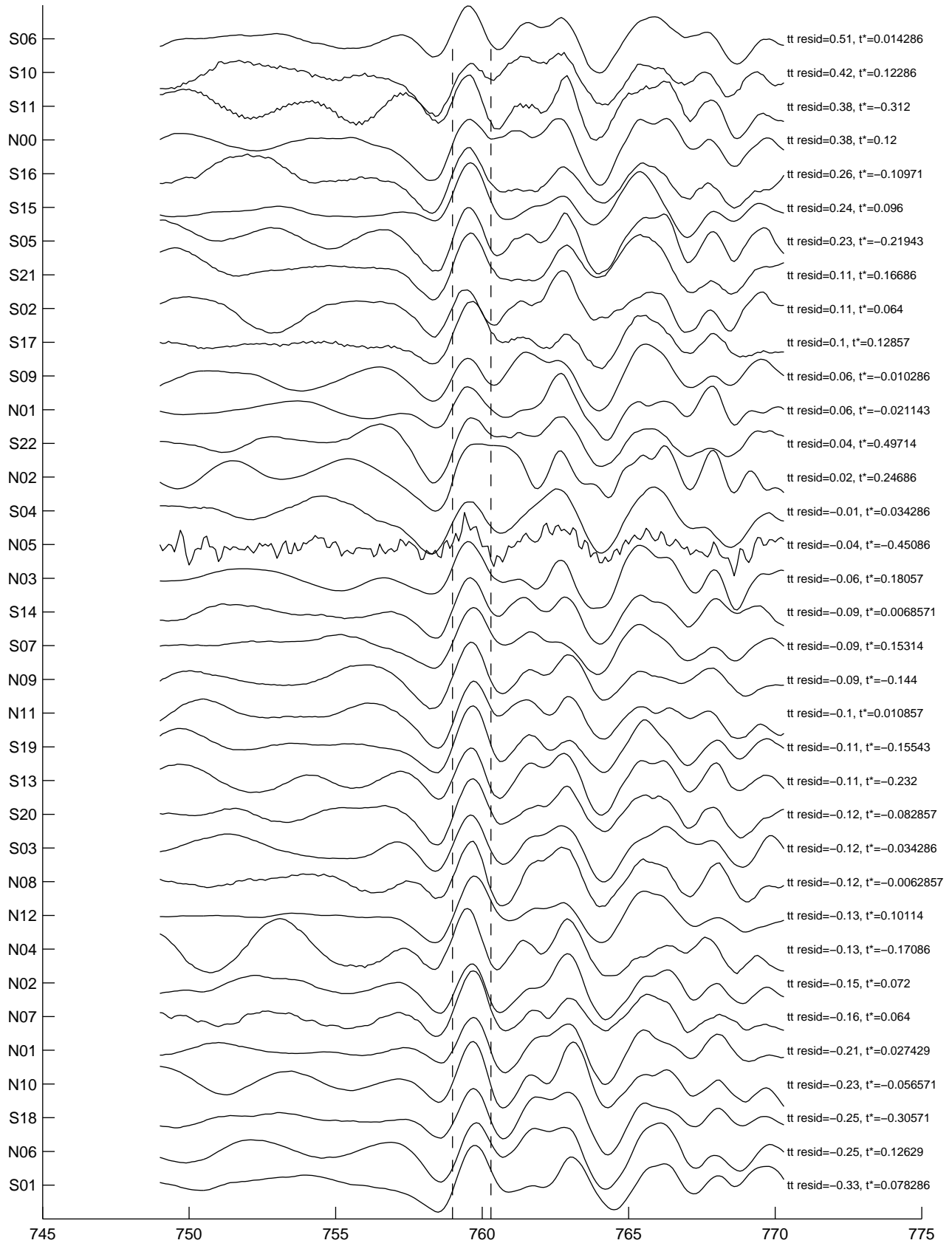




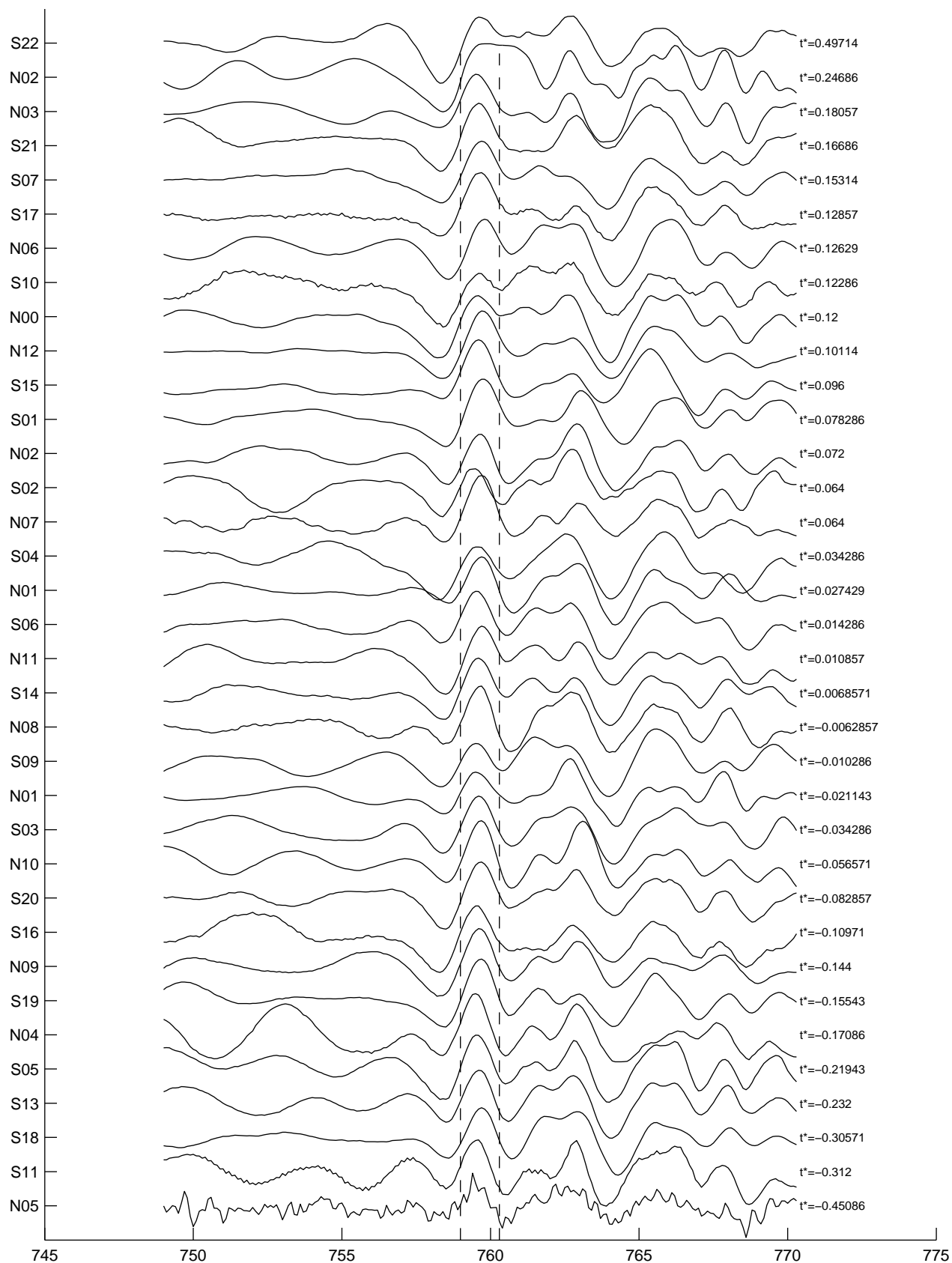
# Sorted by Delta:Event\_2000\_026\_13\_26\_50

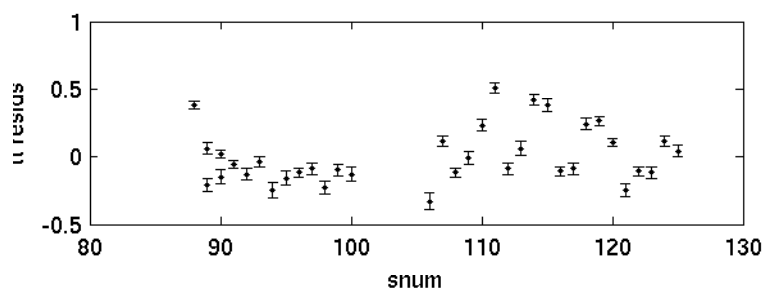
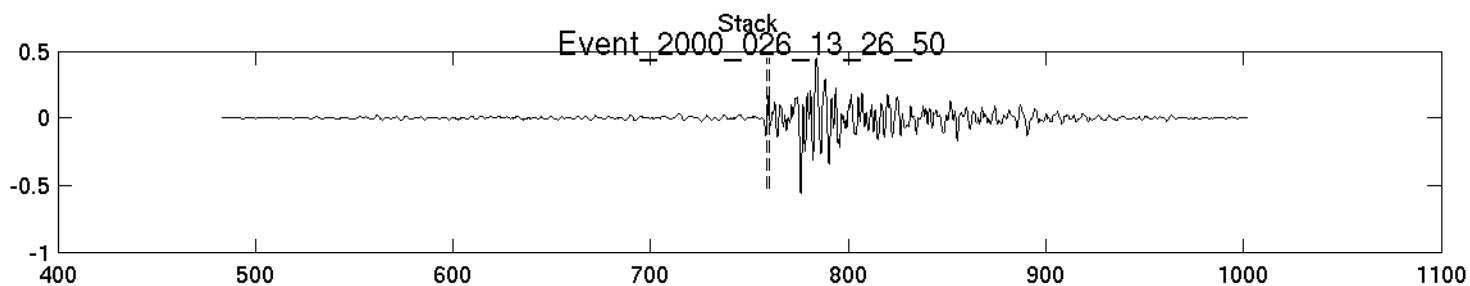


# Sorted by travel time: Event\_2000\_026\_13\_26\_50

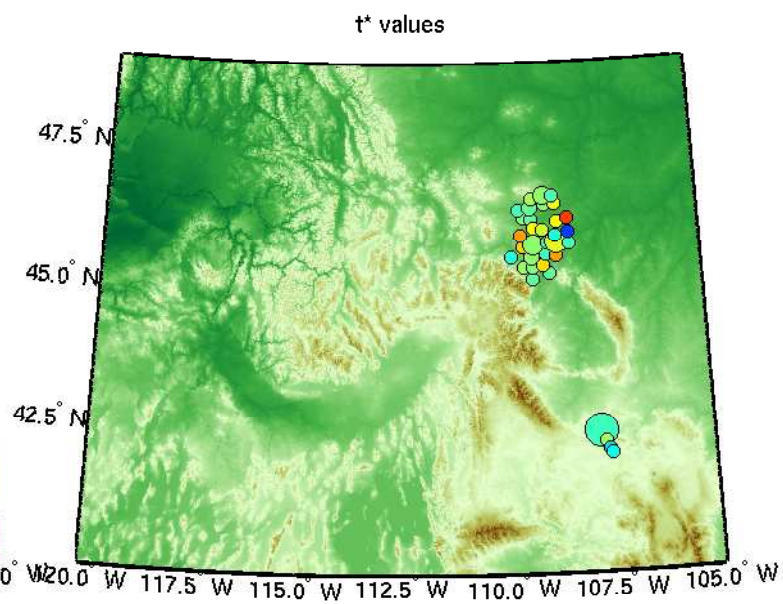
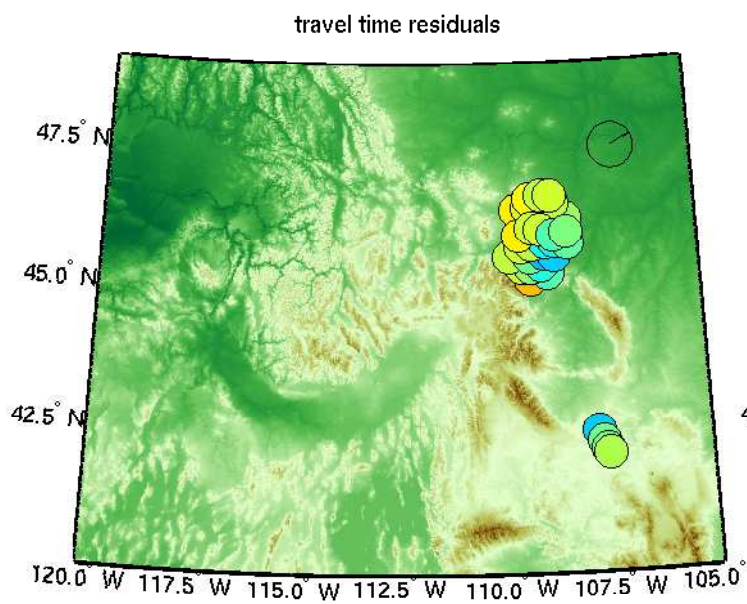
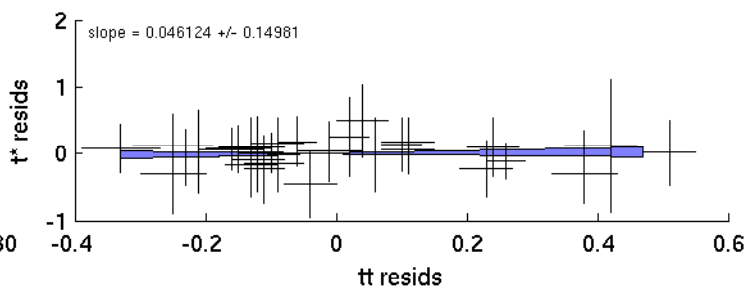
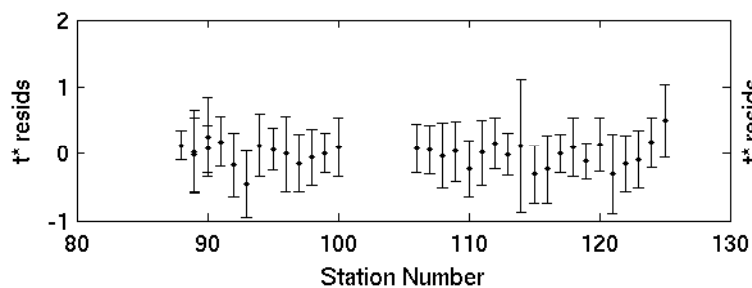


# Sorted by $t^*$ :Event\_2000\_026\_13\_26\_50

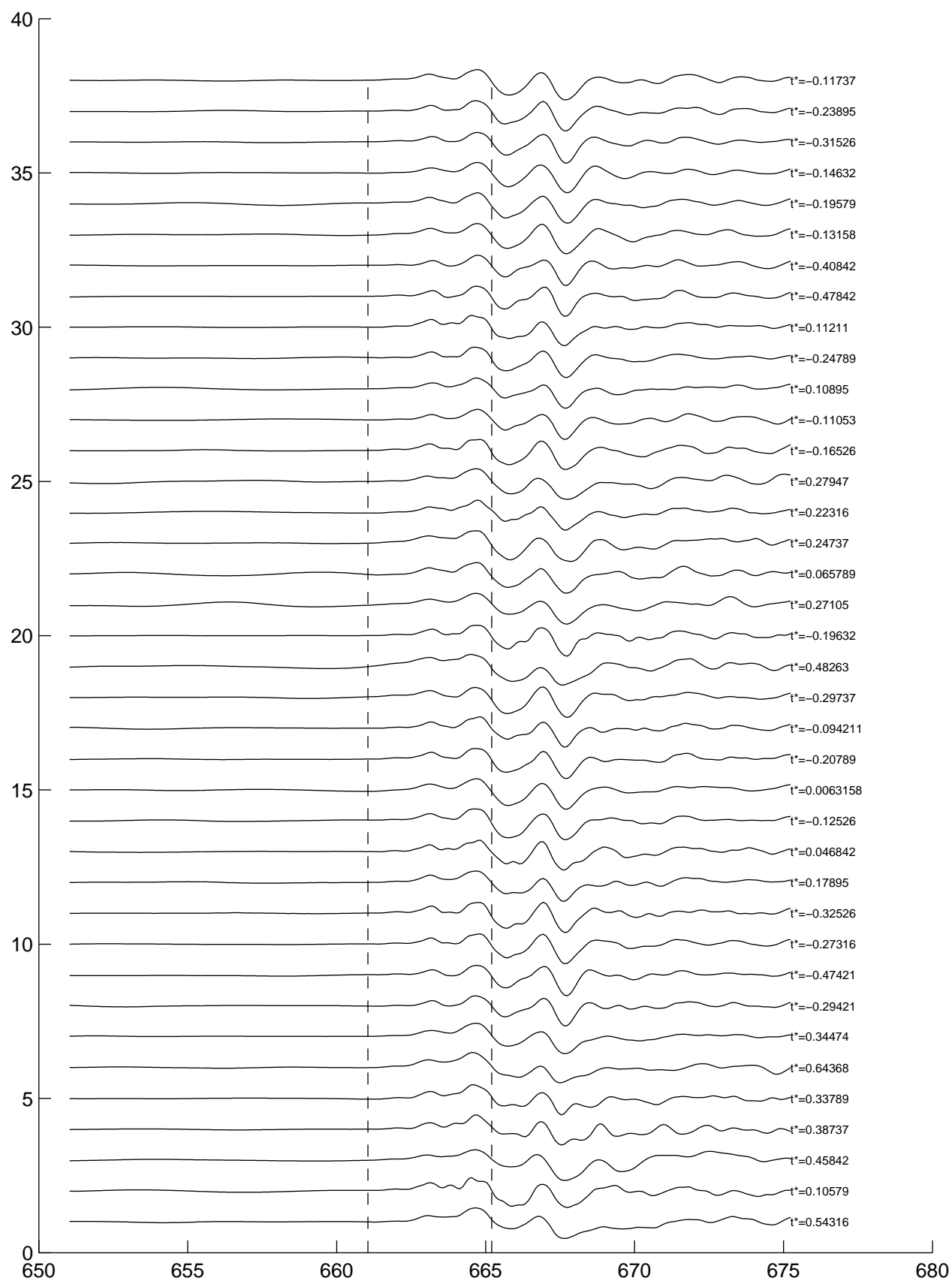




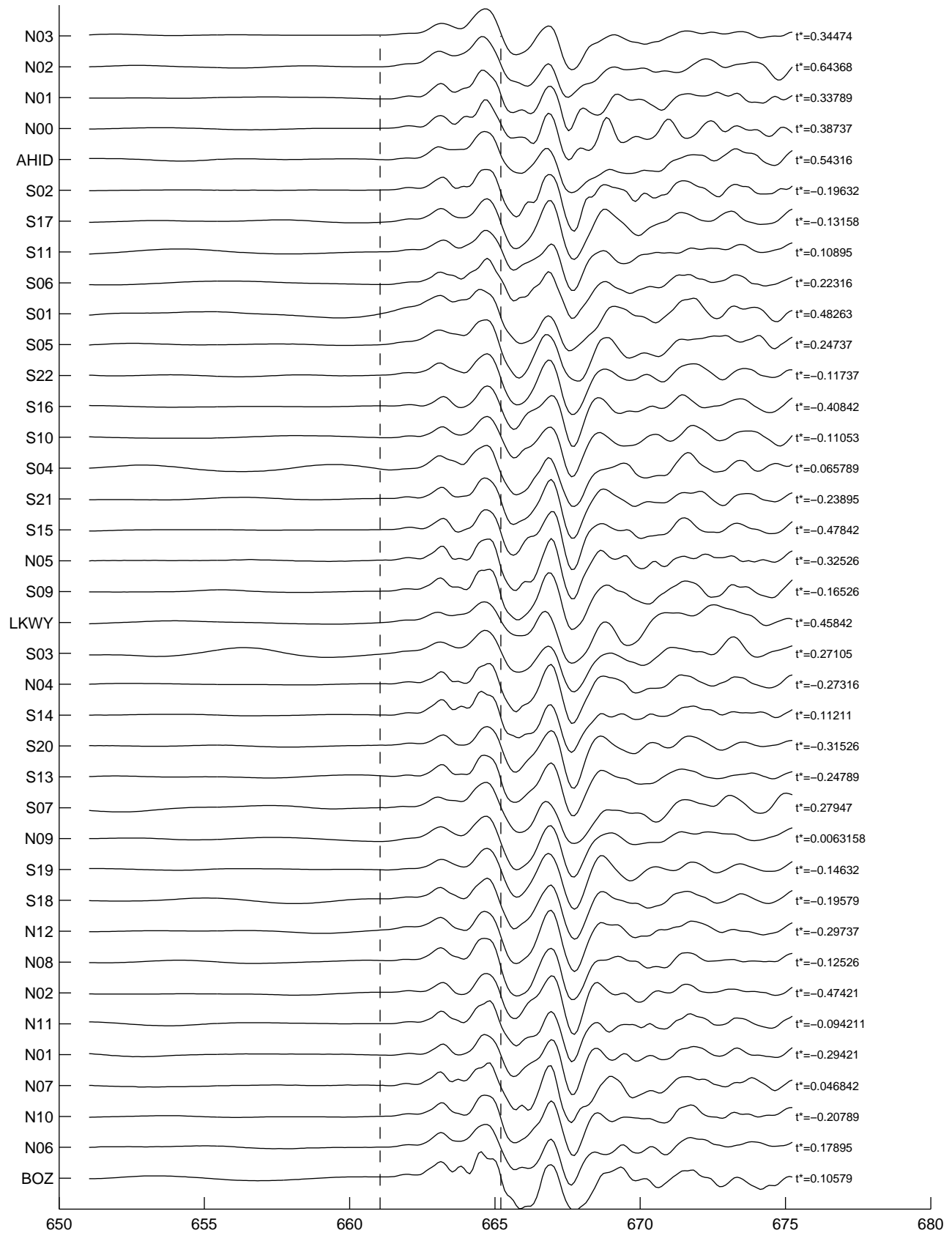
Baz = 240.3335  
Mean xcor value = 0.83029  
Range of  $t^*$  values is 0.948  
Median  $t^*$  err is 0.43511  
Slope = 0.046124 +/- 0.14981



# Event\_2000\_028\_14\_21\_07

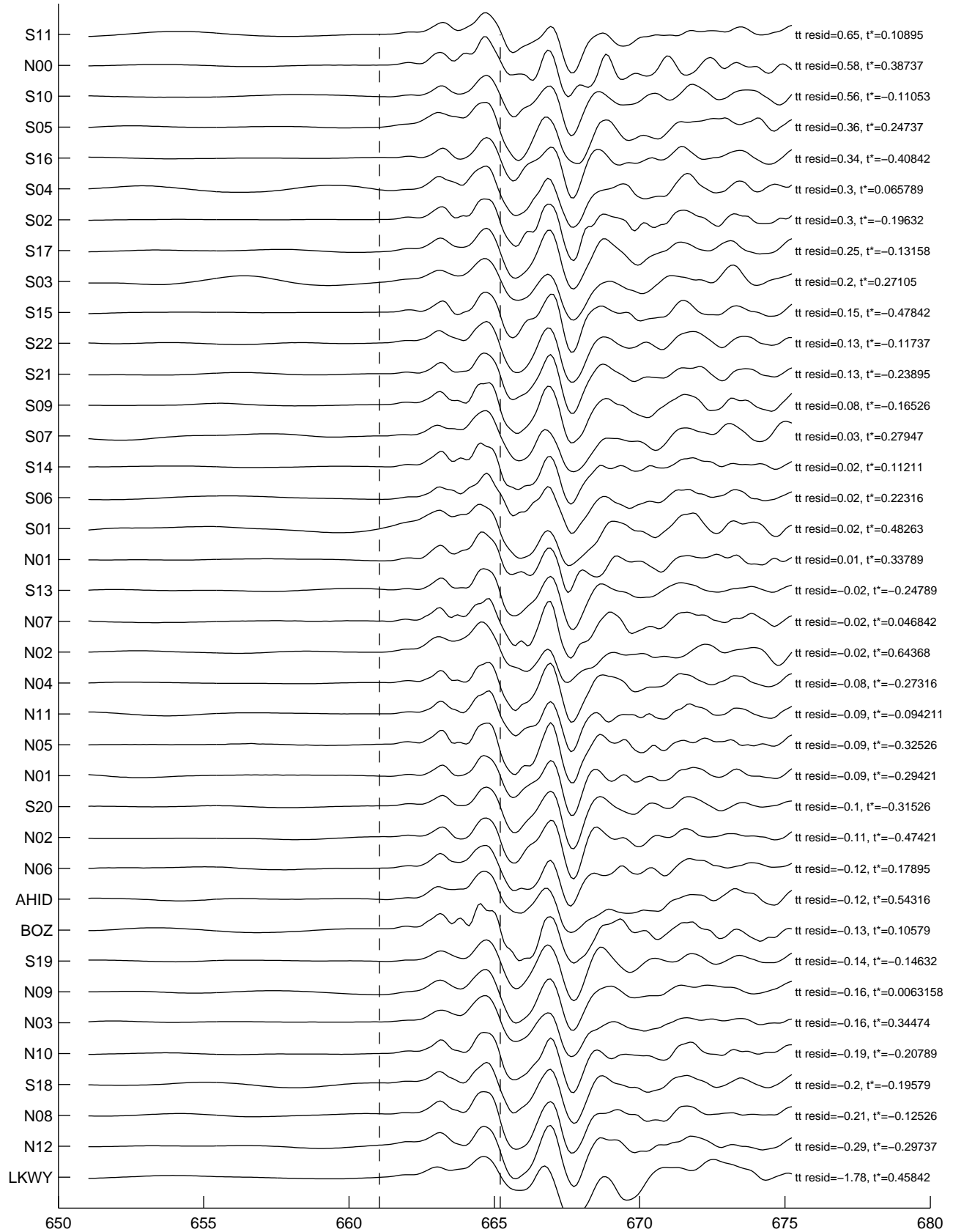


# Sorted by Delta:Event\_2000\_028\_14\_21\_07

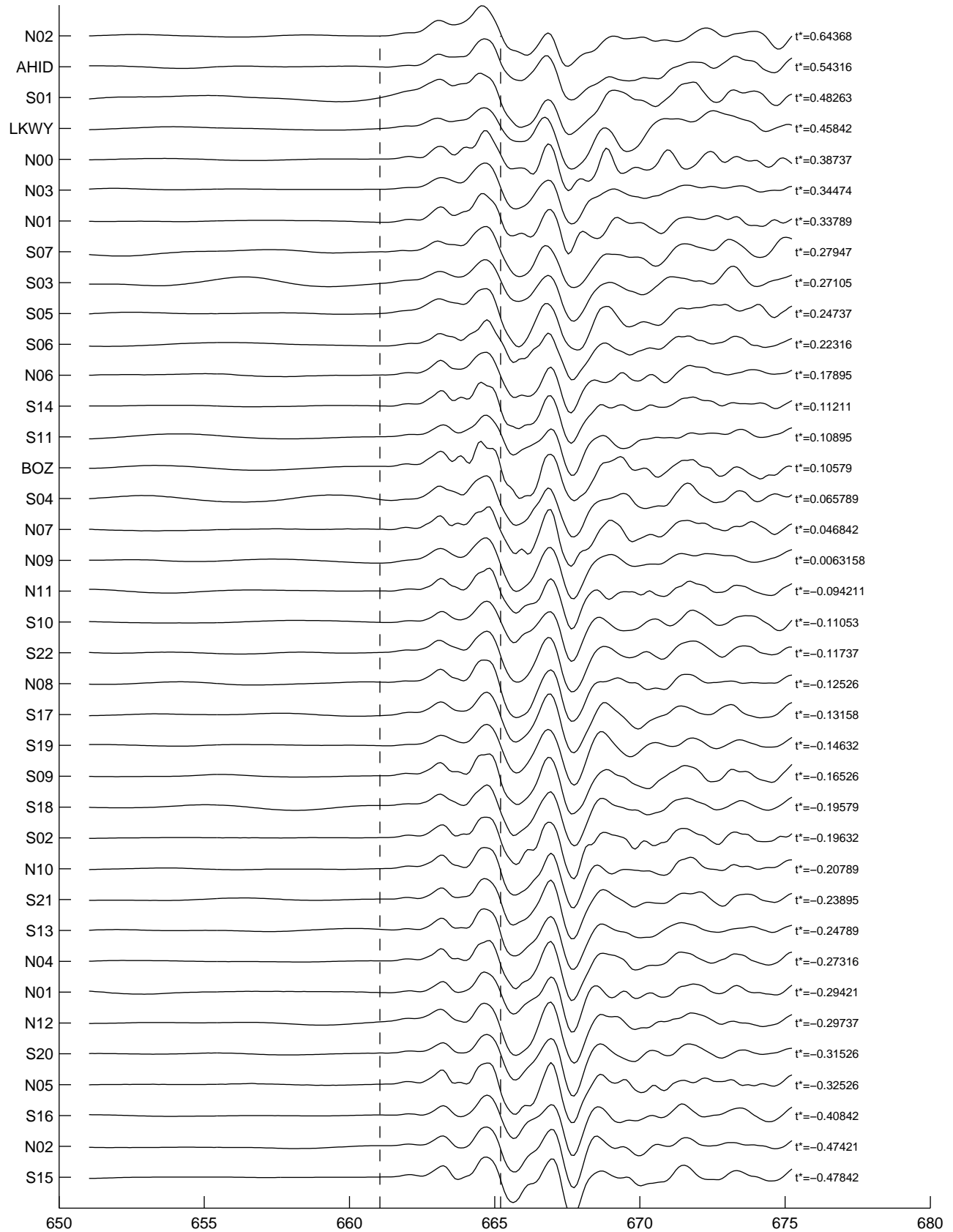




# Sorted by travel time:Event\_2000\_028\_14\_21\_07

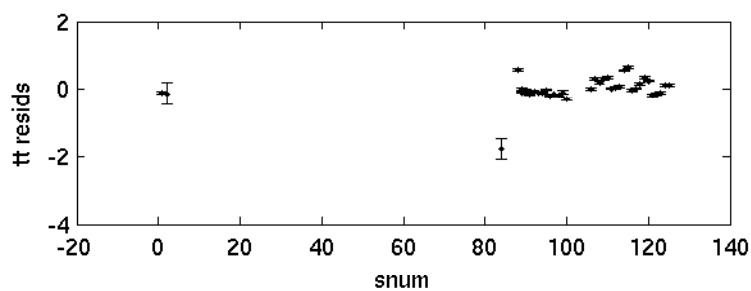
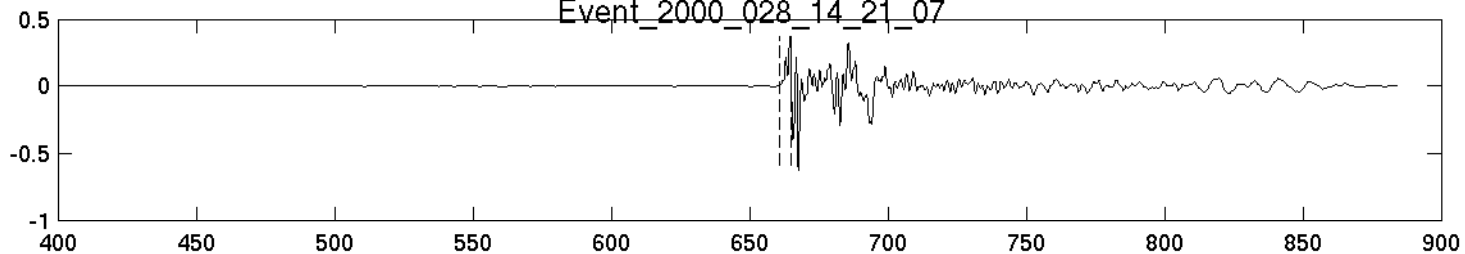


# Sorted by $t^*$ :Event\_2000\_028\_14\_21\_07

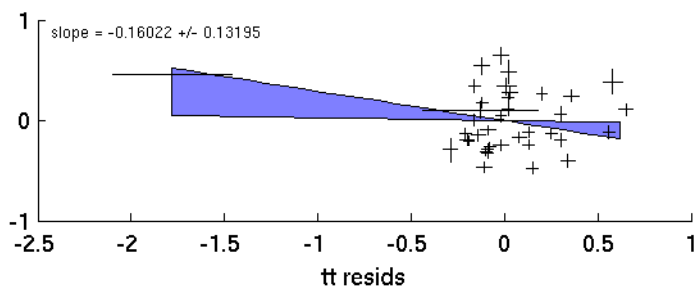
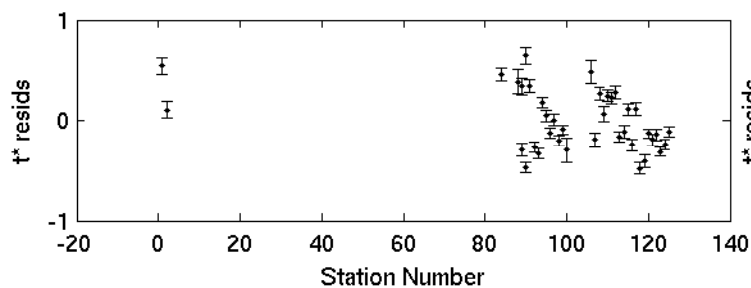


# Event\_2000\_028\_14\_21\_07

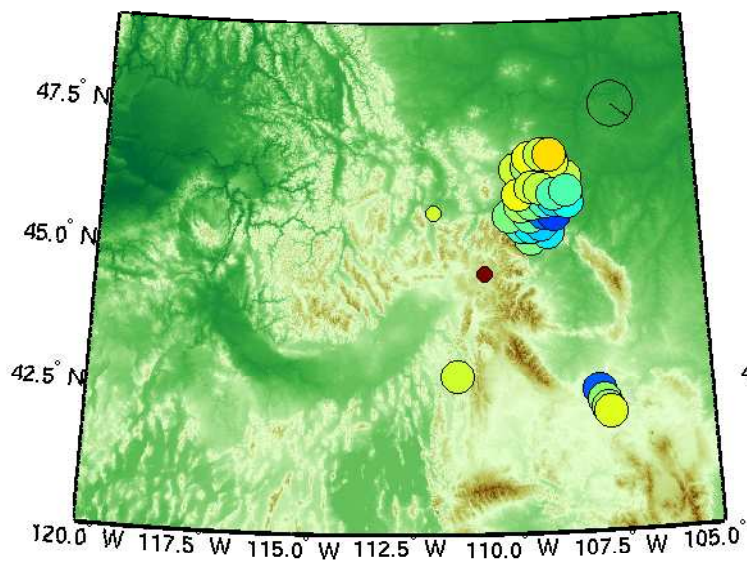
Stack



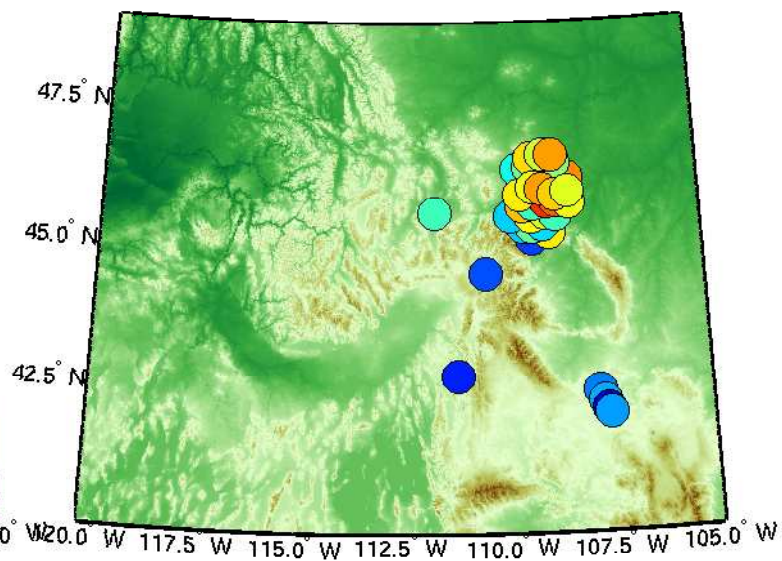
Baz = 310.5587  
Mean xcor value = 0.86921  
Range of t\* values is 1.1221  
Median t\* err is 0.059823  
Slope = -0.16022 +/- 0.13195



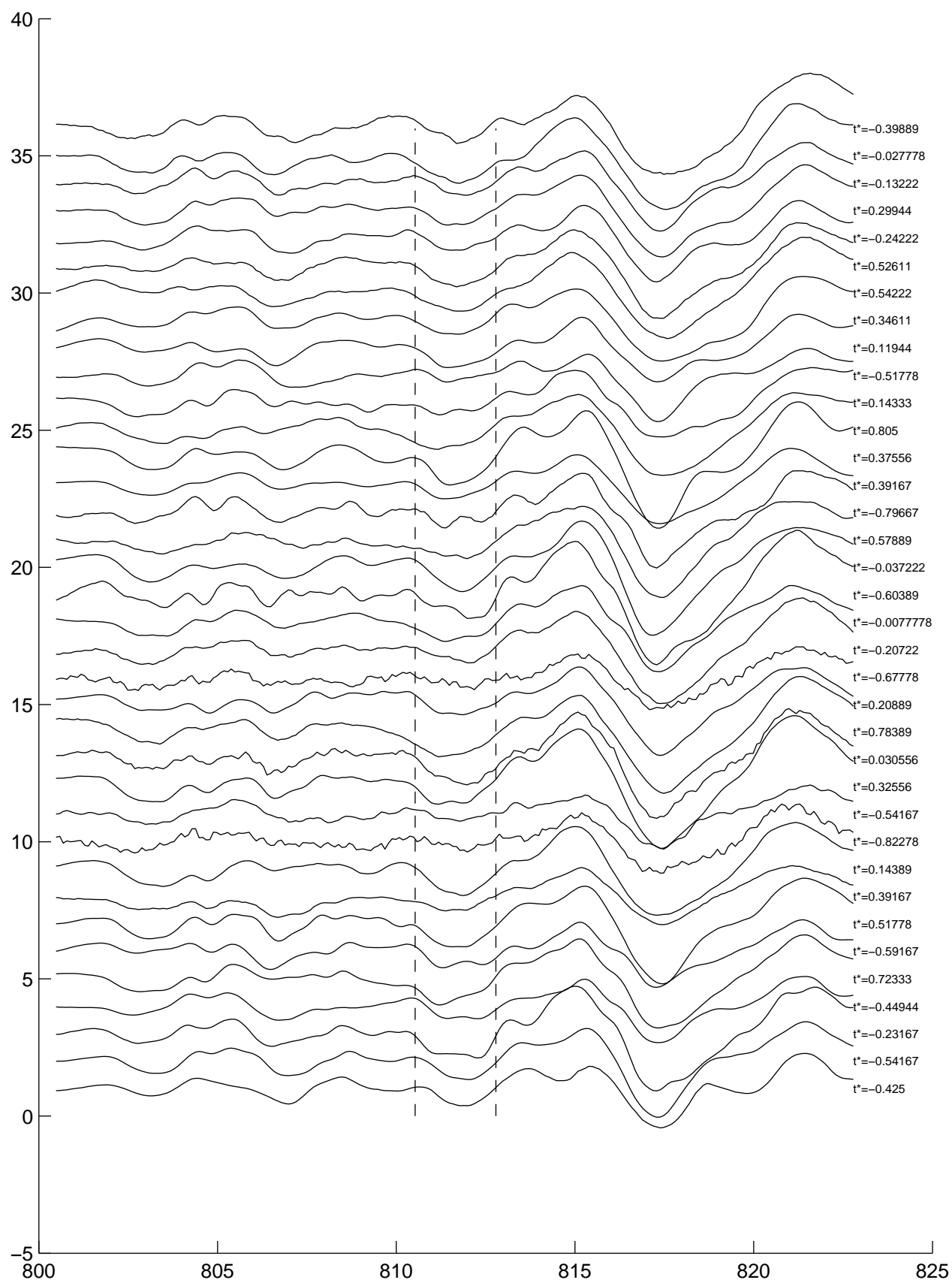
travel time residuals



t\* values

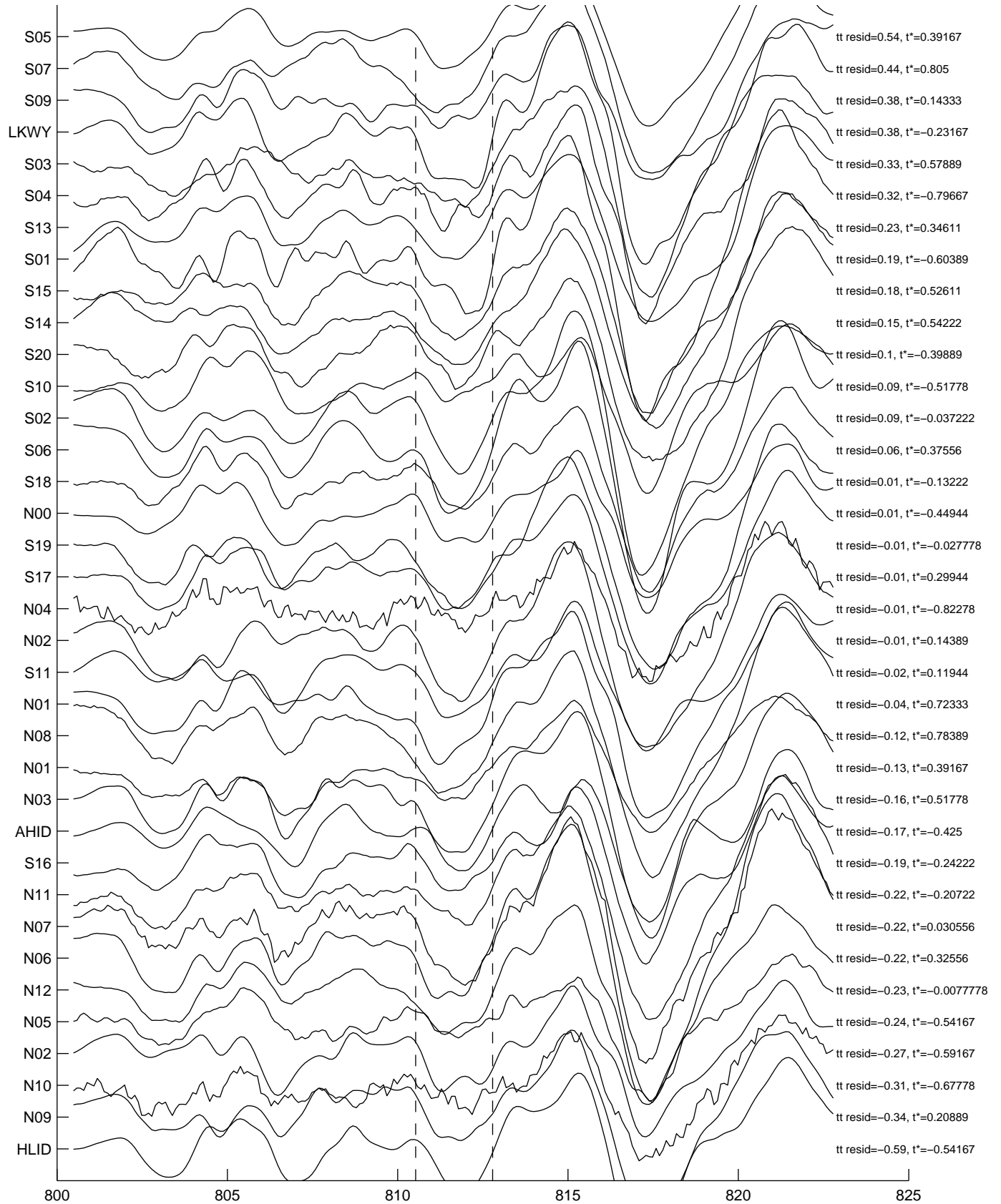


# Event\_2000\_056\_01\_43\_58

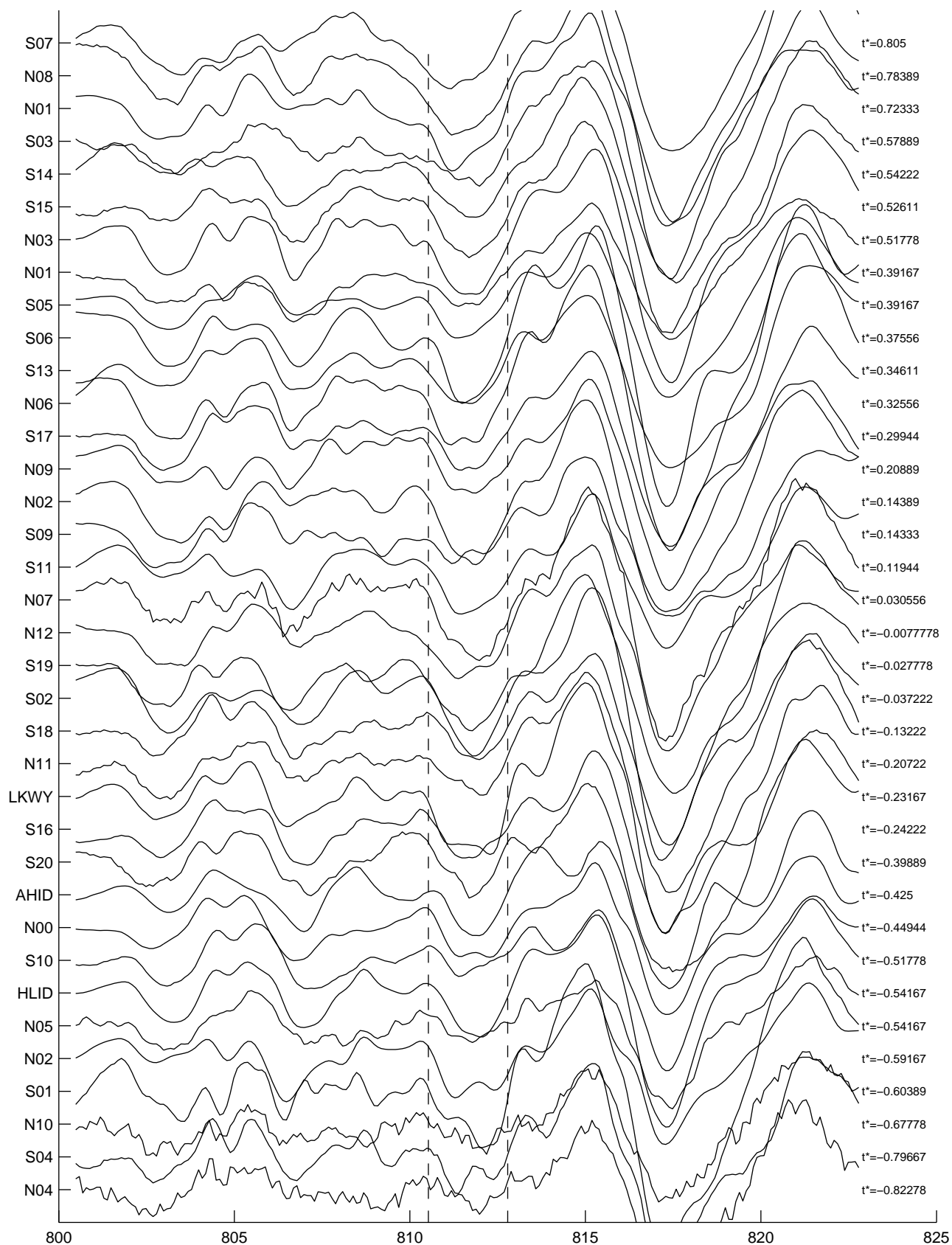




# Sorted by travel time:Event\_2000\_056\_01\_43\_58



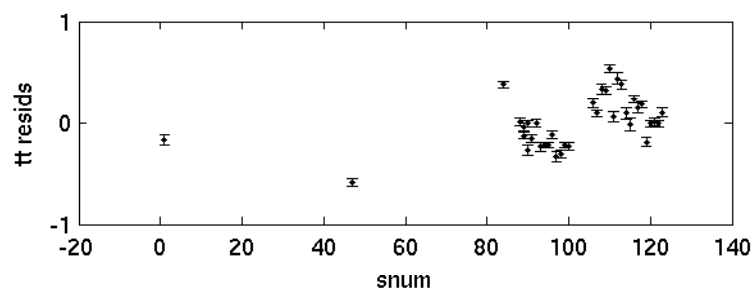
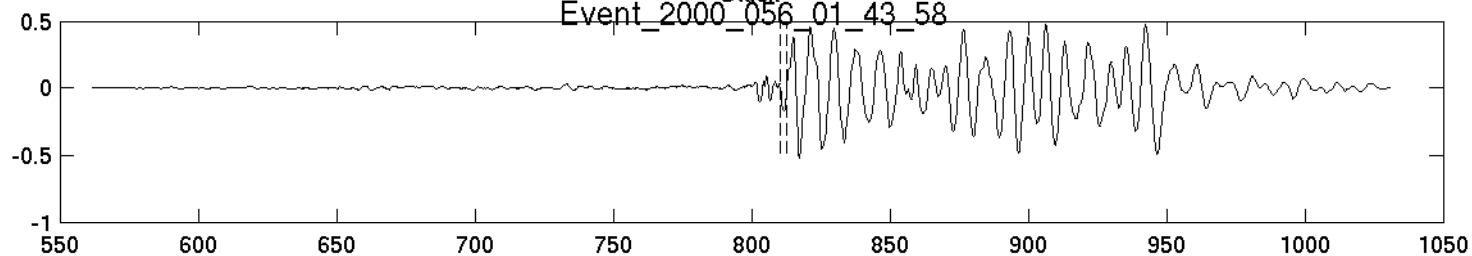
# Sorted by $t^*$ :Event\_2000\_056\_01\_43\_58



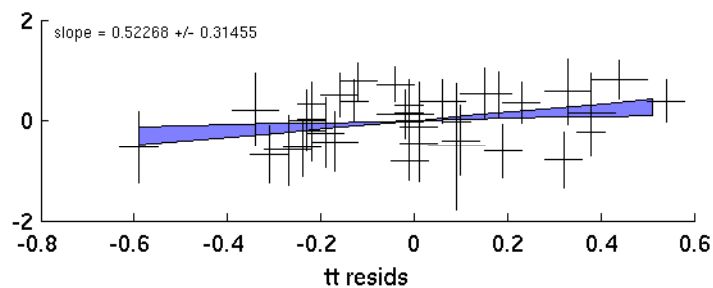
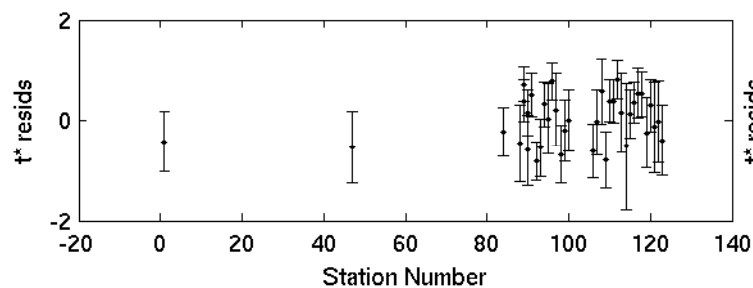


Event\_2000\_056\_01\_43\_58

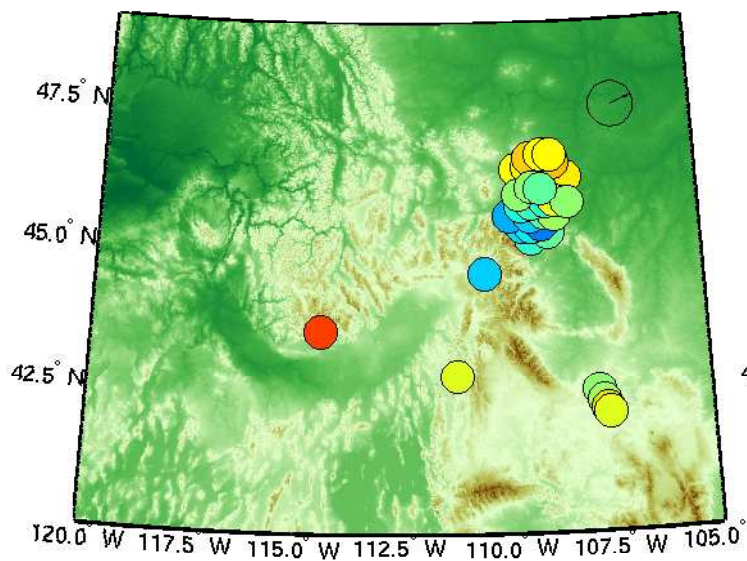
Stack



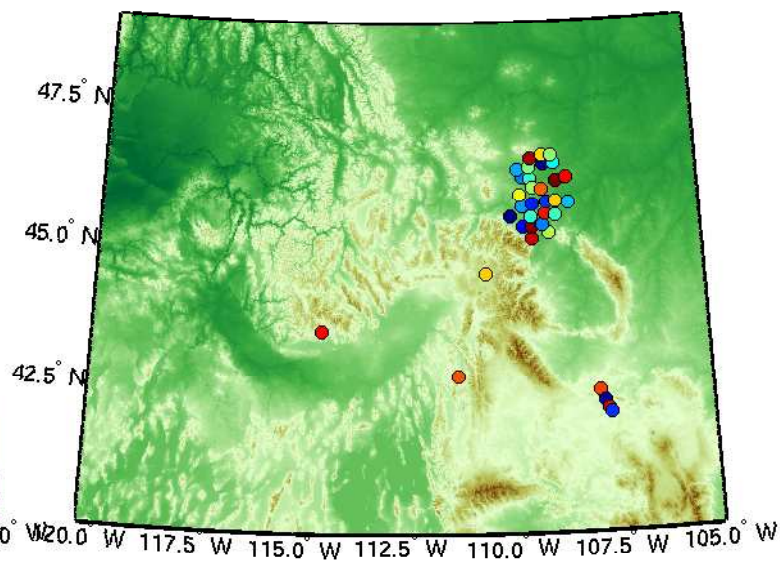
Baz = 247.3116  
Mean xcor value = 0.86639  
Range of  $t^*$  values is 1.6278  
Median  $t^*$  err is 0.56552  
Slope = 0.52268 +/- 0.31455



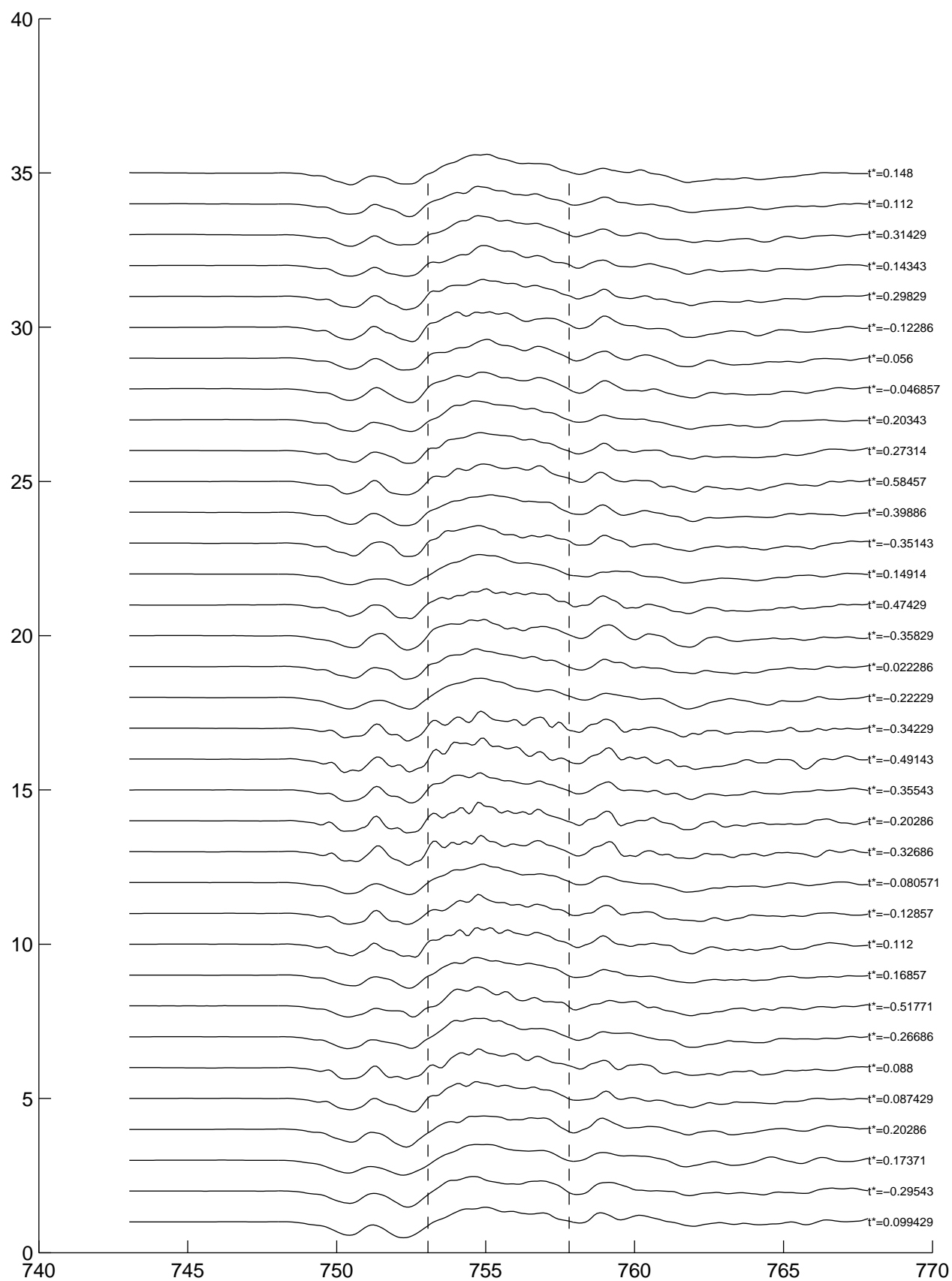
travel time residuals



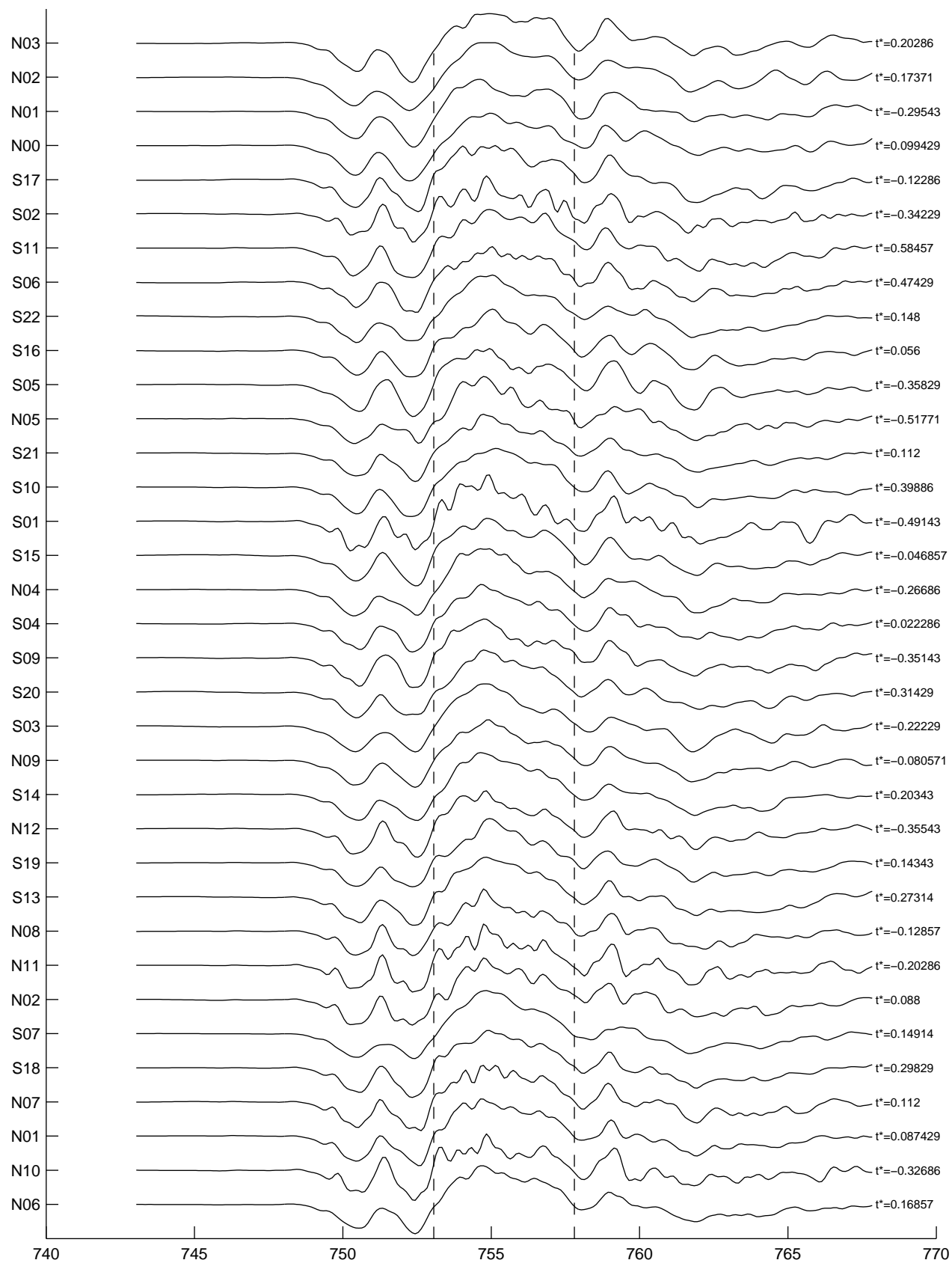
$t^*$  values



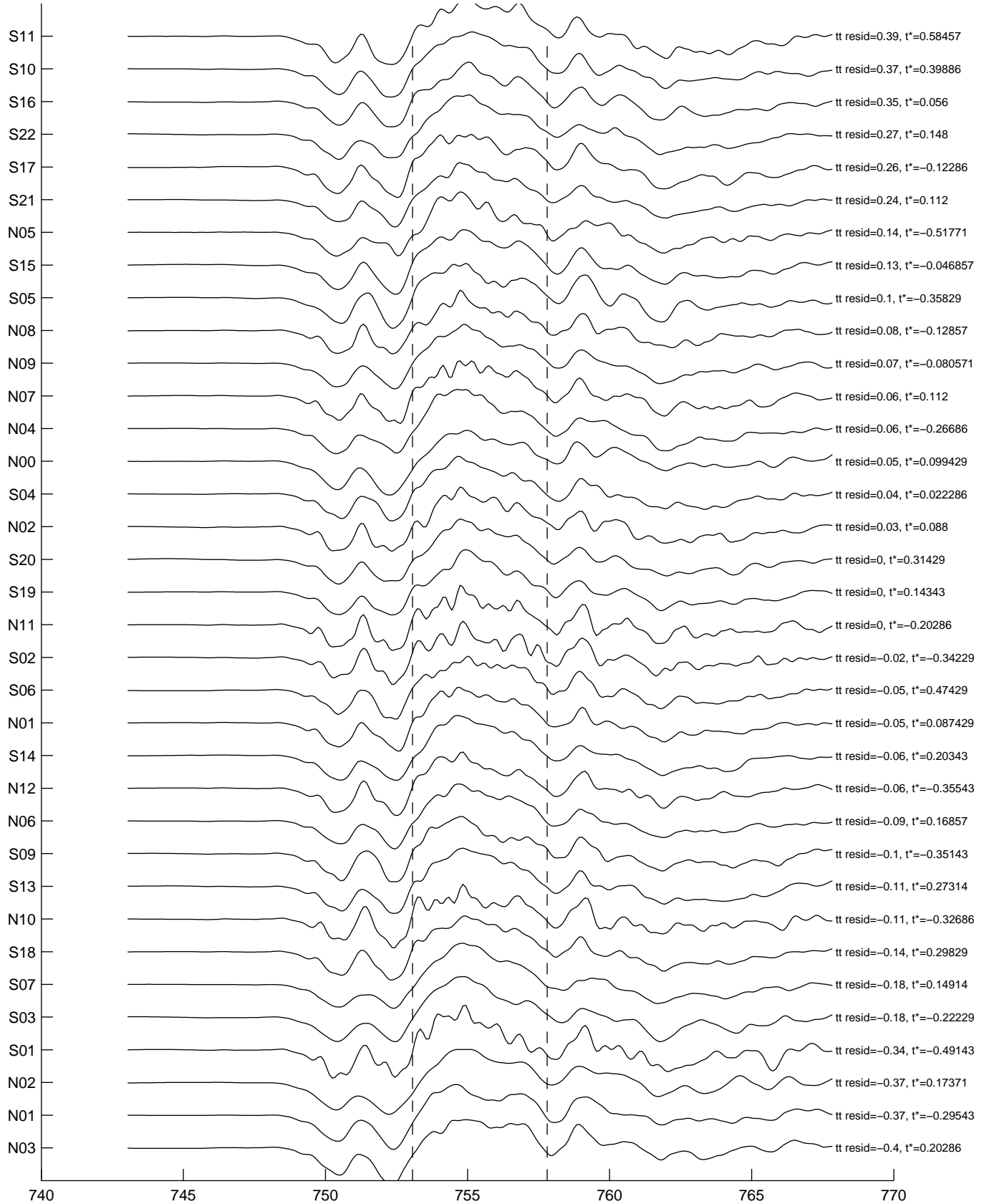
# Event\_2000\_088\_11\_00\_22



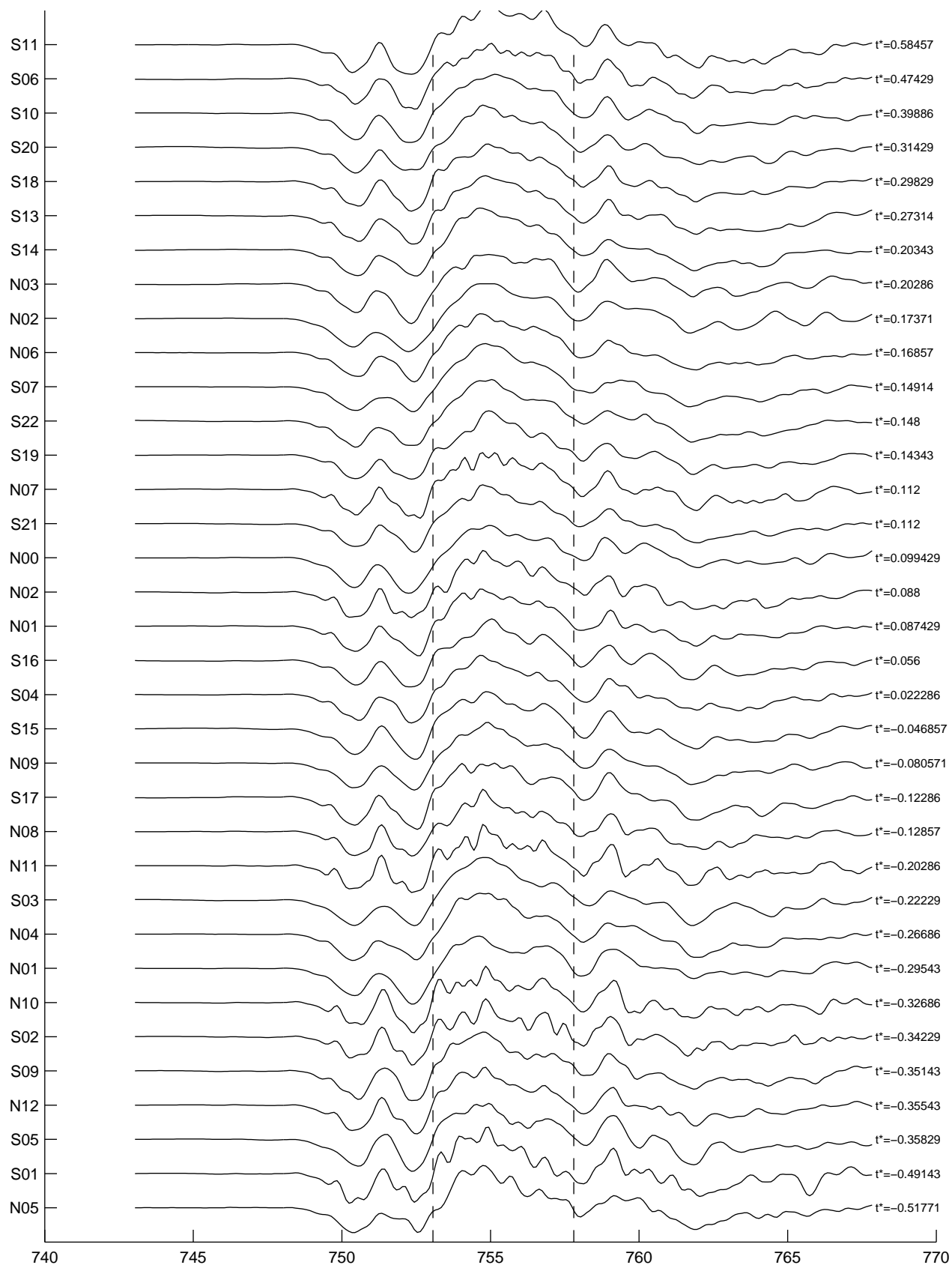
# Sorted by Delta:Event\_2000\_088\_11\_00\_22

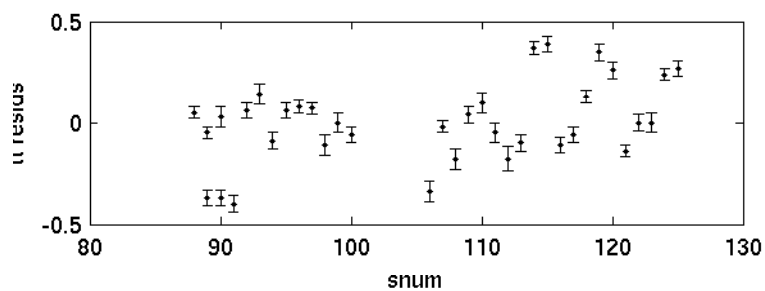
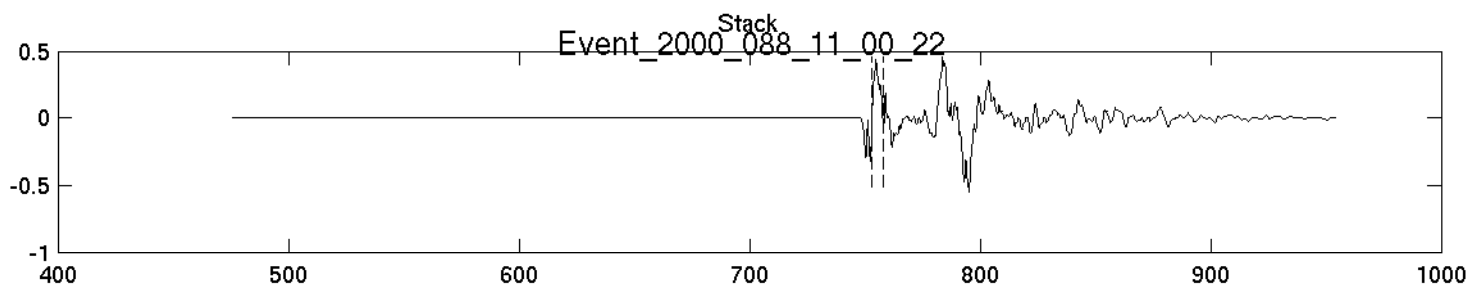


# Sorted by travel time: Event\_2000\_088\_11\_00\_22

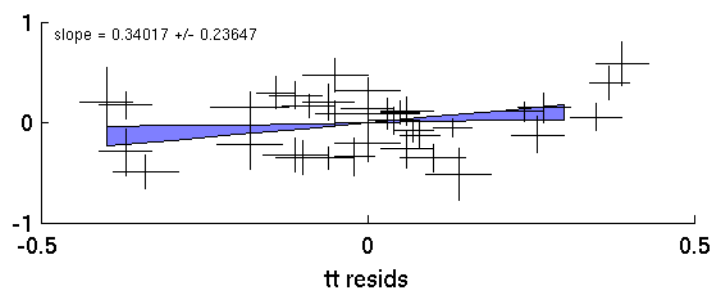
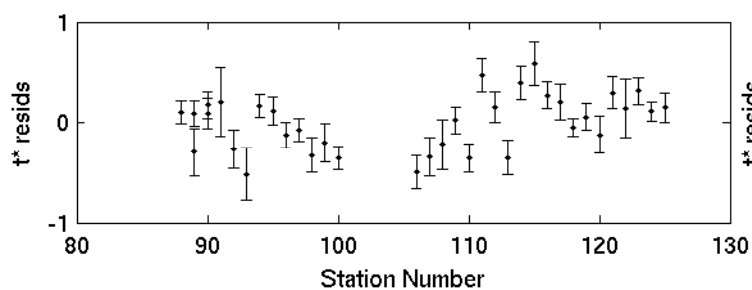


# Sorted by $t^*$ :Event\_2000\_088\_11\_00\_22

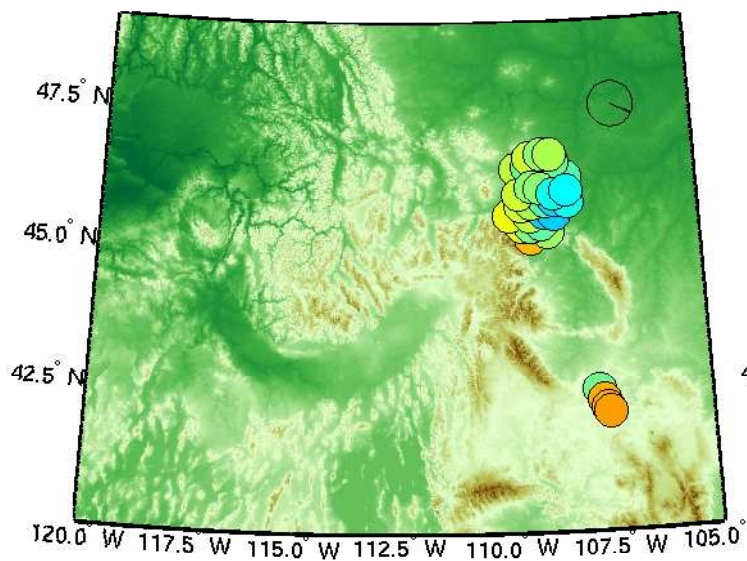




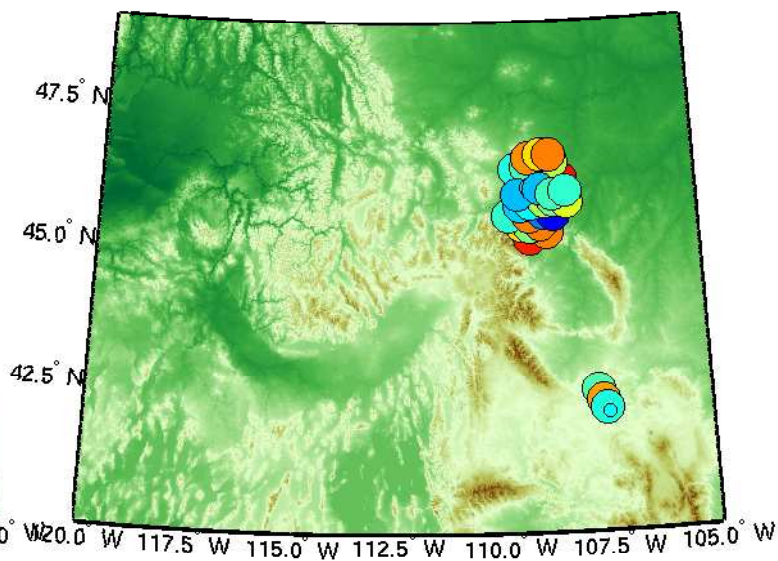
Baz = 297.7514  
Mean xcor value = 0.94429  
Range of  $t^*$  values is 1.1023  
Median  $t^*$  err is 0.15595  
Slope = 0.34017 +/- 0.23647



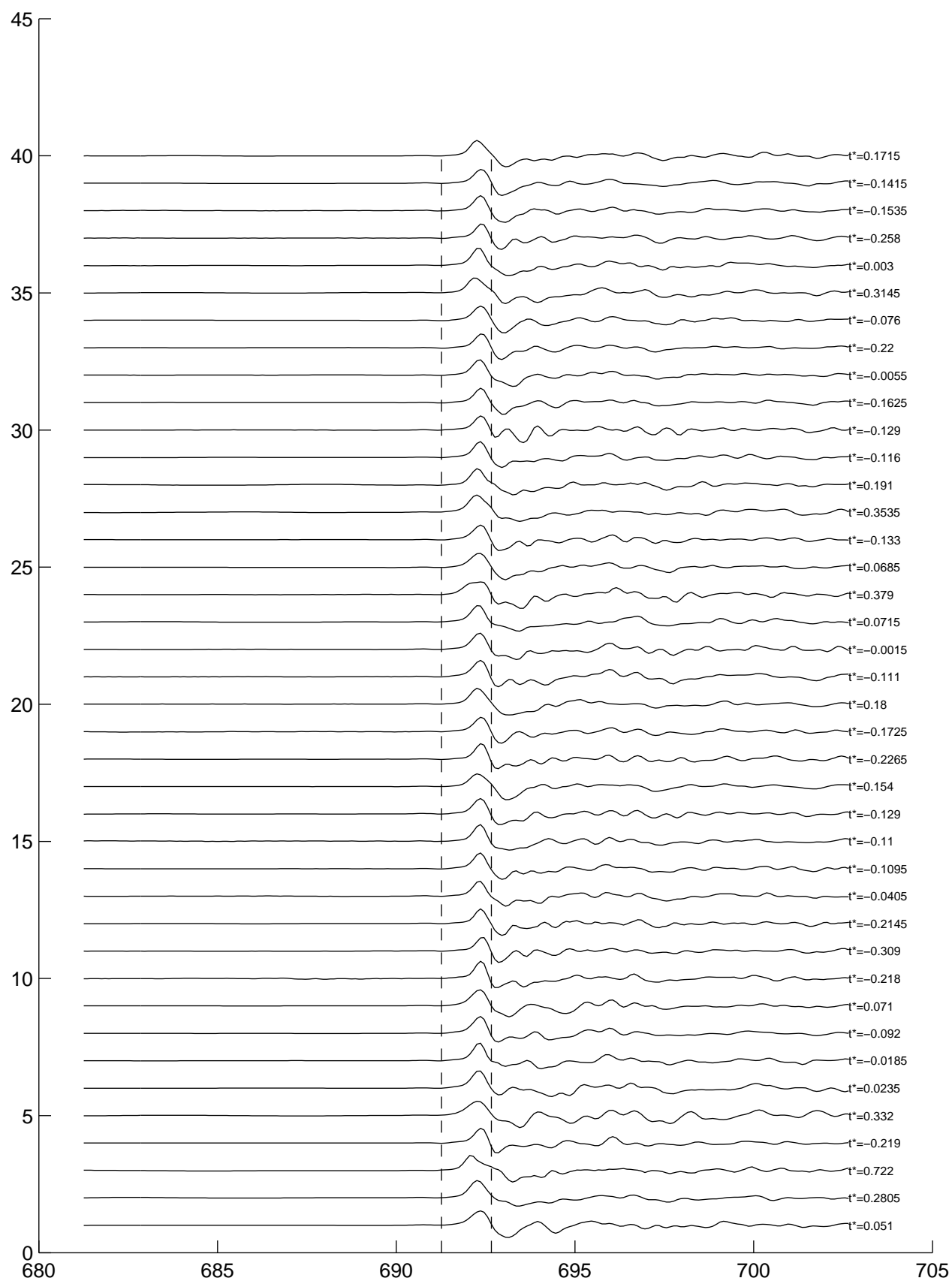
travel time residuals



$t^*$  values

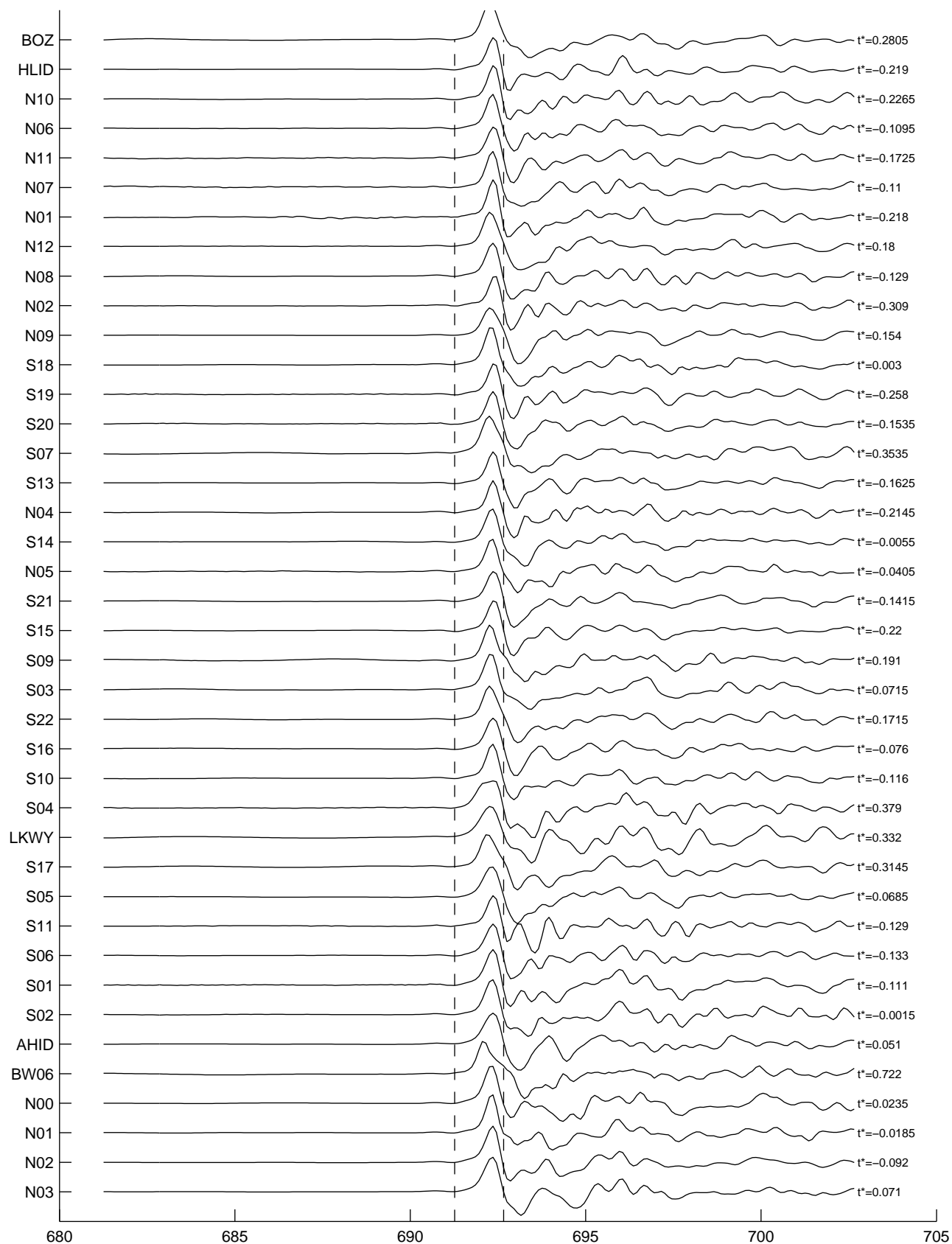


# Event\_2000\_114\_09\_27\_23

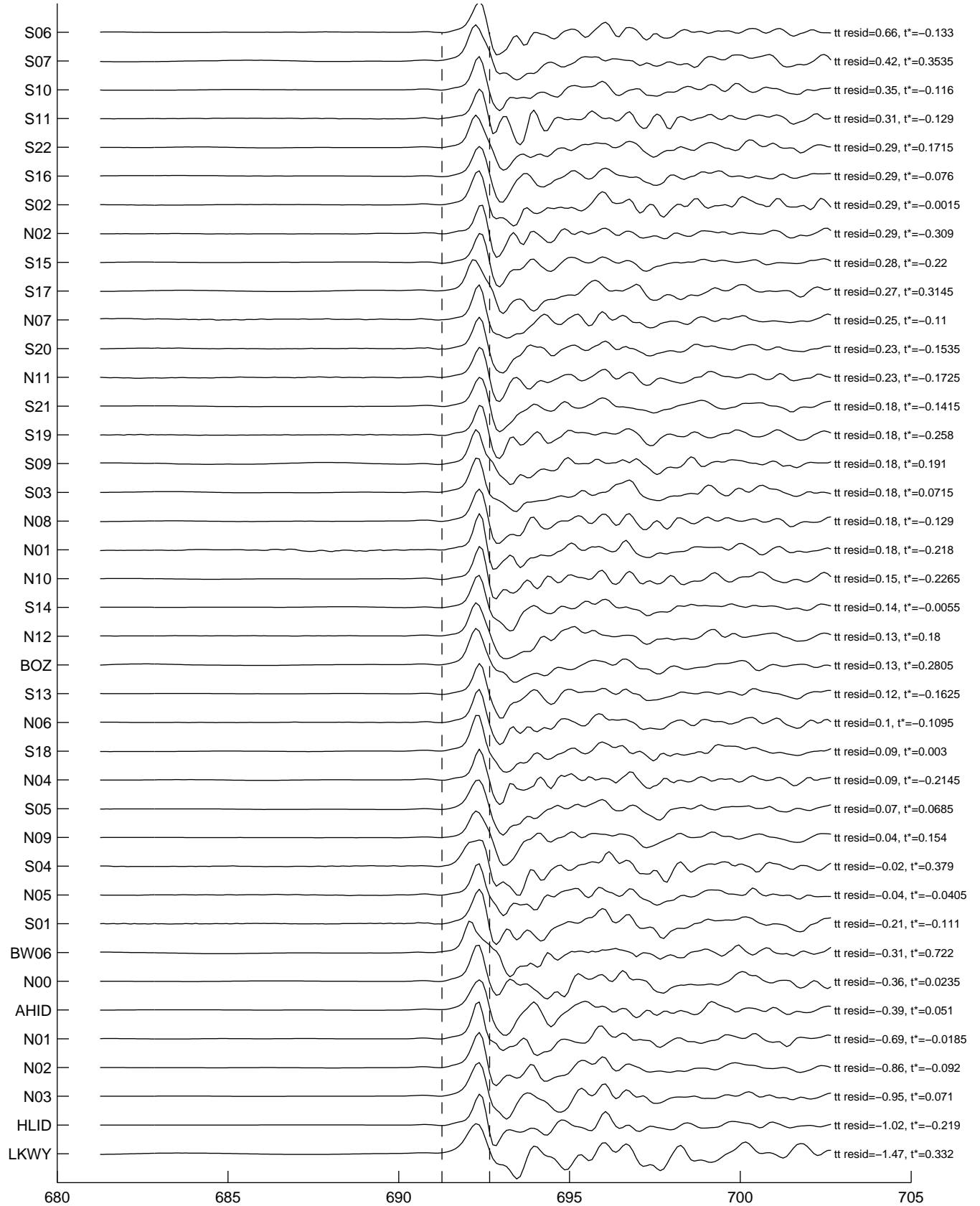




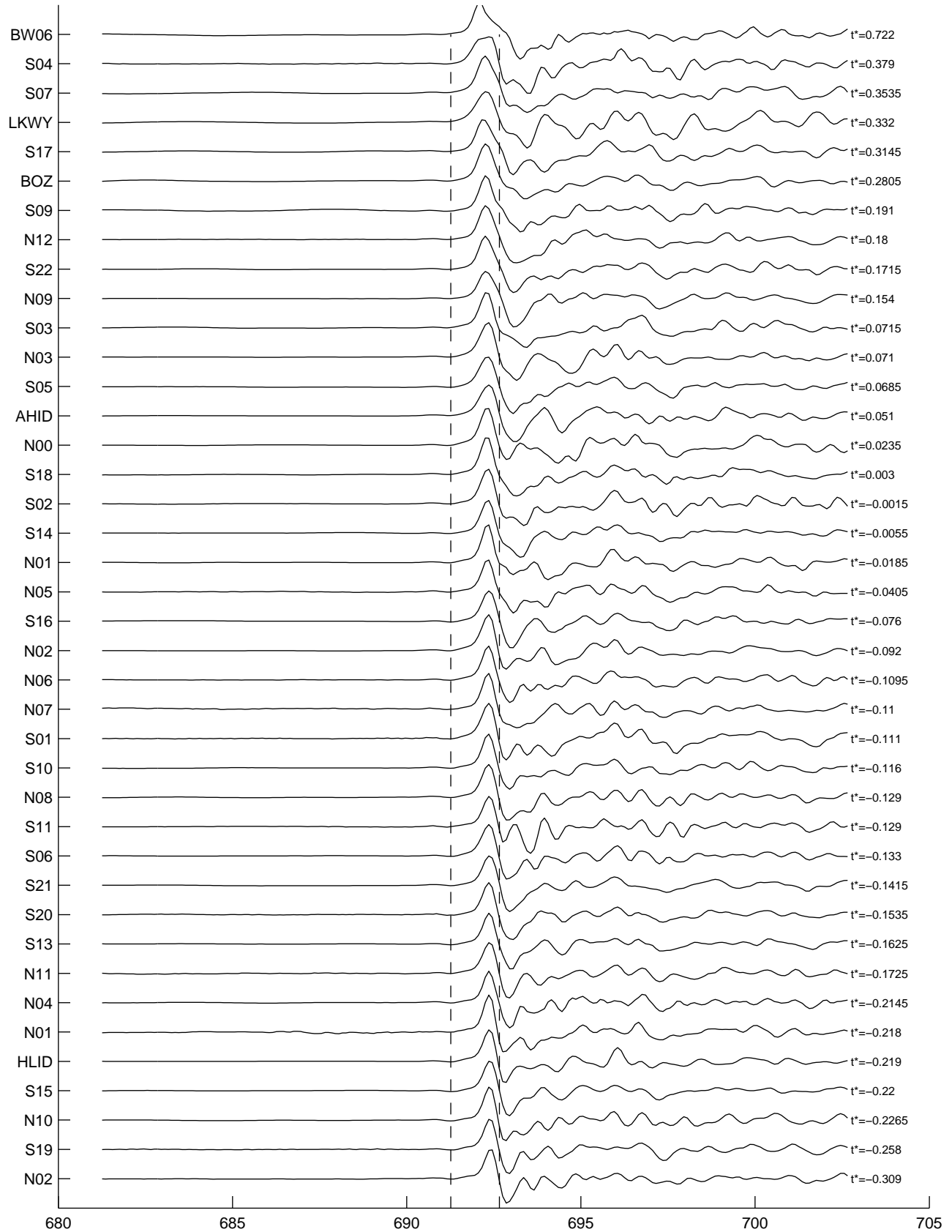
# Sorted by Delta:Event\_2000\_114\_09\_27\_23



# Sorted by travel time:Event\_2000\_114\_09\_27\_23

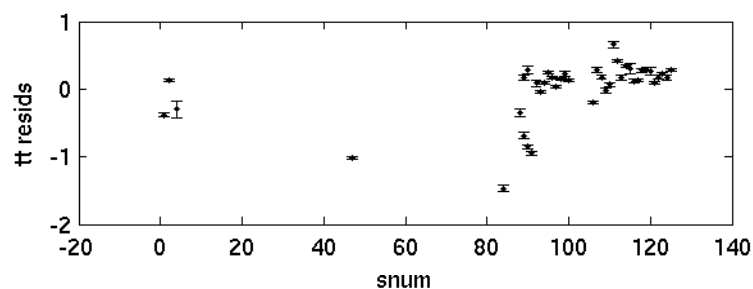
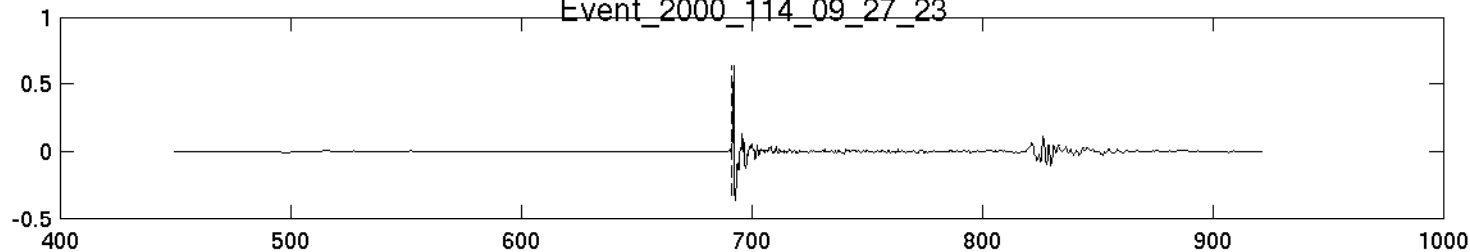


# Sorted by $t^*$ :Event\_2000\_114\_09\_27\_23

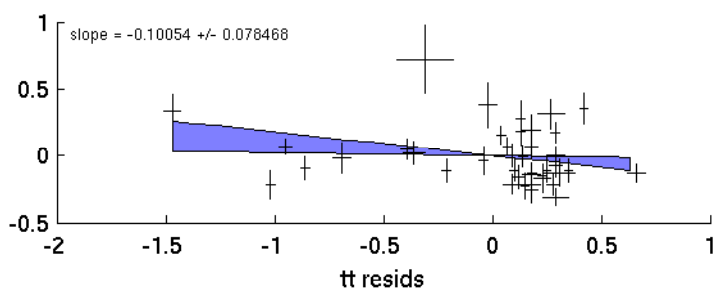
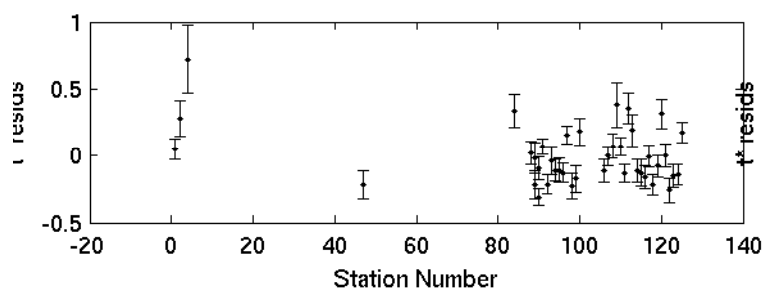


# Event\_2000\_114\_09\_27\_23

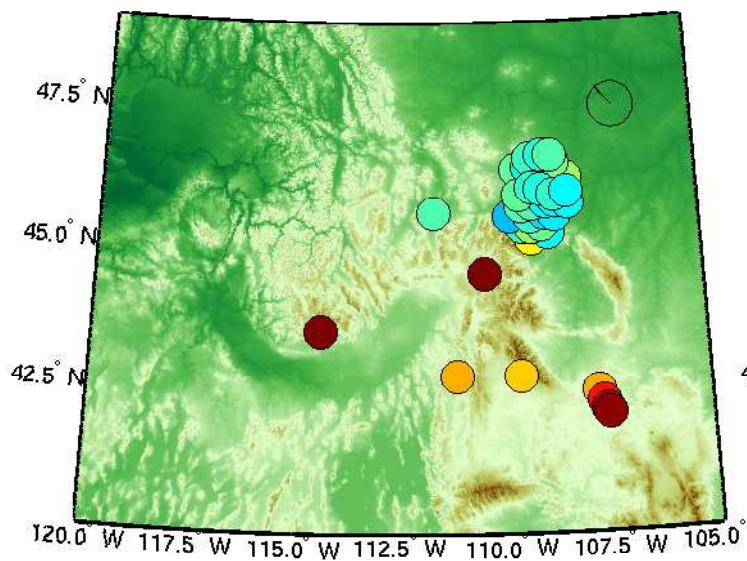
Stack



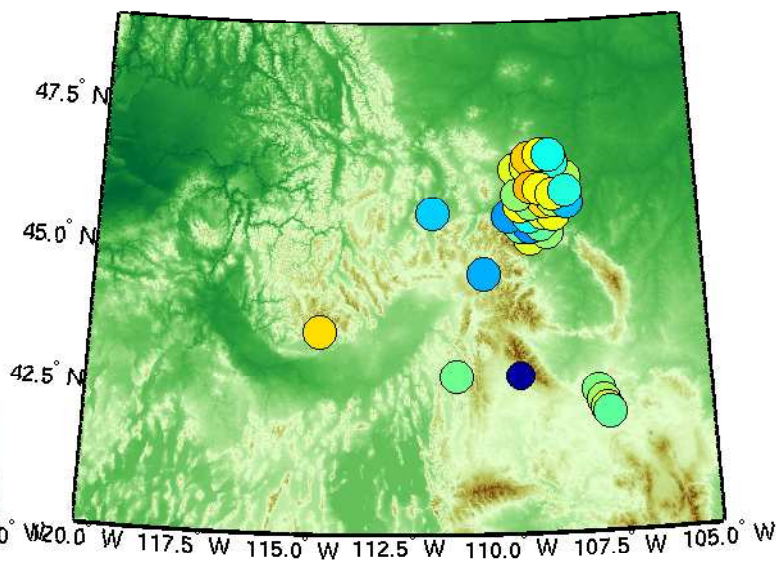
Baz = 140.3919  
Mean xcor value = 0.768  
Range of t\* values is 1.031  
Median t\* err is 0.088506  
Slope = -0.10054 +/- 0.078468



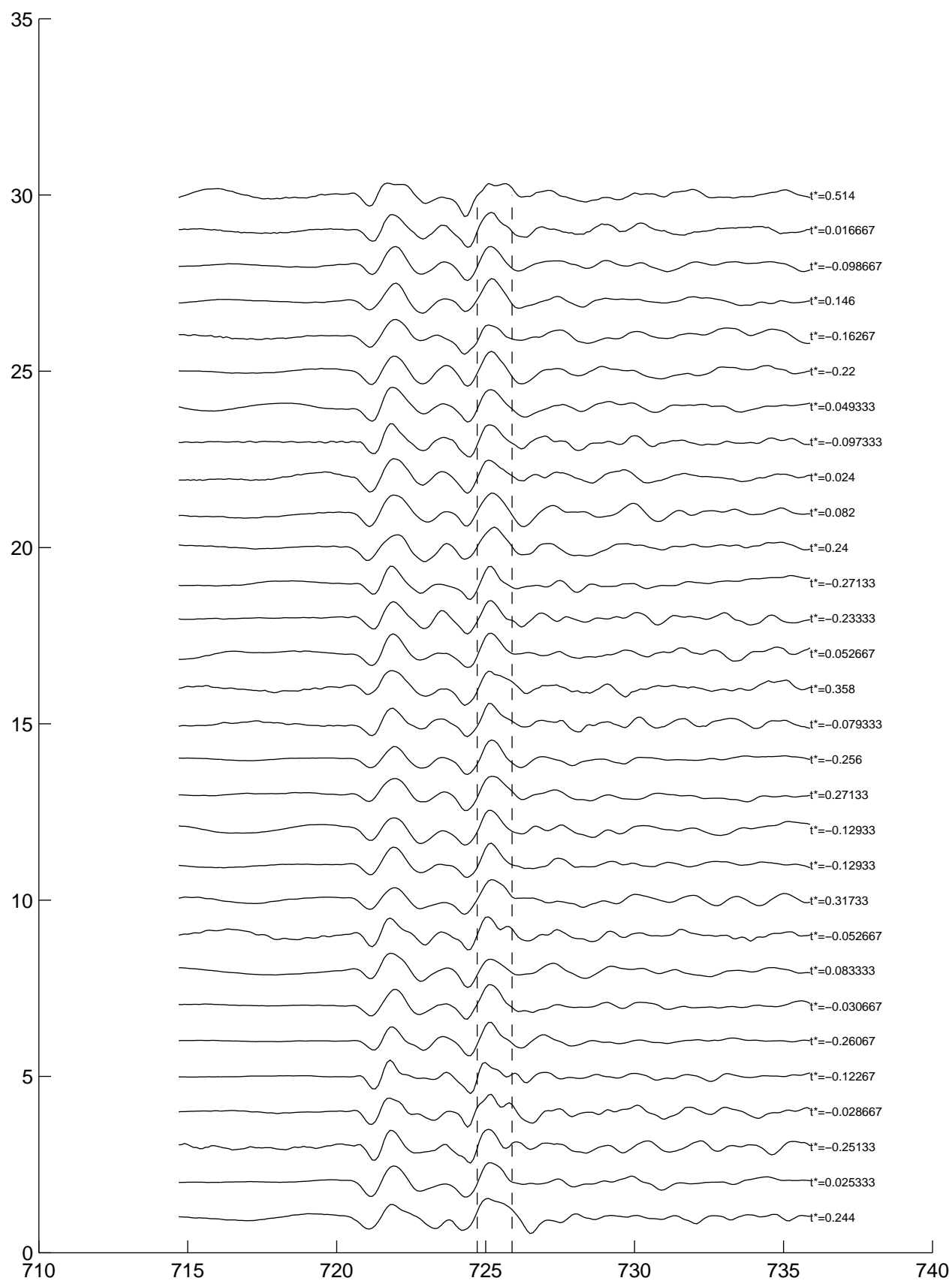
travel time residuals



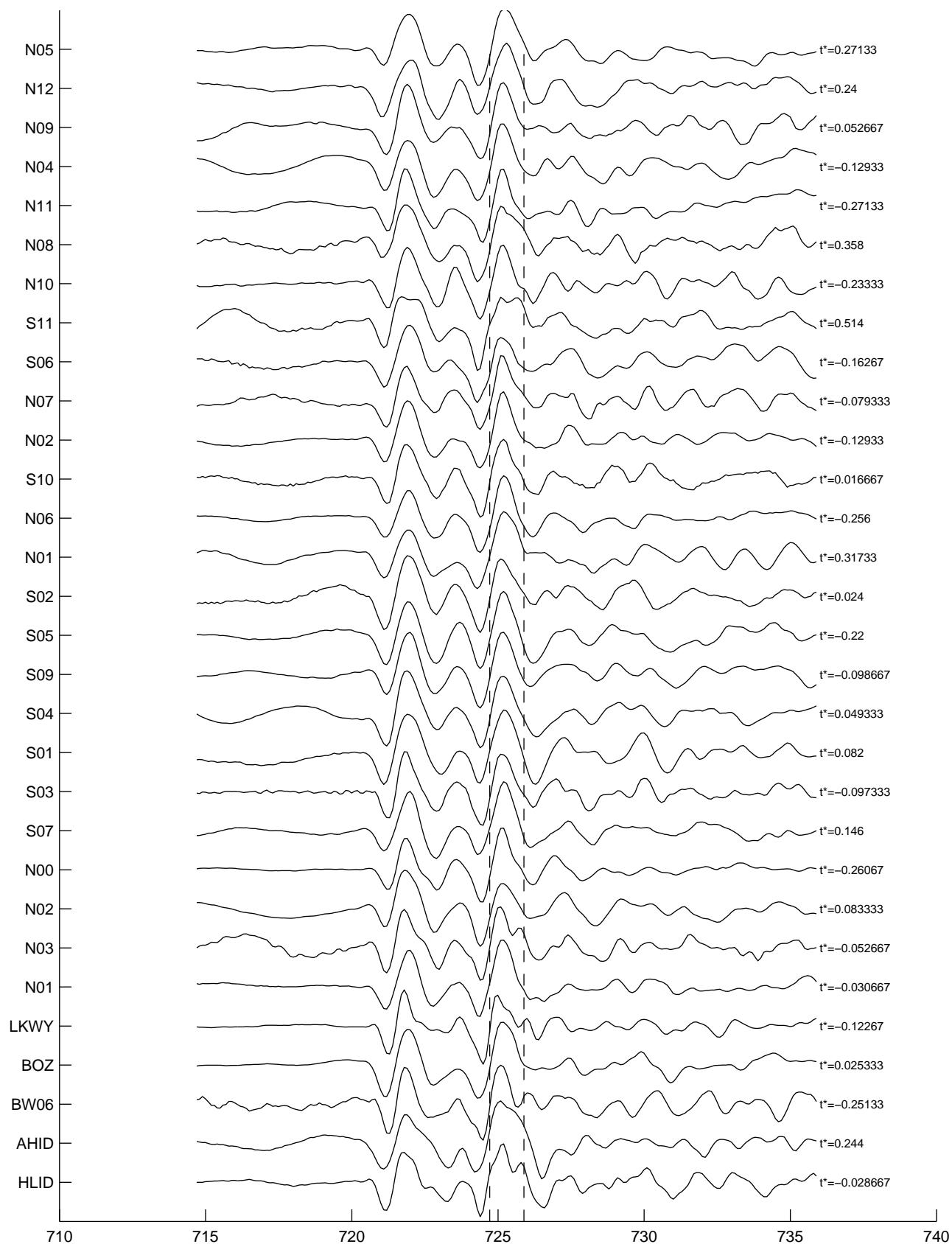
t\* values



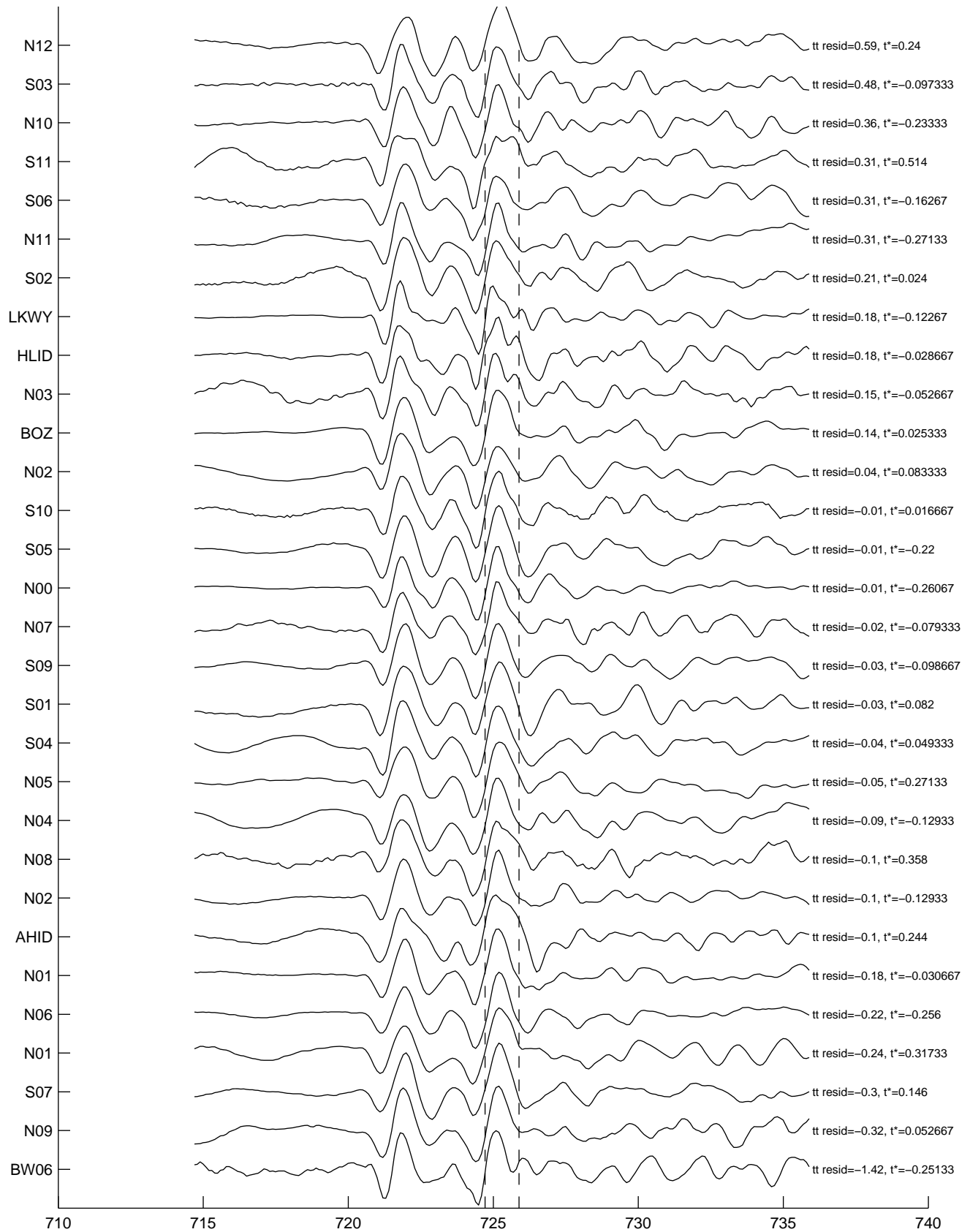
# Event\_2000\_125\_20\_36\_32



# Sorted by Delta:Event\_2000\_125\_20\_36\_32

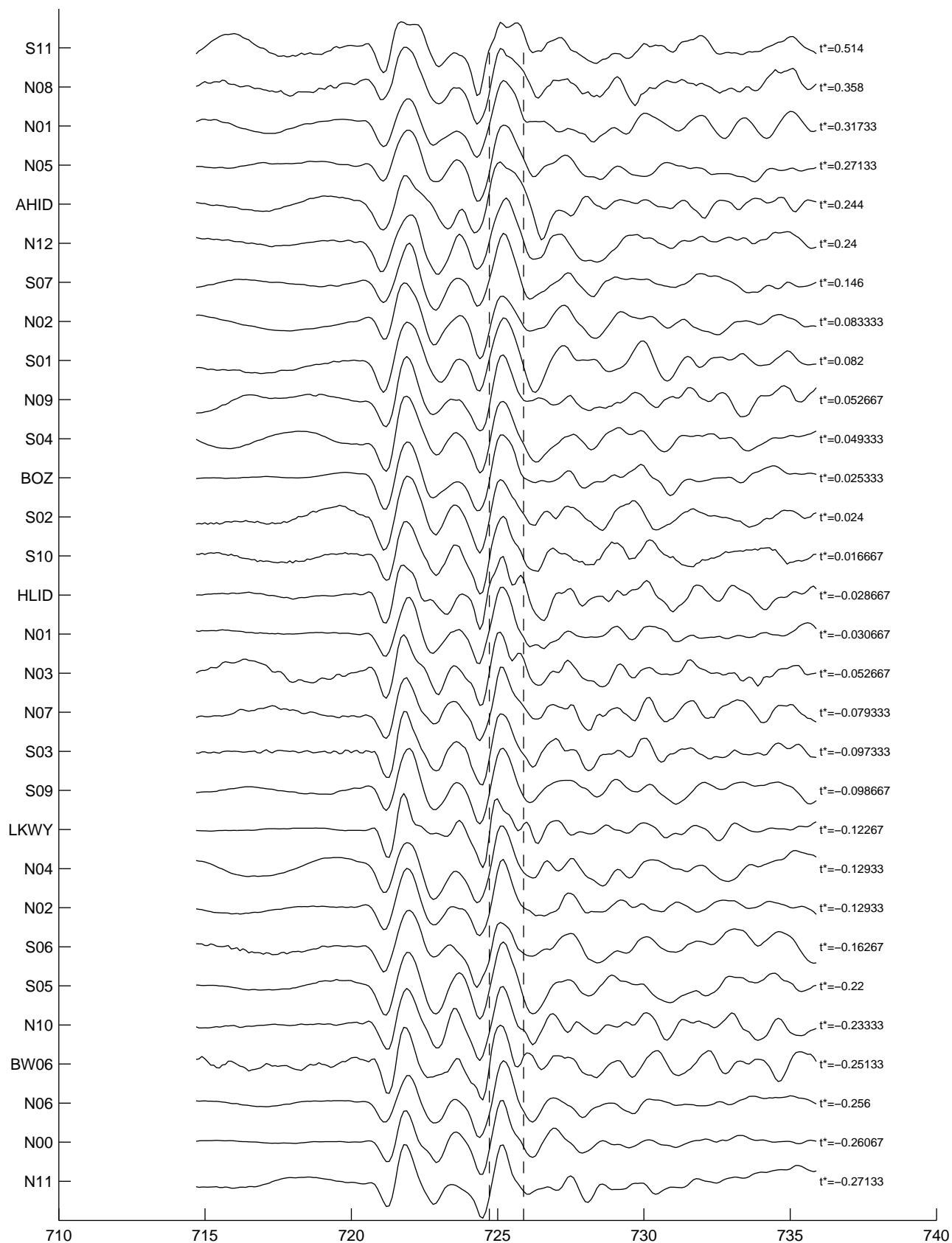


# Sorted by travel time: Event\_2000\_125\_20\_36\_32



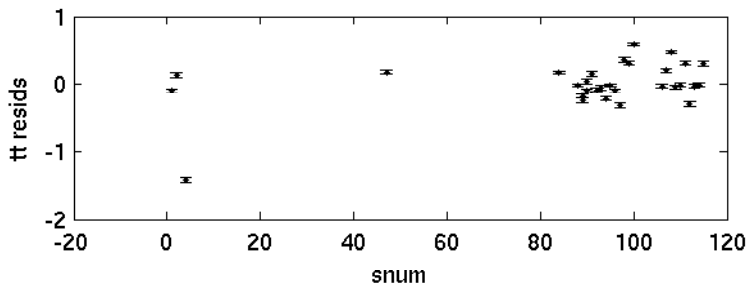
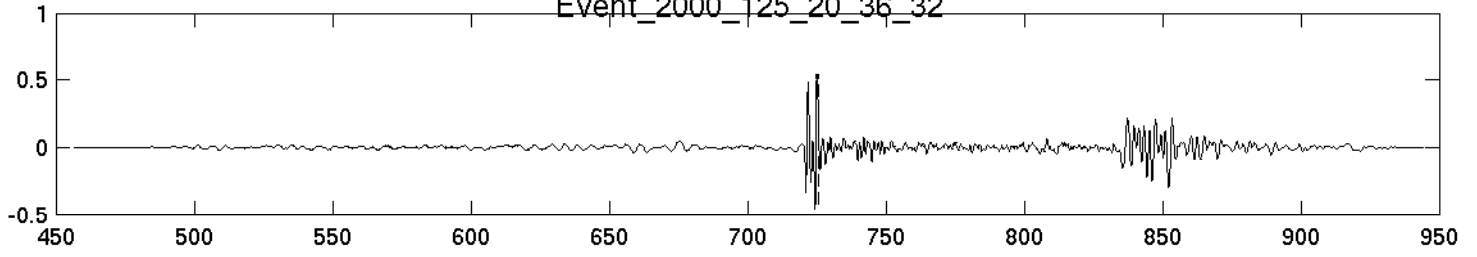


# Sorted by t\*:Event\_2000\_125\_20\_36\_32

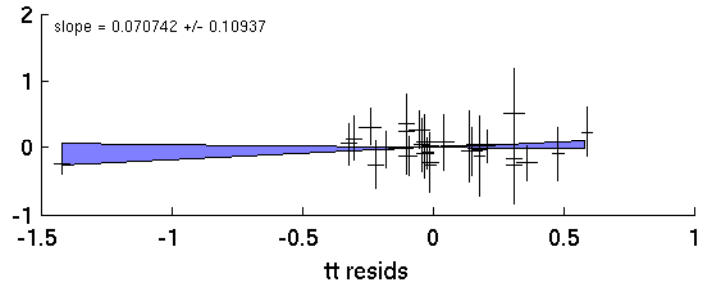
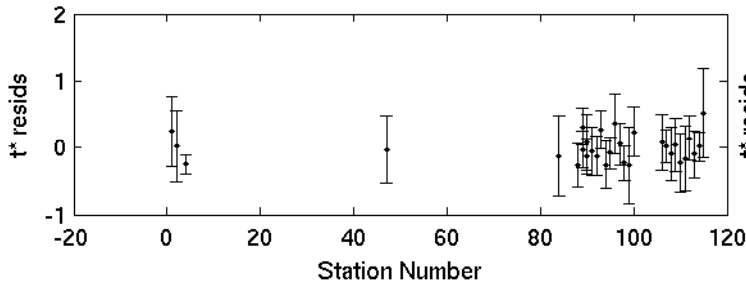


# Event\_2000\_125\_20\_36\_32

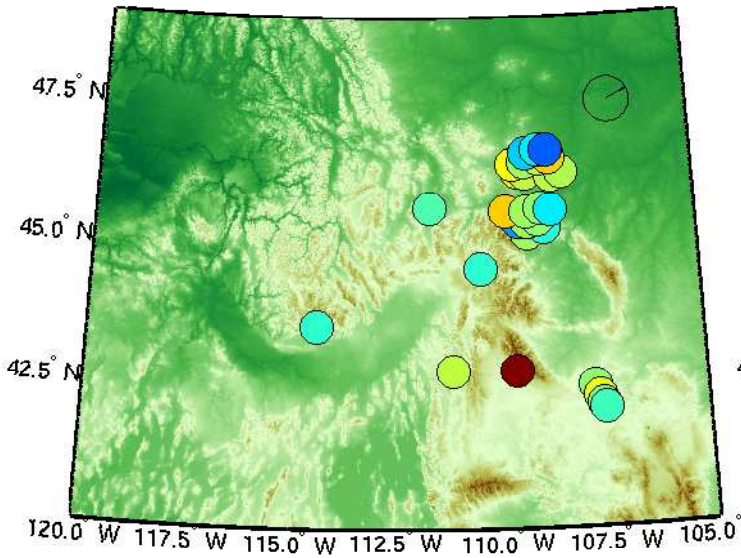
Stack



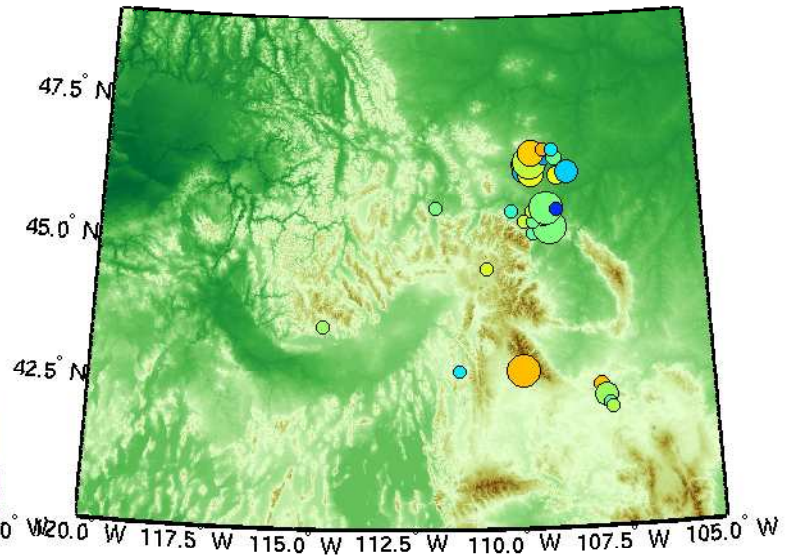
Baz = 242.9745  
Mean xcor value = 0.68367  
Range of  $t^*$  values is 0.78533  
Median  $t^*$  err is 0.35784  
Slope = 0.070742 +/- 0.10937



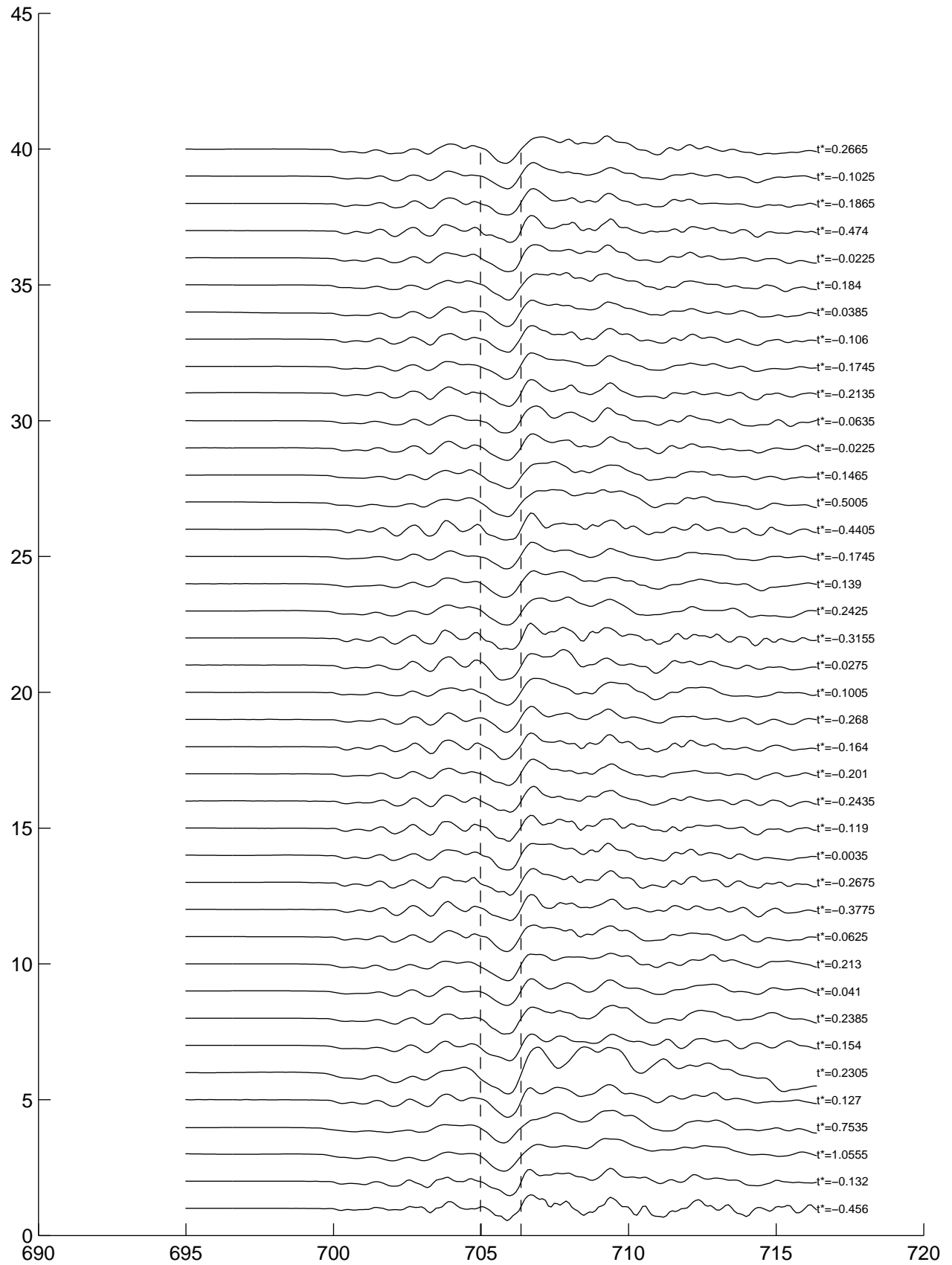
travel time residuals



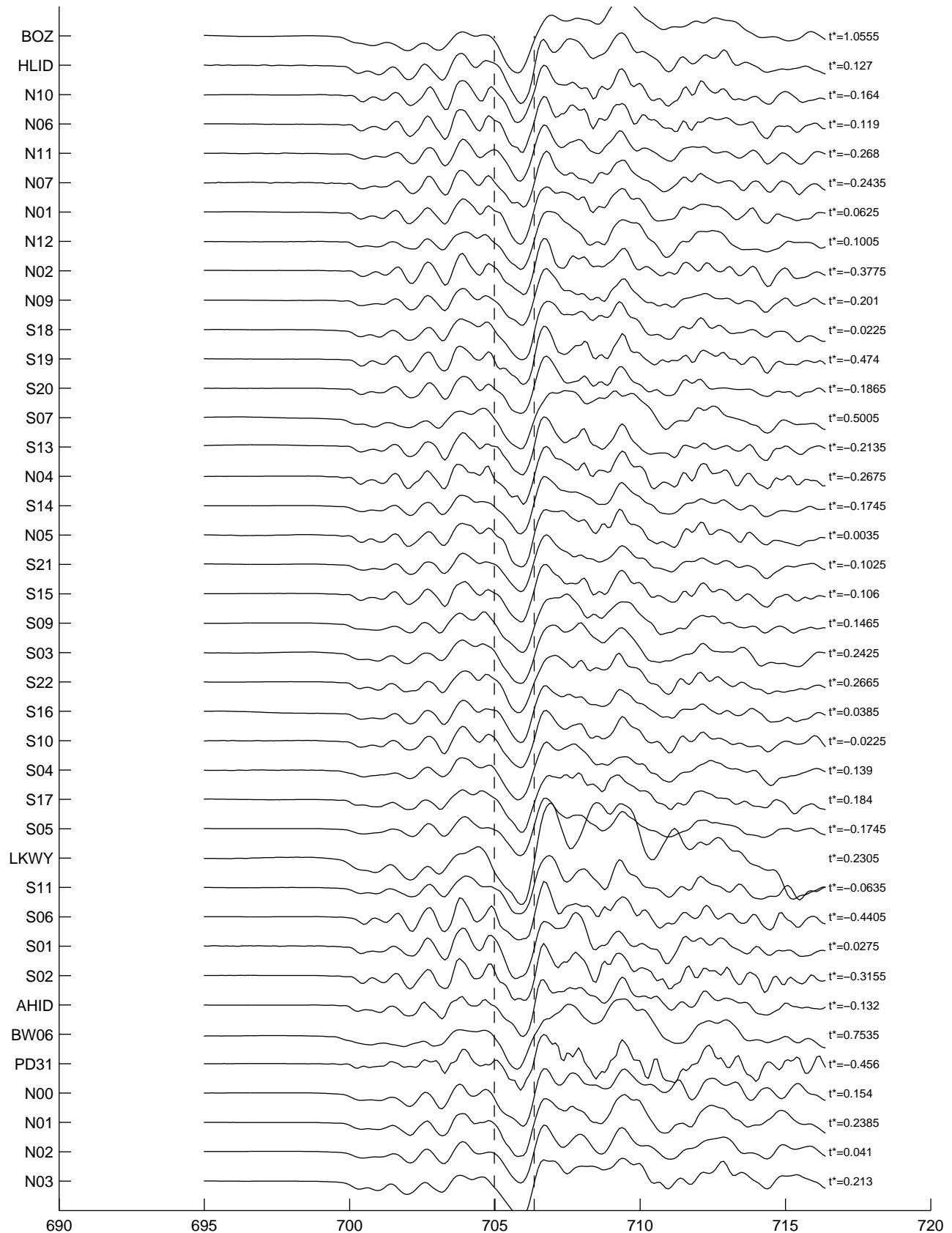
$t^*$  values



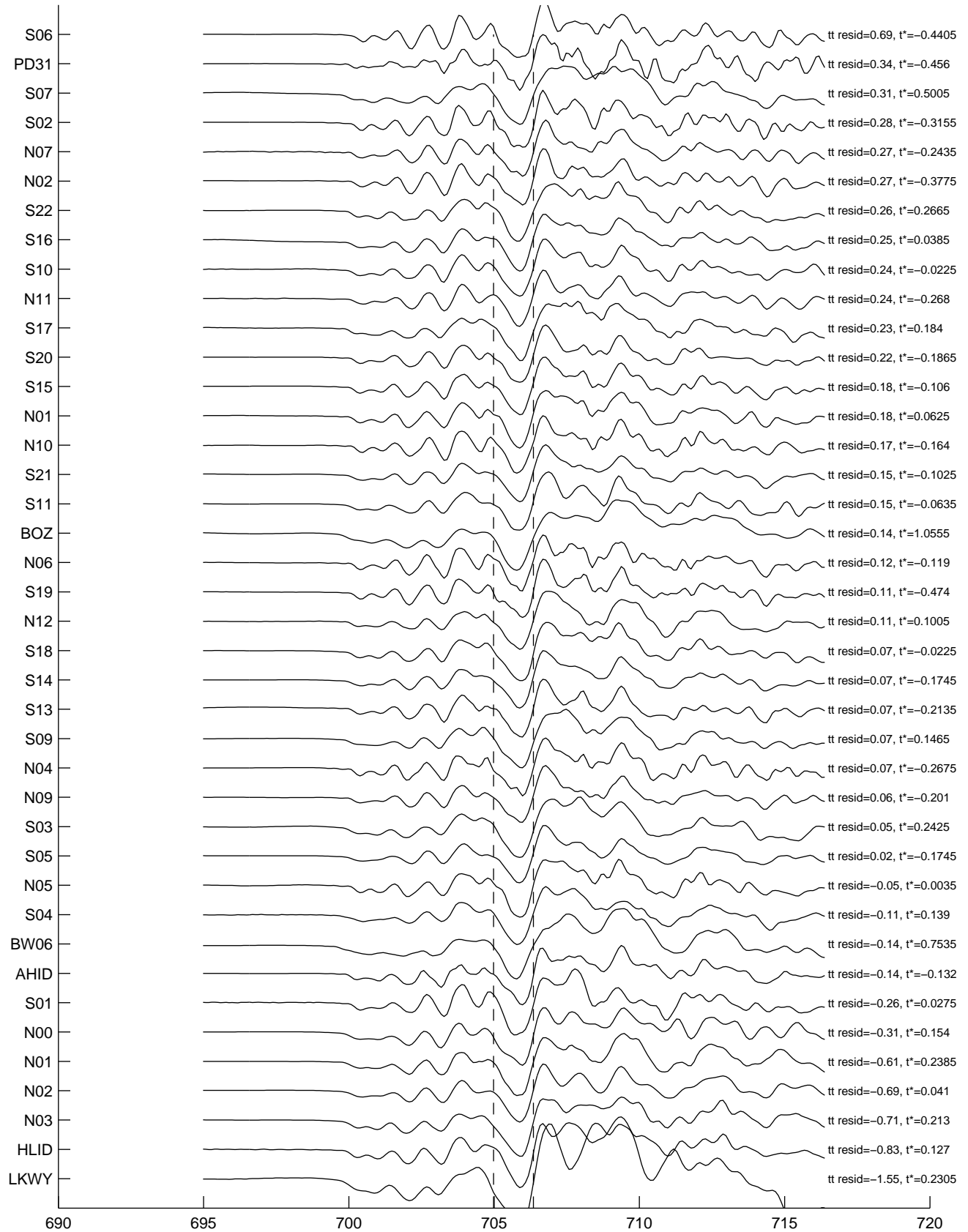
# Event\_2000\_133\_18\_43\_18



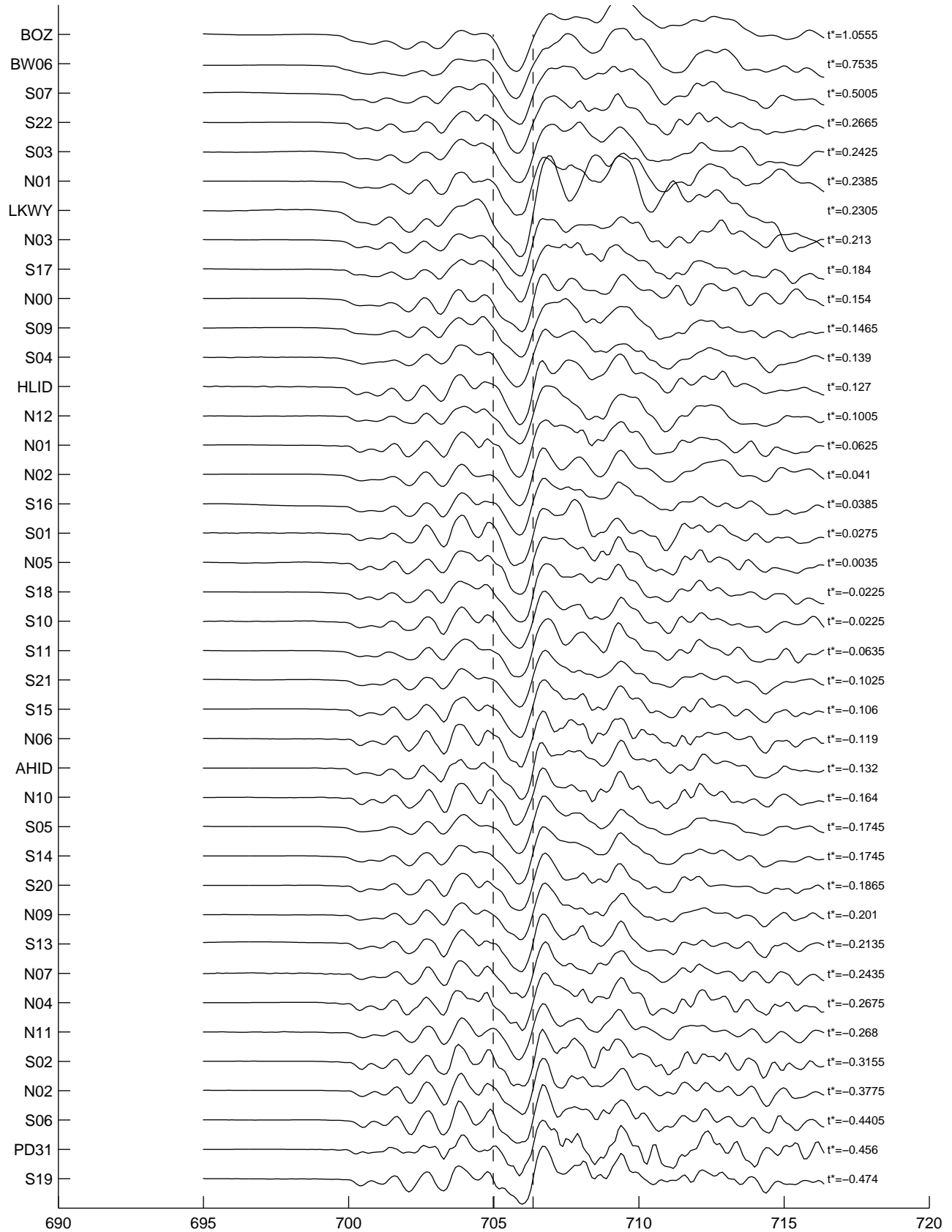
# Sorted by Delta:Event\_2000\_133\_18\_43\_18



# Sorted by travel time:Event\_2000\_133\_18\_43\_18

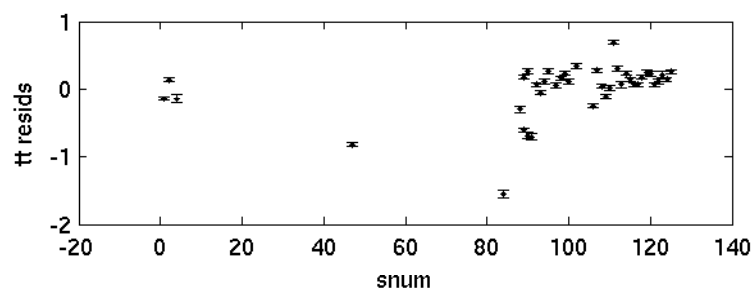
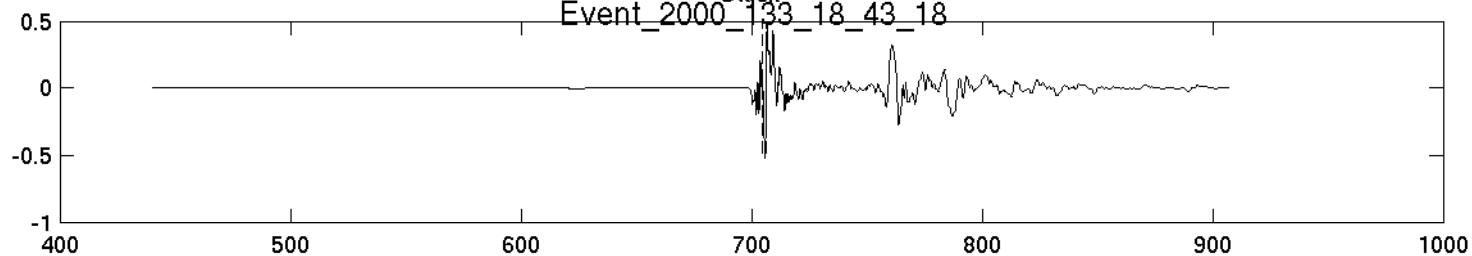


Sorted by t\*:Event\_2000\_133\_18\_43\_18

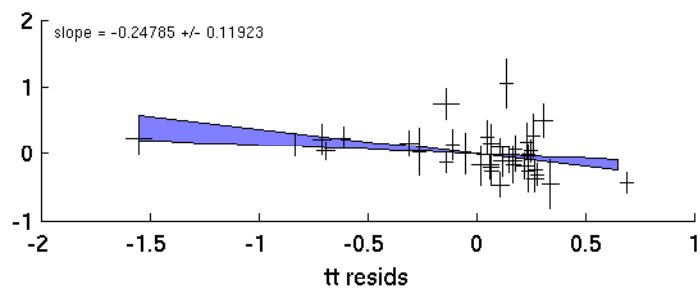
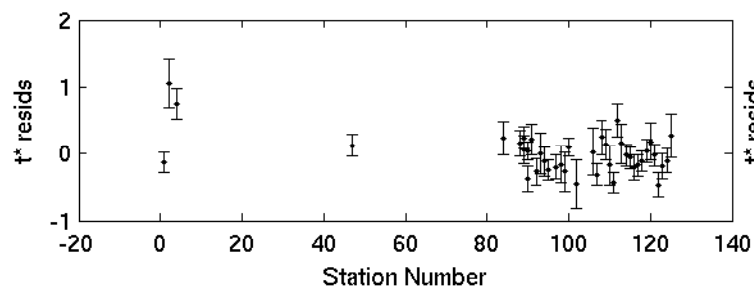


Event\_2000\_133\_18\_43\_18

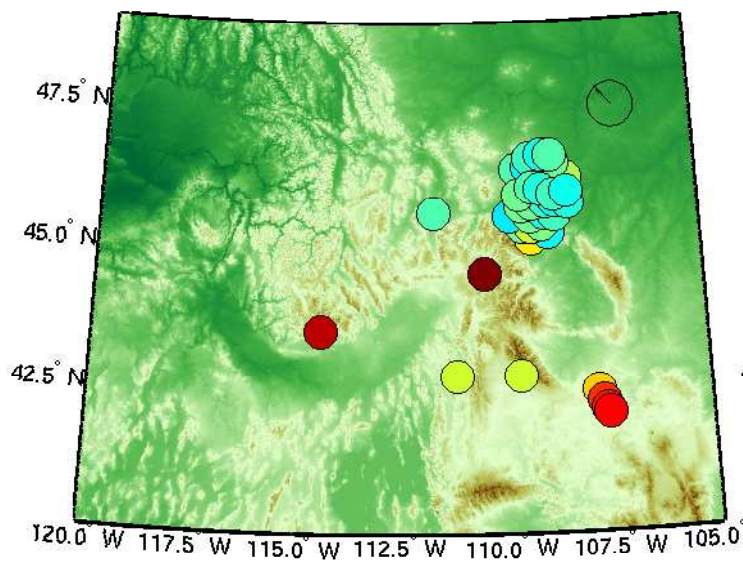
Stack



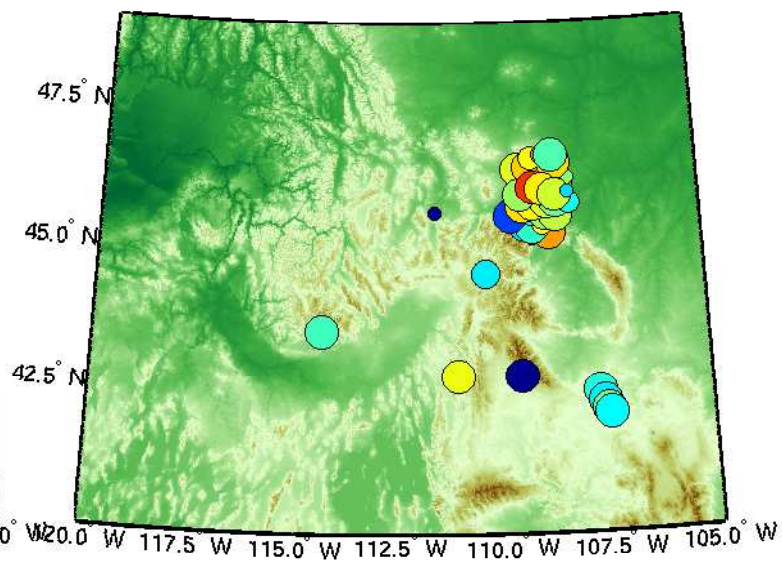
Baz = 140.7047  
Mean xcor value = 0.8525  
Range of  $t^*$  values is 1.5295  
Median  $t^*$  err is 0.19295  
Slope =  $-0.24785 \pm 0.11923$



travel time residuals

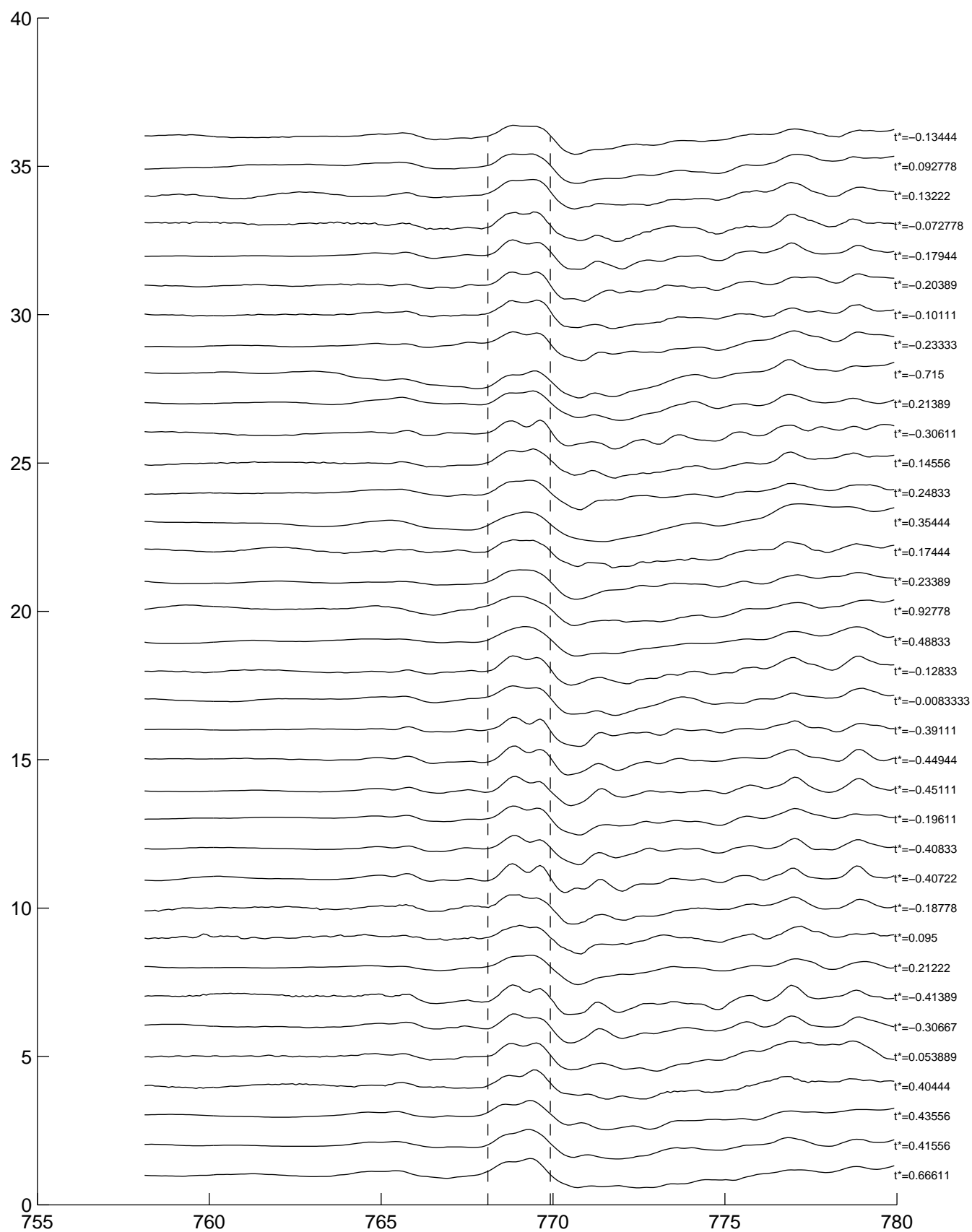


$t^*$  values

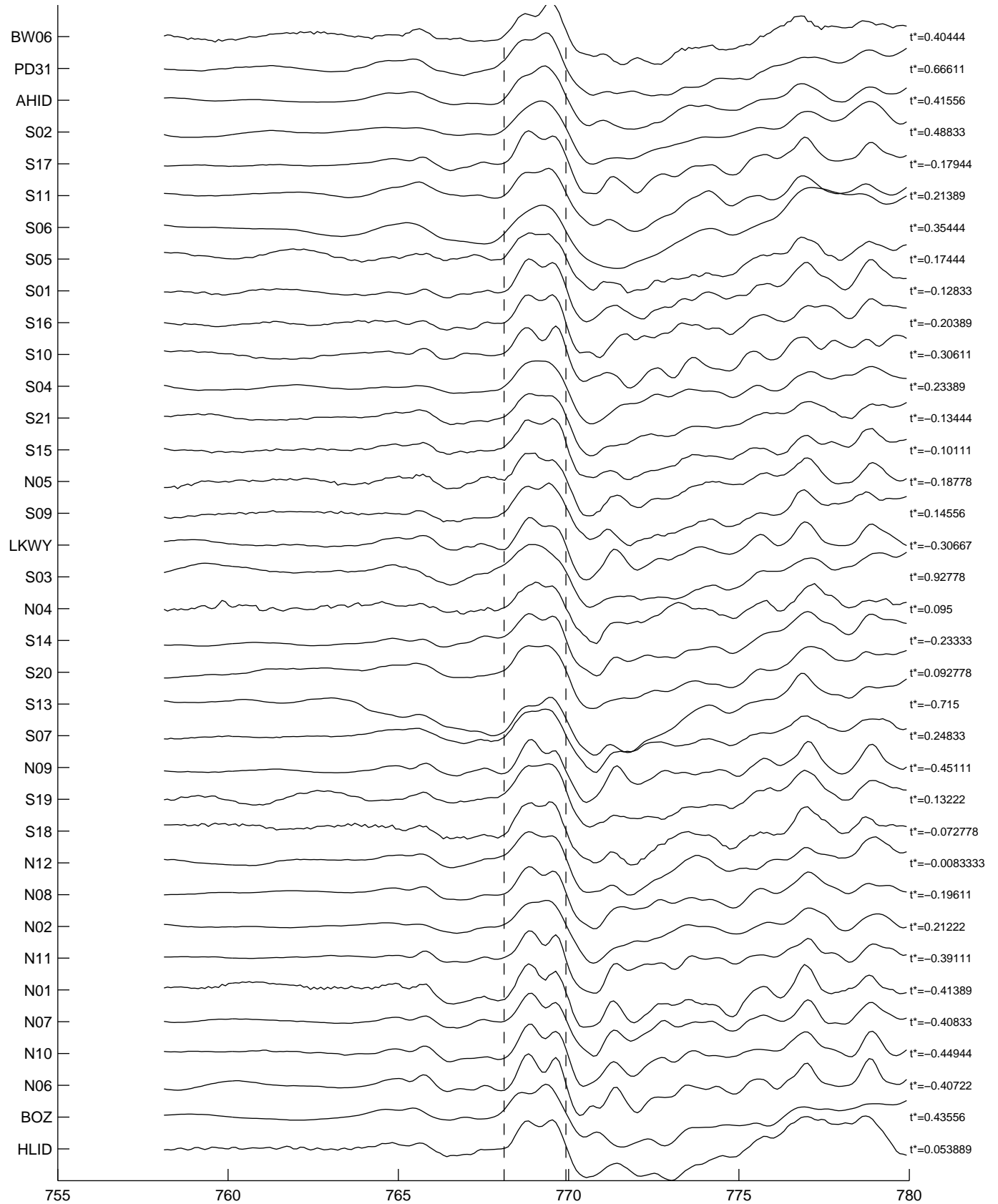




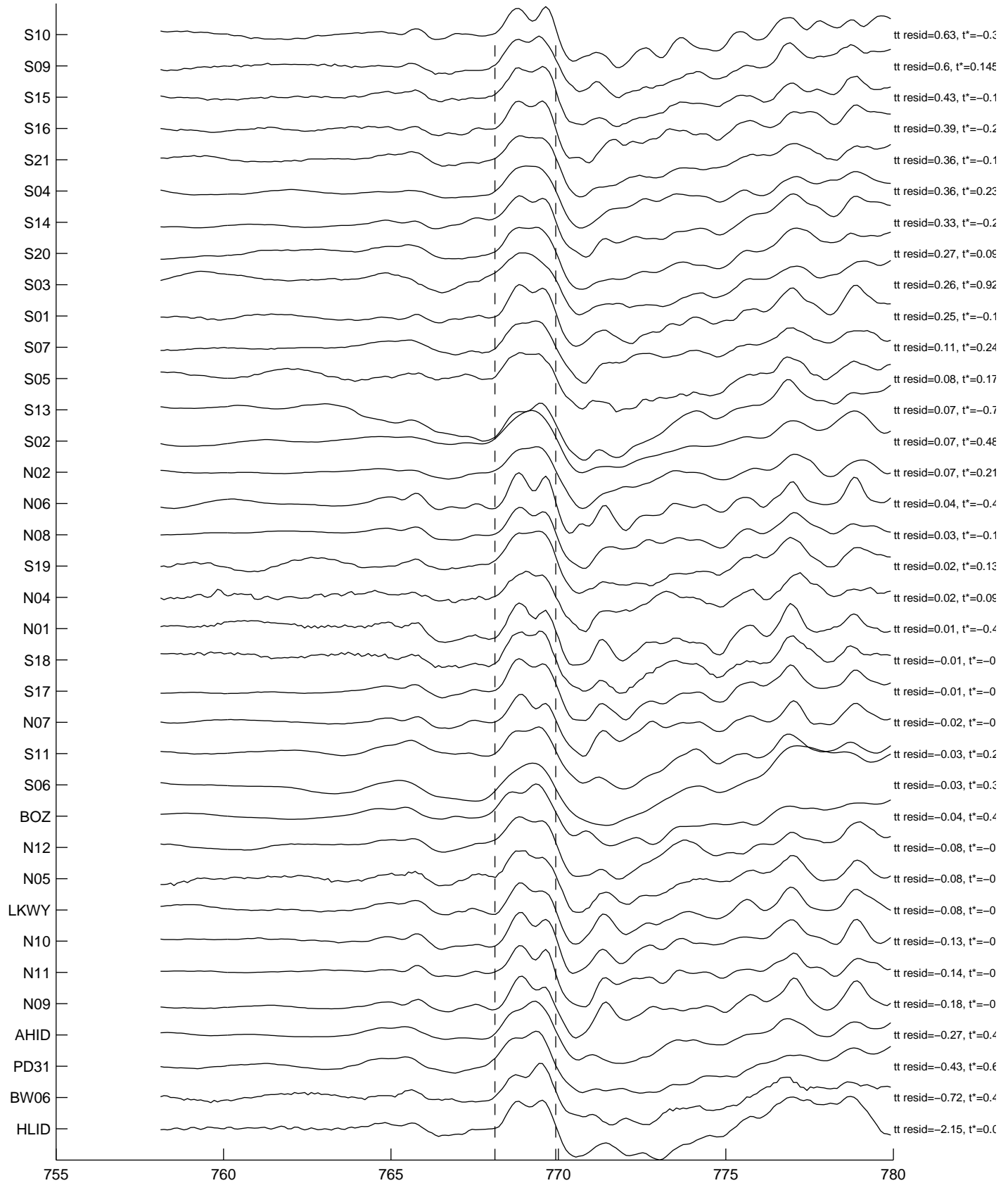
# Event\_2000\_158\_14\_57\_02



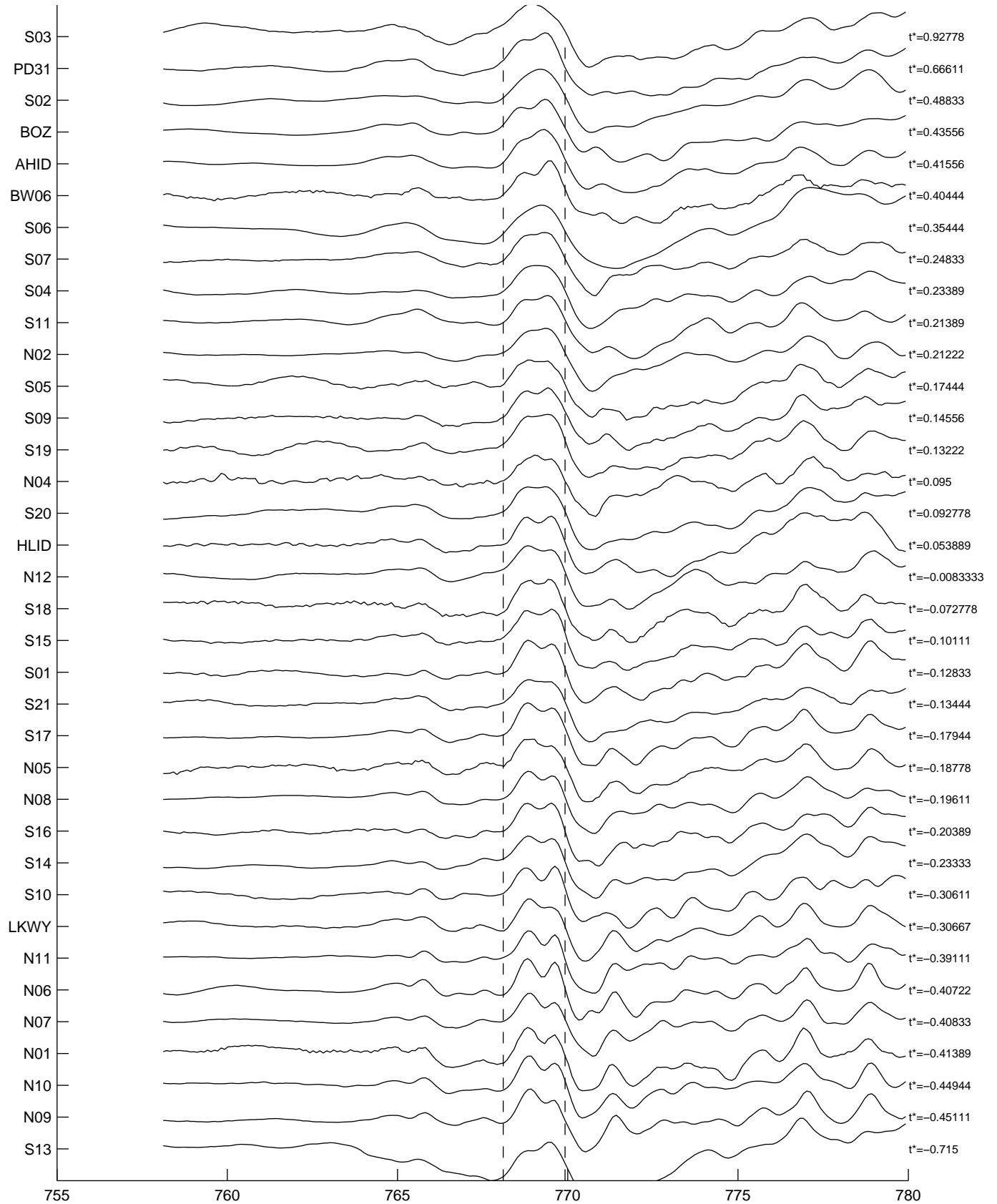
# Sorted by Delta:Event\_2000\_158\_14\_57\_02



# Sorted by travel time: Event\_2000\_158\_14\_57\_02

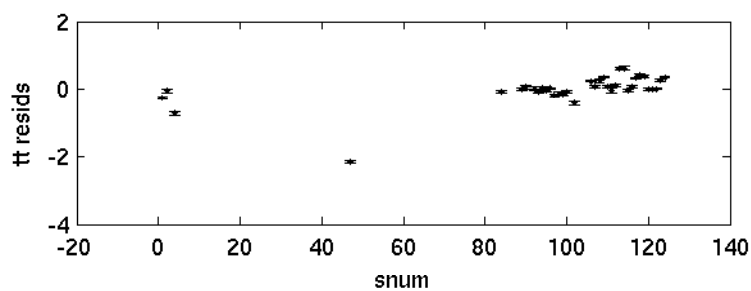
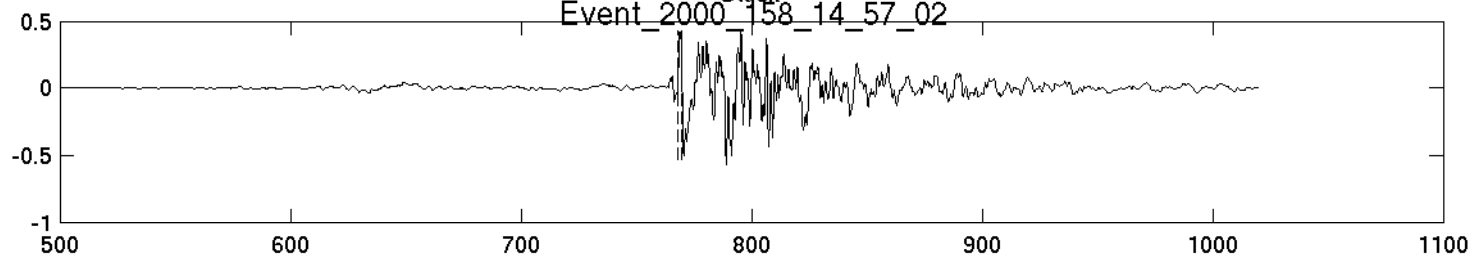


# Sorted by $t^*$ :Event\_2000\_158\_14\_57\_02

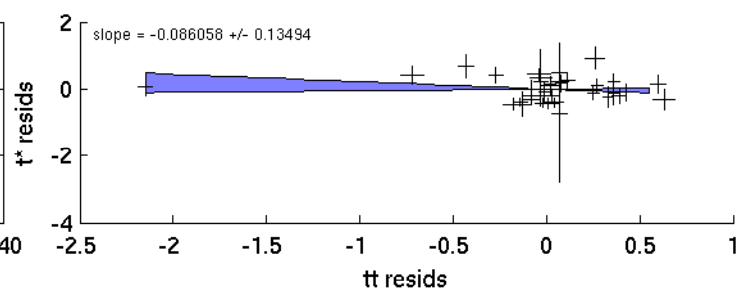
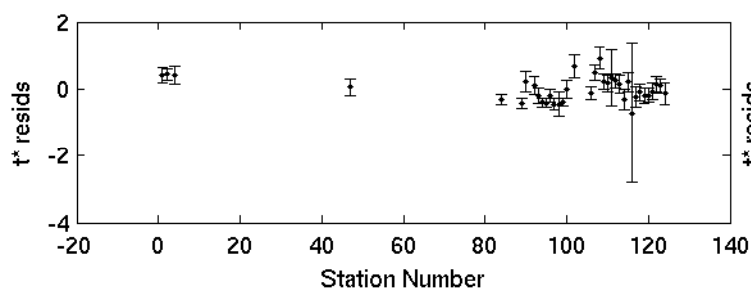


Event\_2000\_158\_14\_57\_02

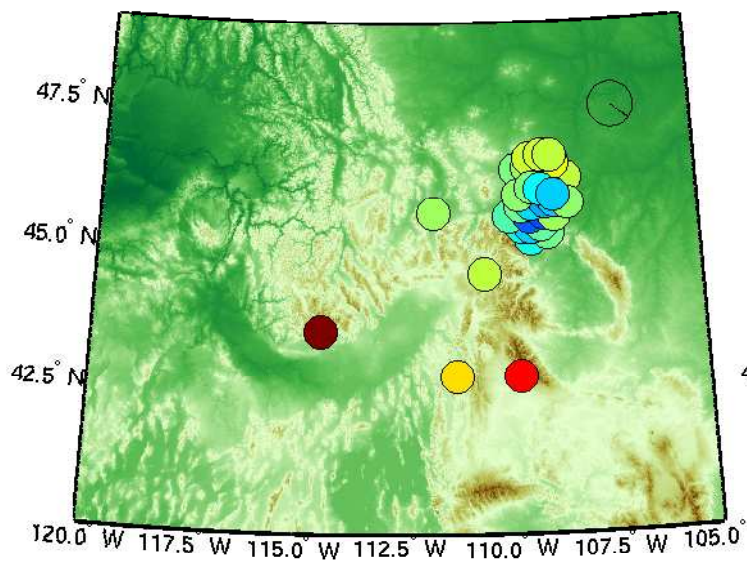
Stack



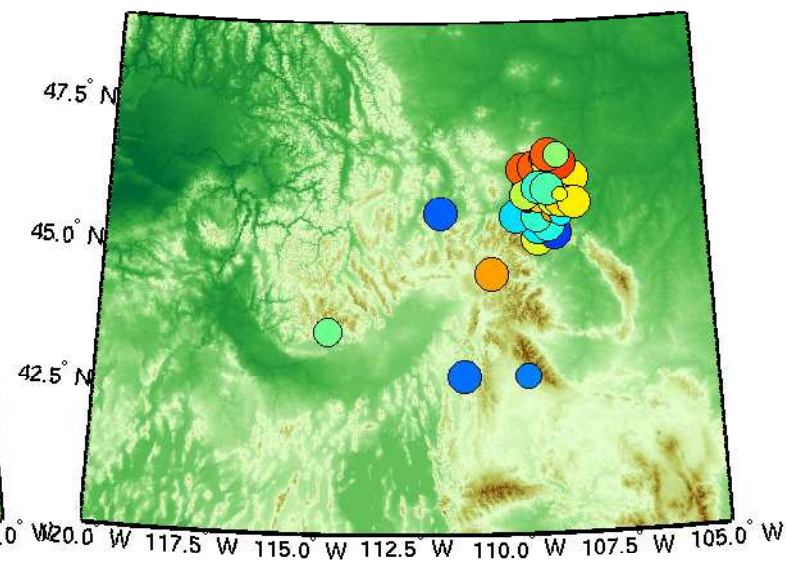
Baz = 310.4633  
Mean xcor value = 0.83083  
Range of  $t^*$  values is 1.6428  
Median  $t^*$  err is 0.23796  
Slope = -0.086058 +/- 0.13494



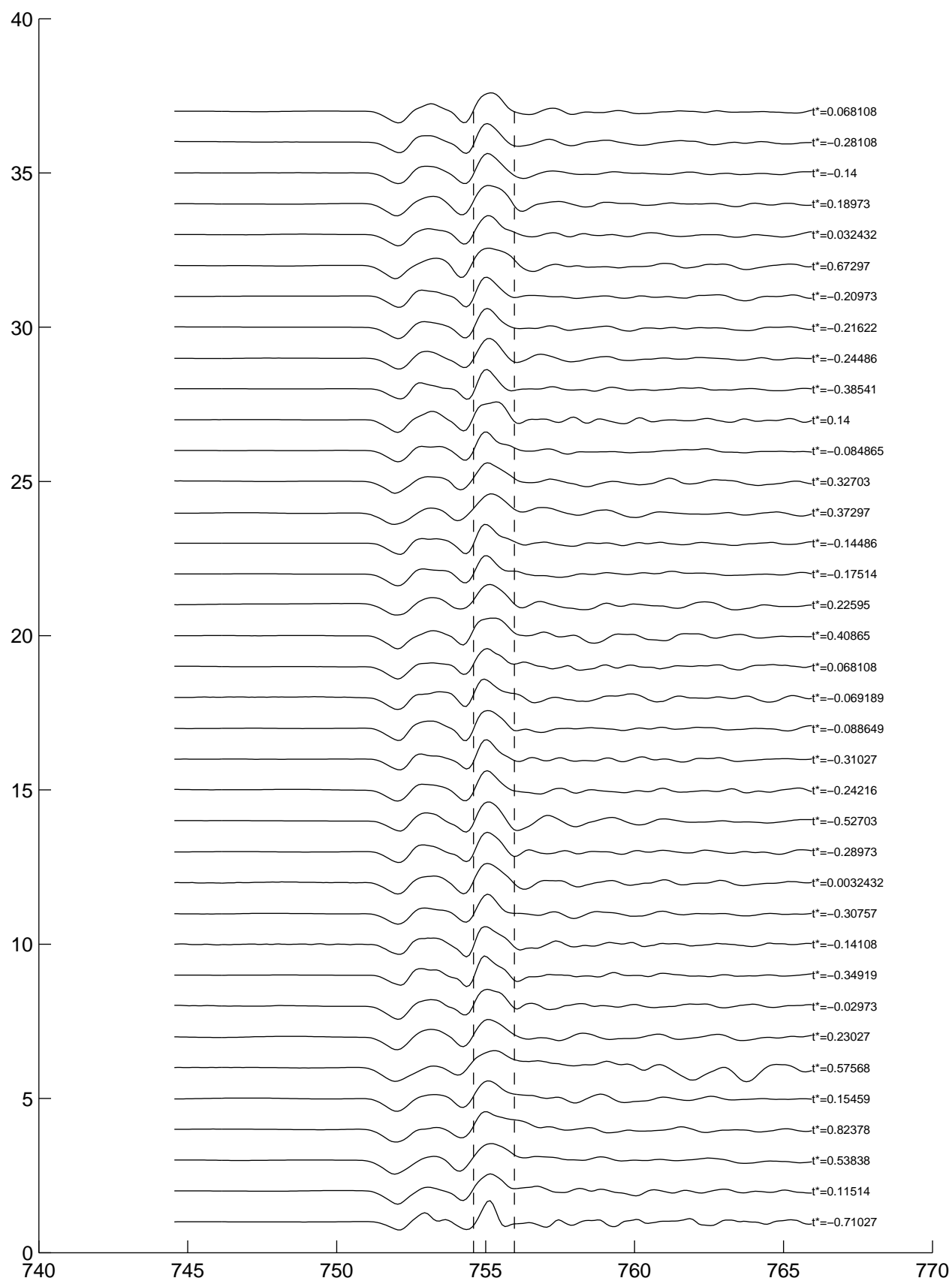
travel time residuals



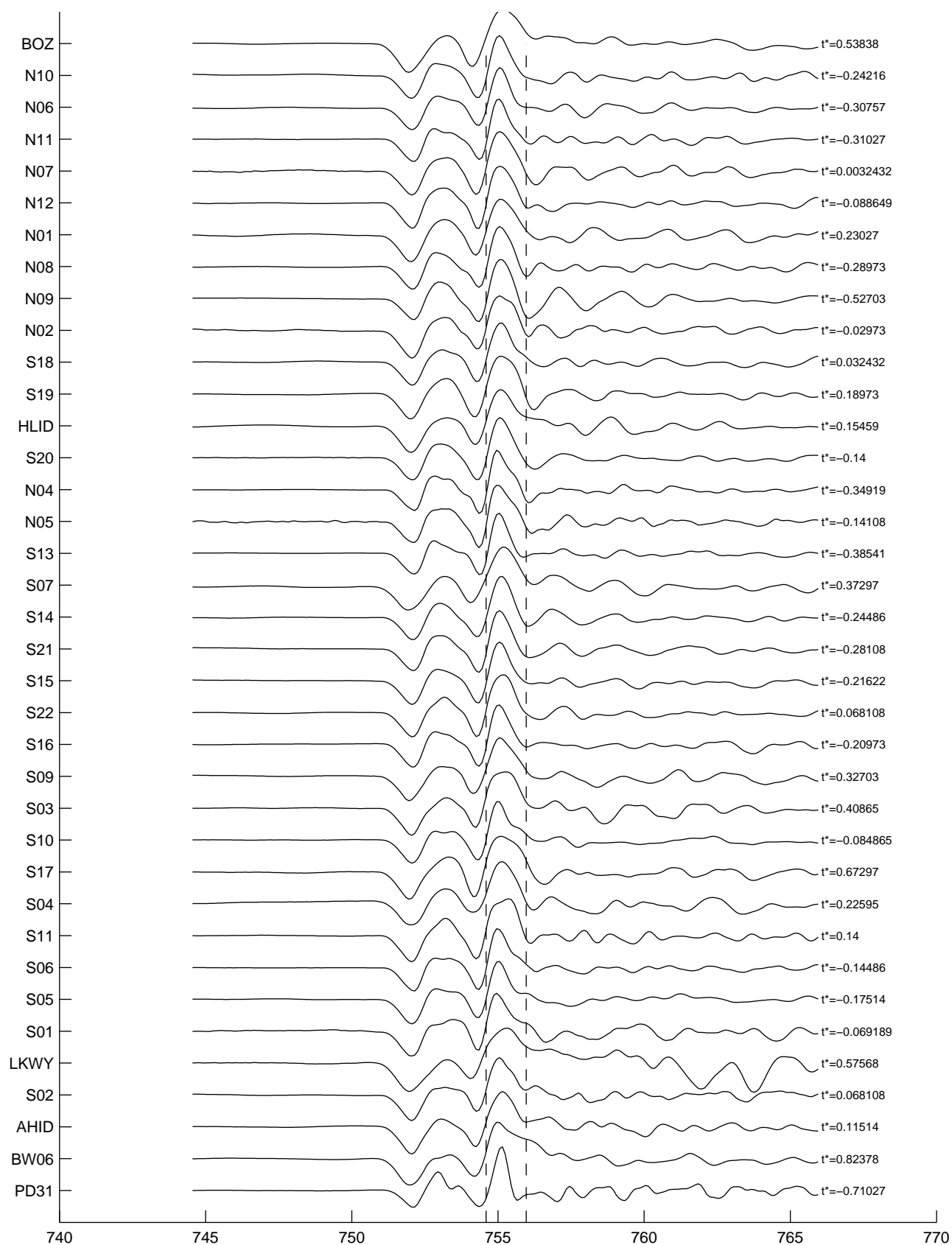
$t^*$  values



# Event\_2000\_168\_07\_55\_35

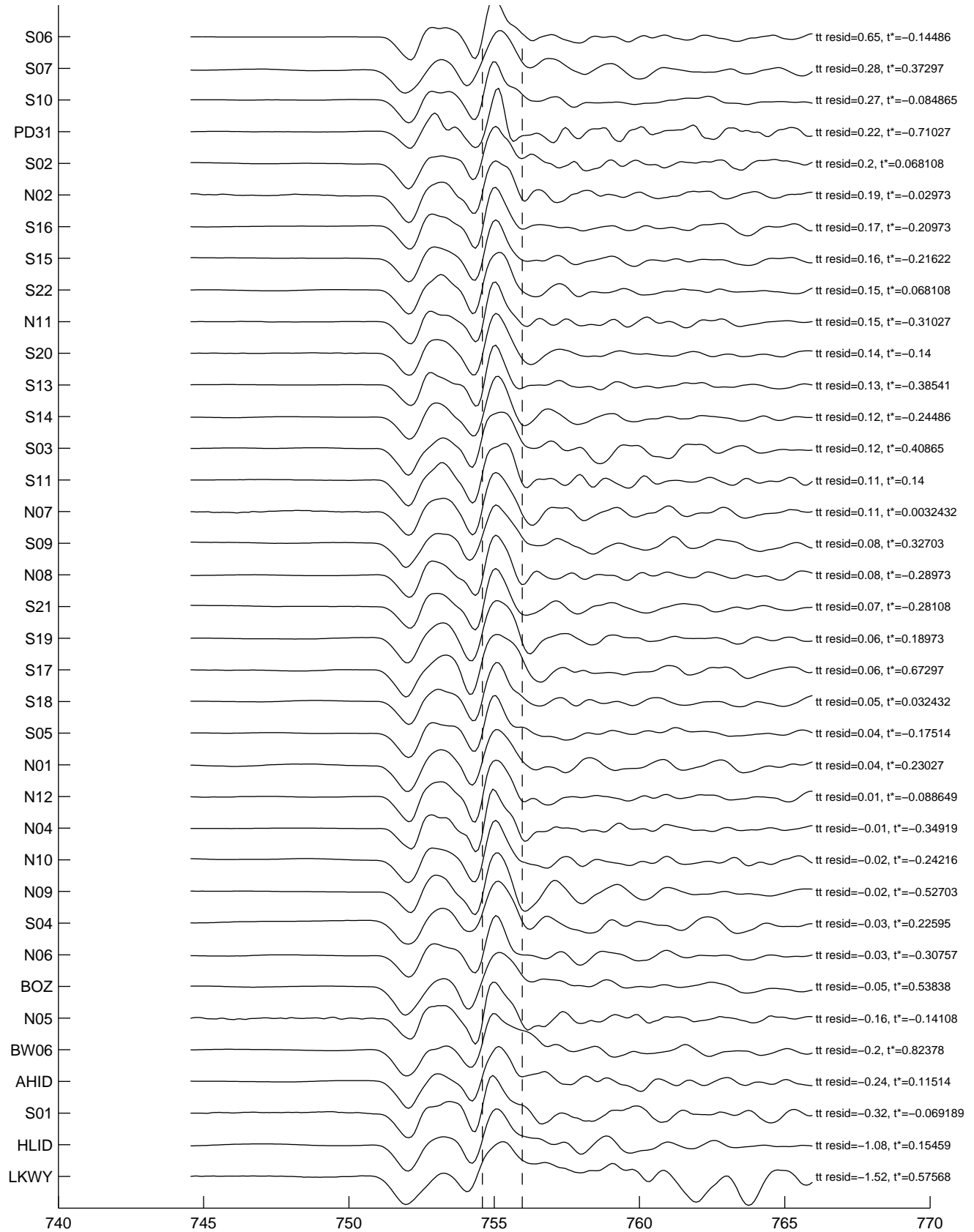


# Sorted by Delta:Event\_2000\_168\_07\_55\_35

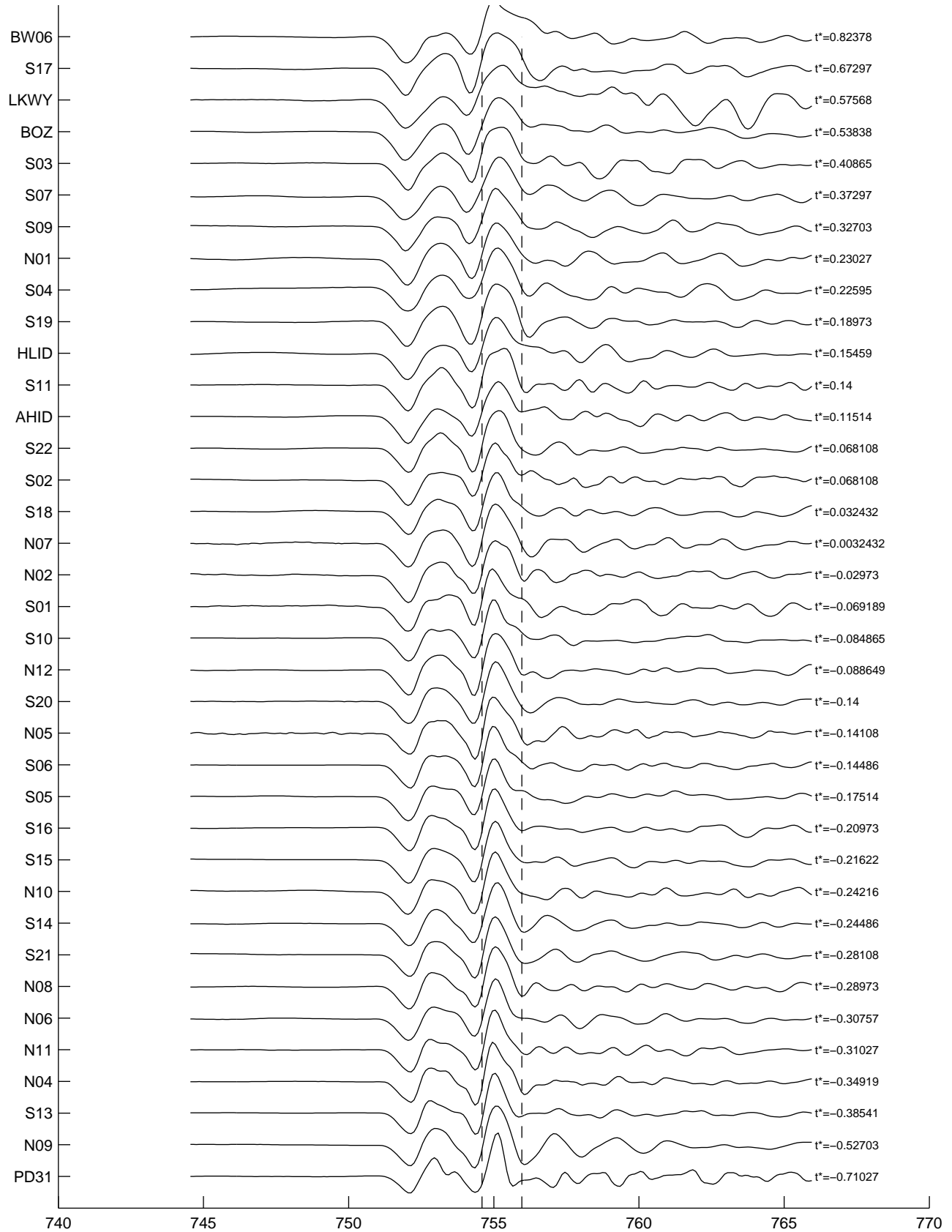




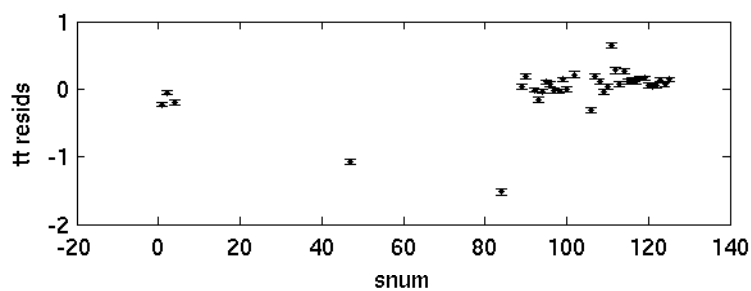
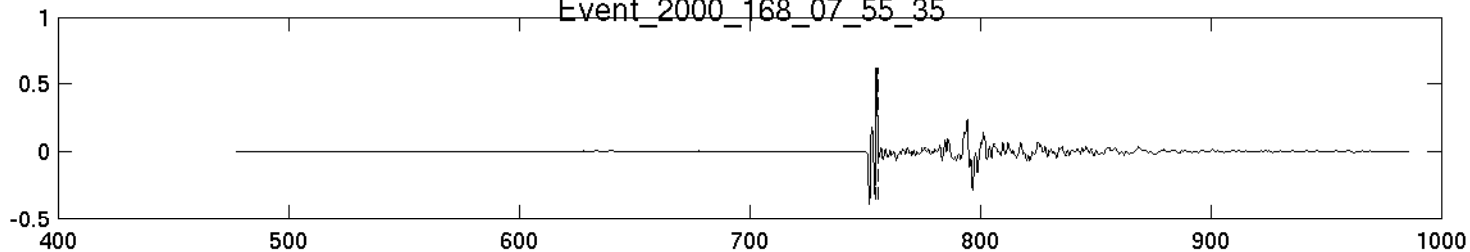
# Sorted by travel time: Event\_2000\_168\_07\_55\_35



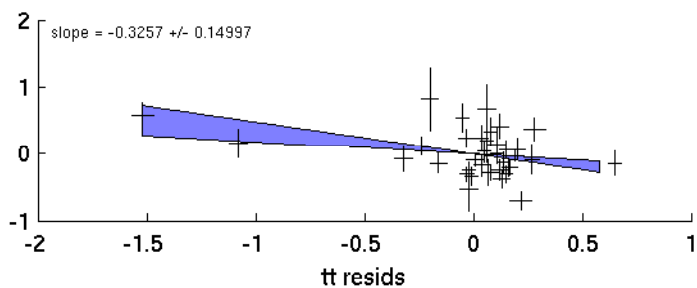
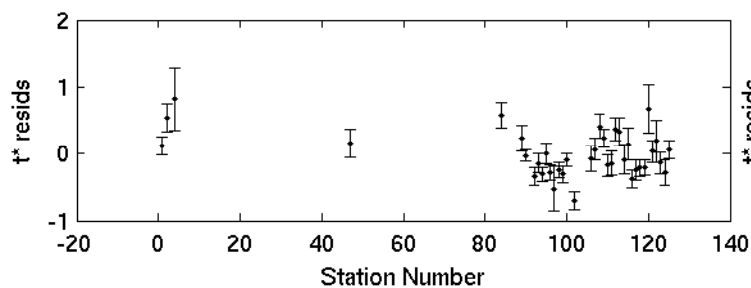
# Sorted by t\*:Event\_2000\_168\_07\_55\_35



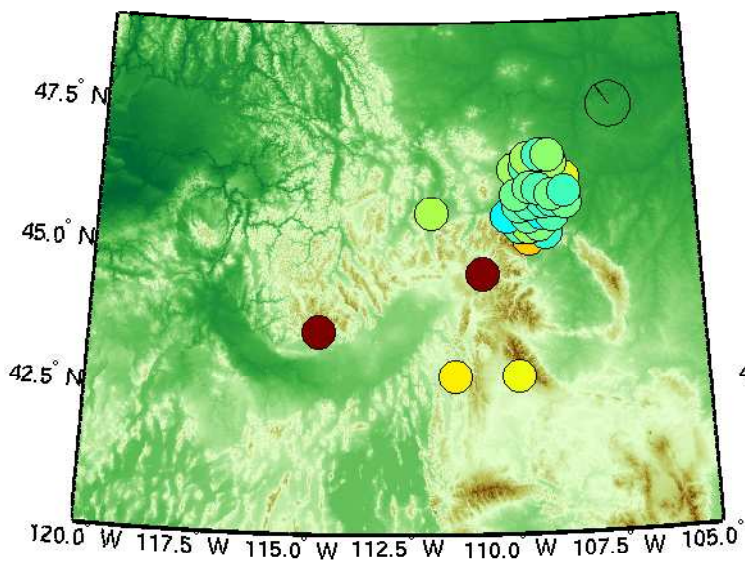
# Stack Event\_2000\_168\_07\_55\_35



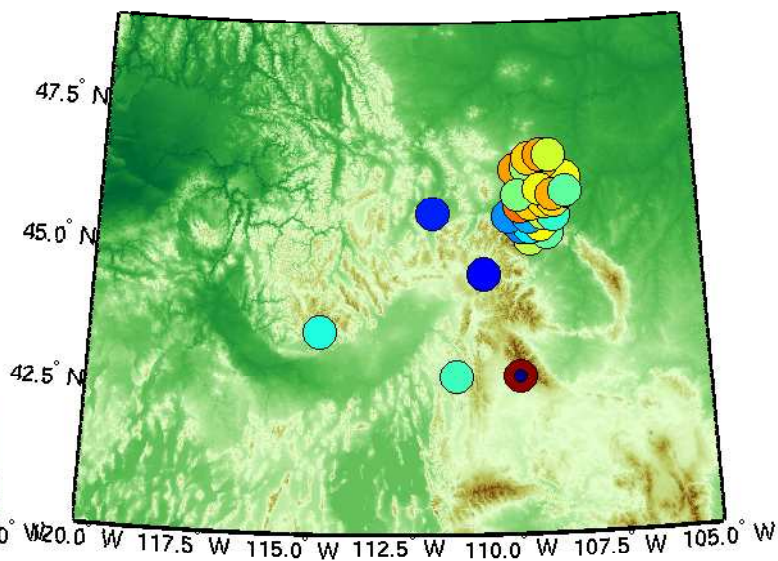
Baz = 148.2873  
Mean xcor value = 0.84757  
Range of t\* values is 1.5341  
Median t\* err is 0.15815  
Slope = -0.3257 +/- 0.14997



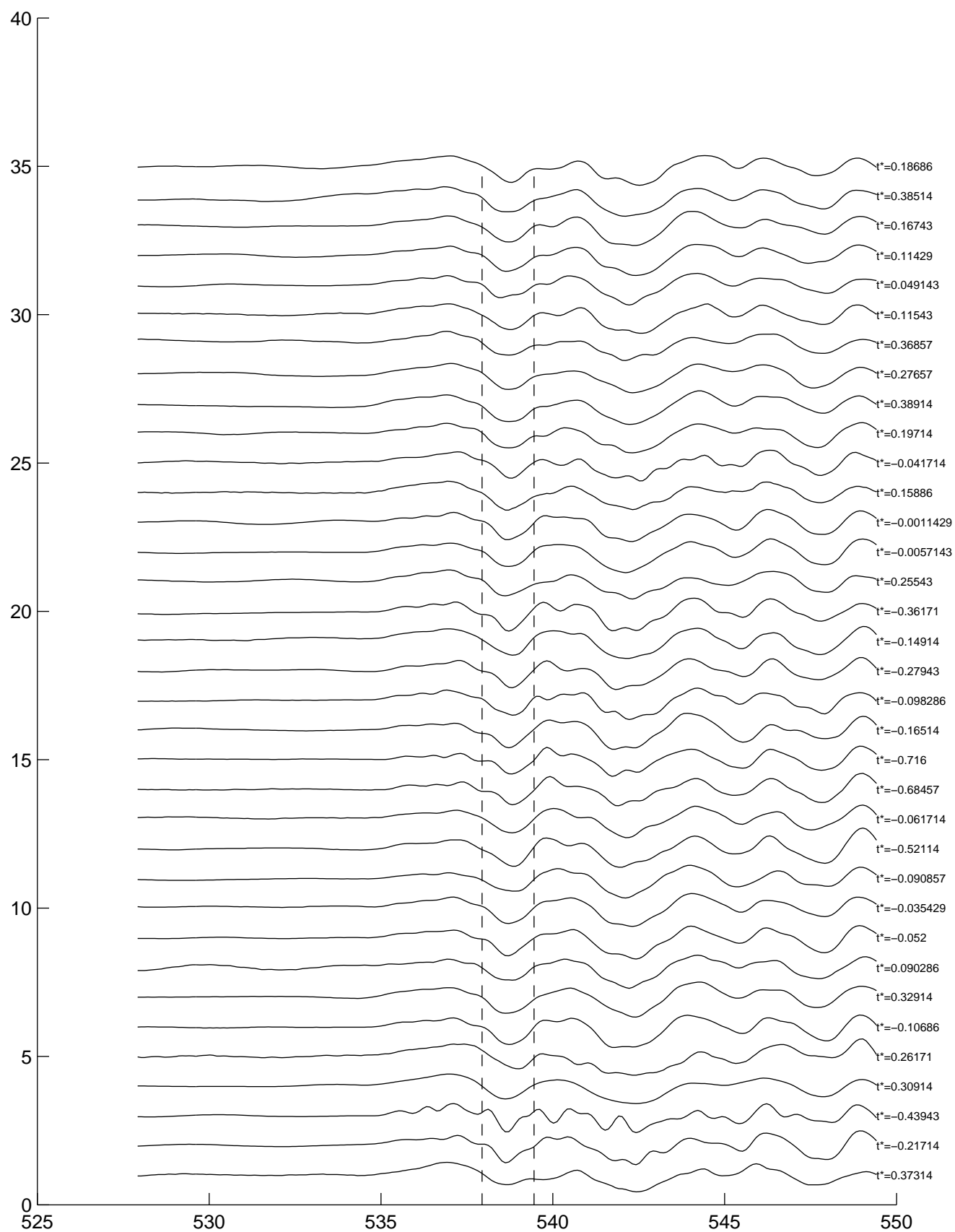
travel time residuals



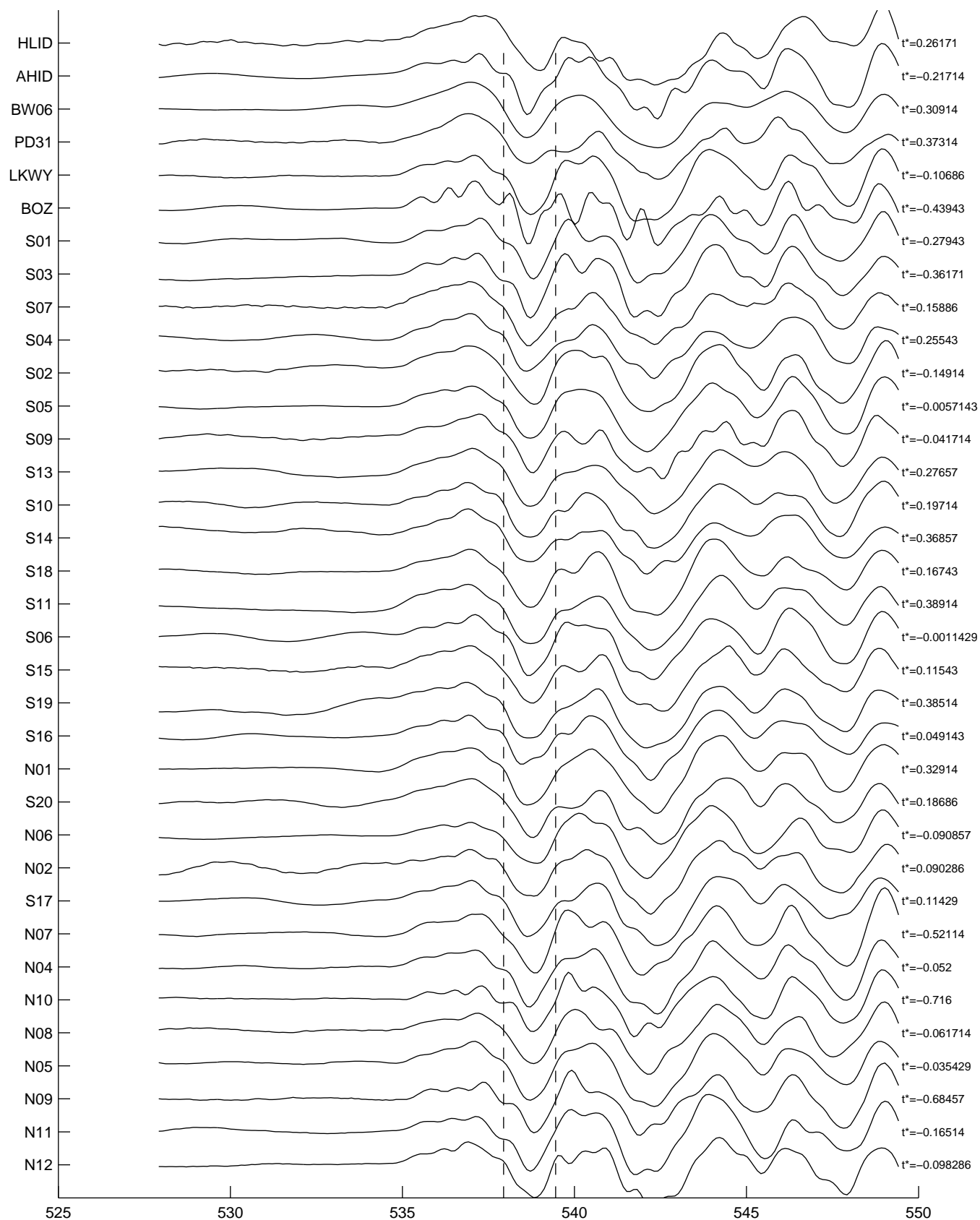
t\* values



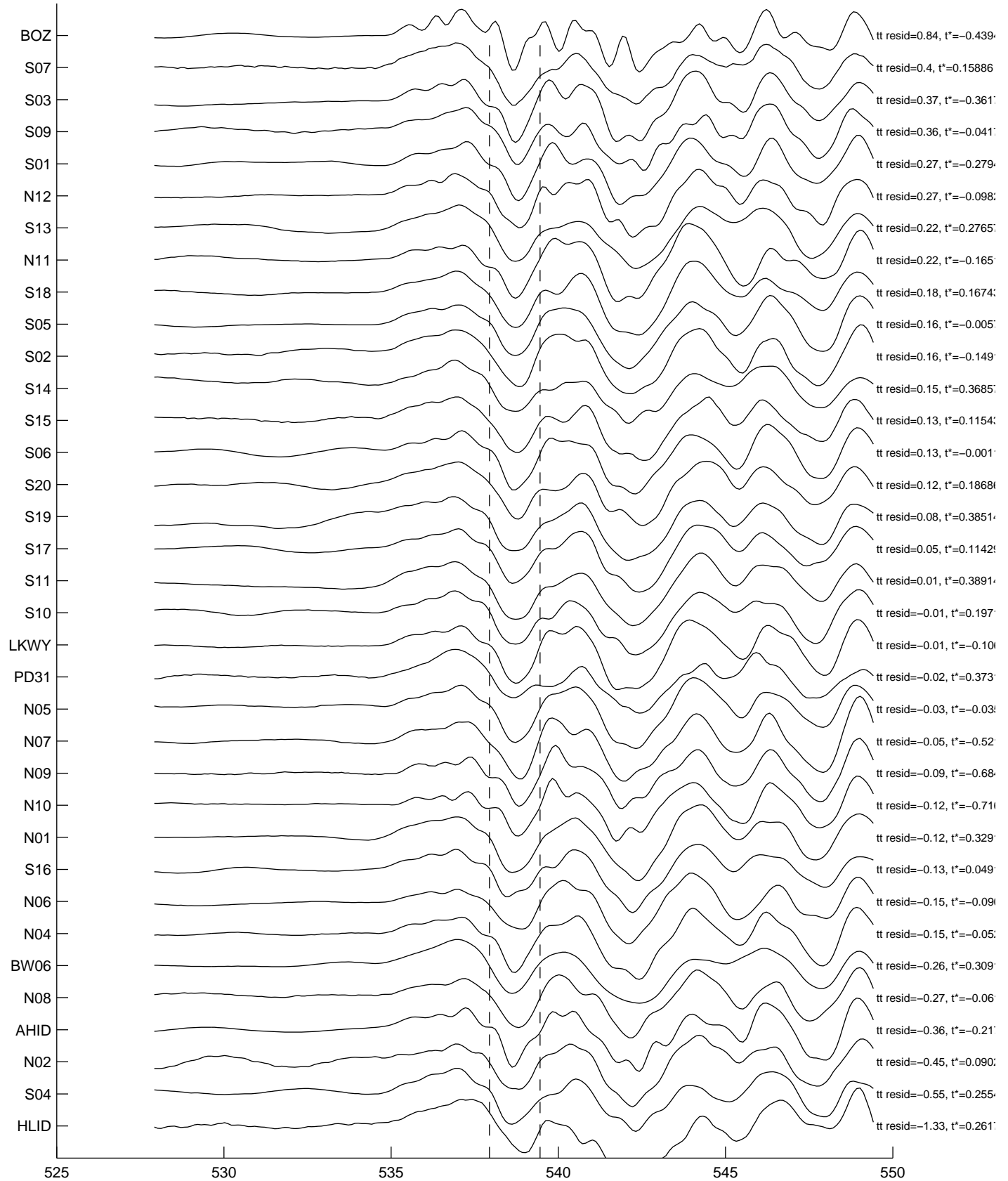
# Event\_2000\_169\_15\_40\_41



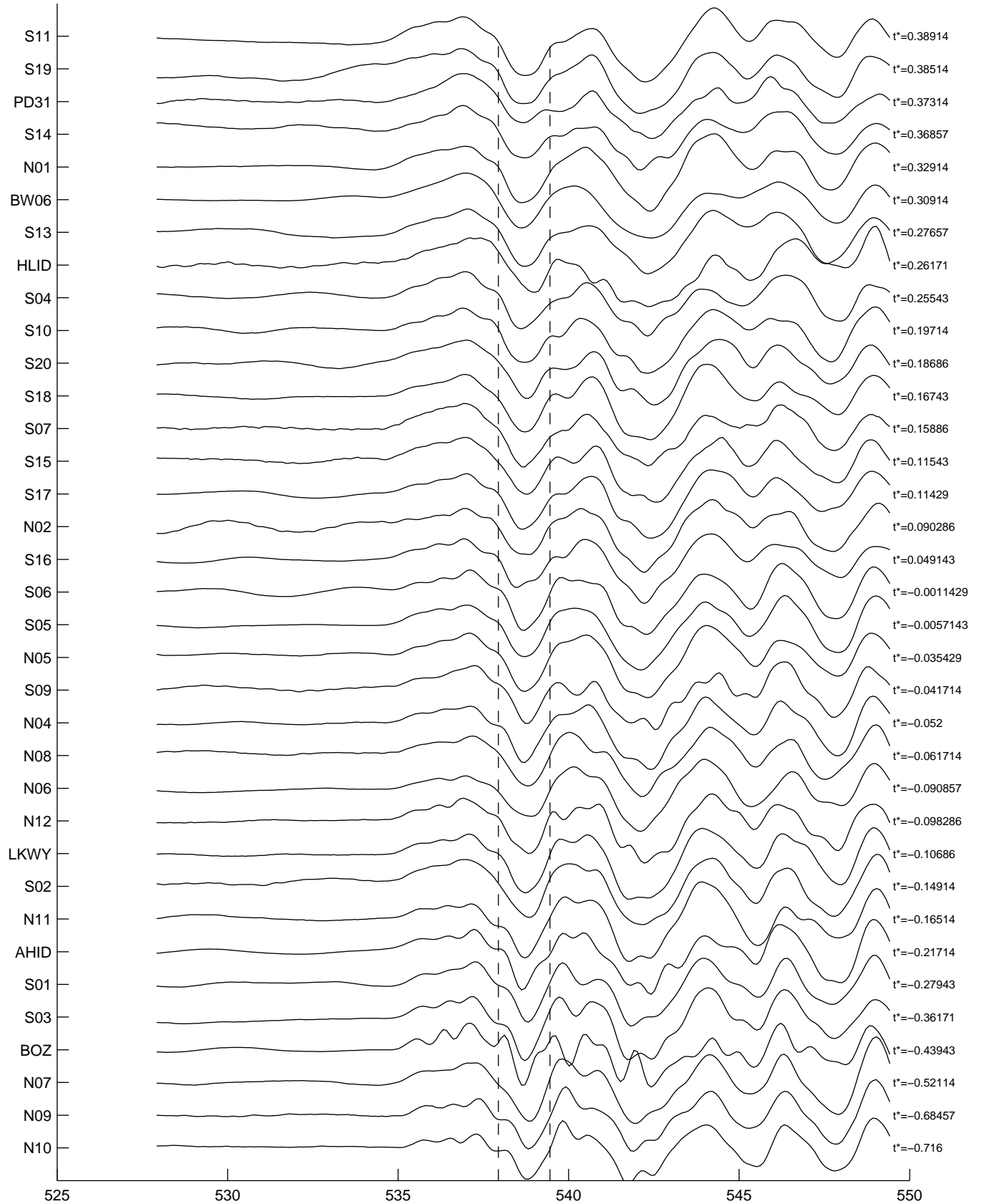
# Sorted by Delta:Event\_2000\_169\_15\_40\_41



# Sorted by travel time: Event\_2000\_169\_15\_40\_41

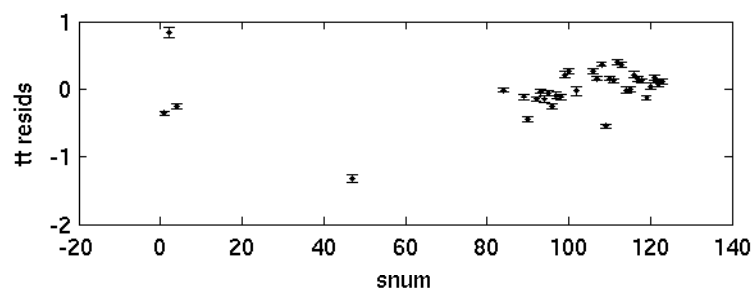
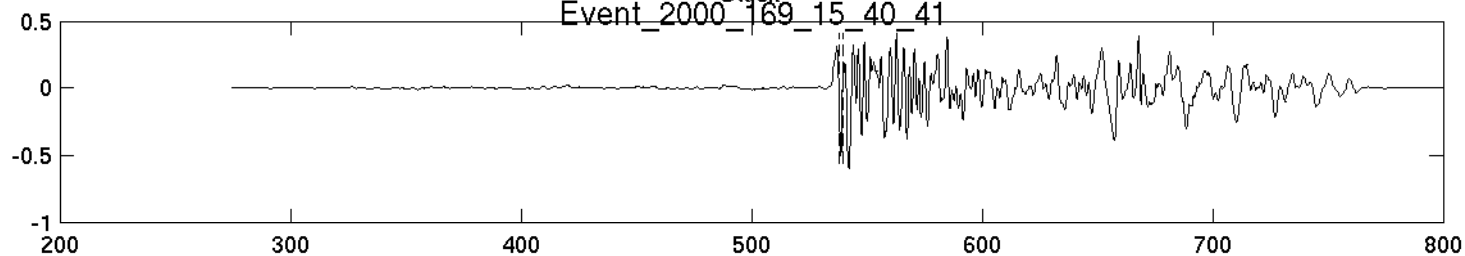


Sorted by  $t^*$ :Event\_2000\_169\_15\_40\_41

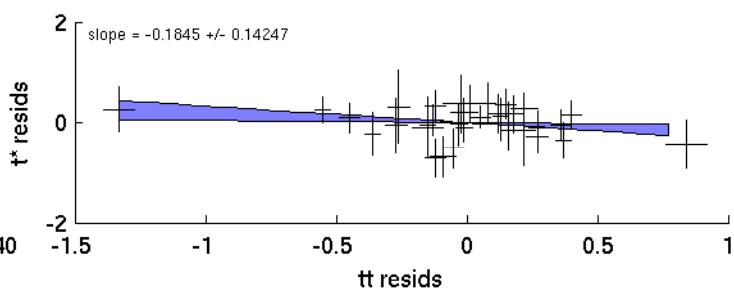
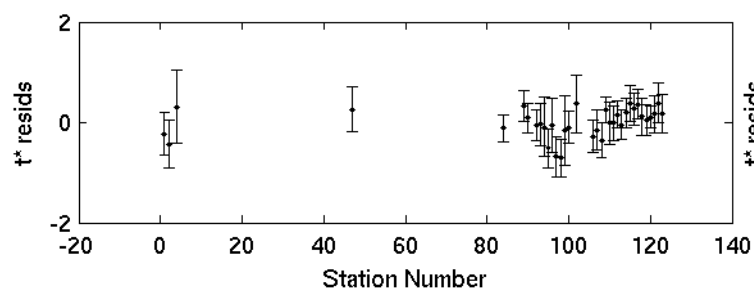




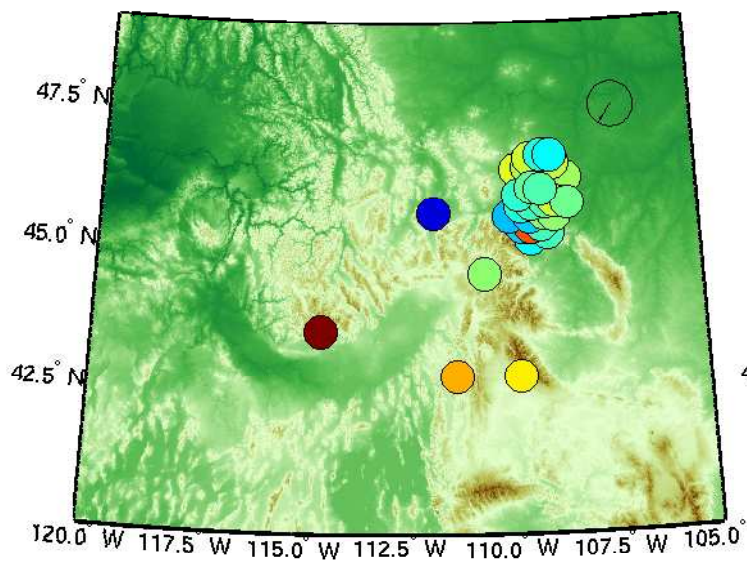
Stack  
Event\_2000\_169\_15\_40\_41



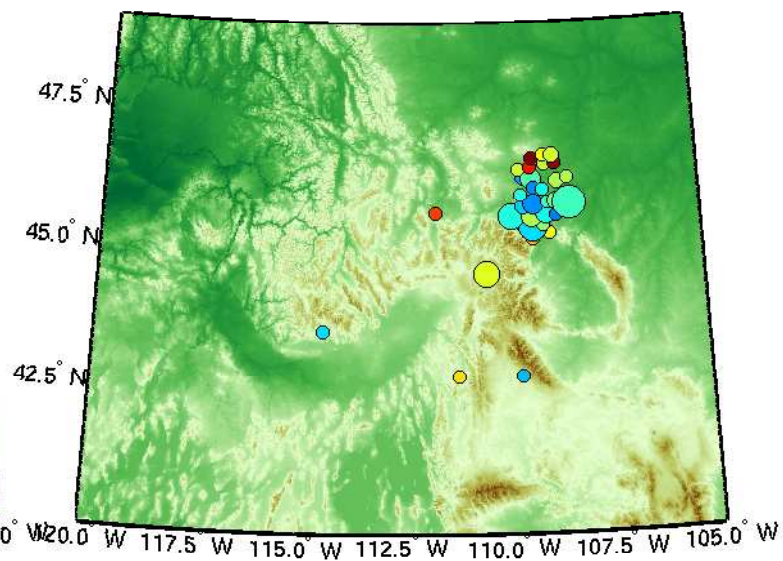
Baz = 35.1956  
Mean xcor value = 0.81457  
Range of  $t^*$  values is 1.1051  
Median  $t^*$  err is 0.36315  
Slope =  $-0.1845 \pm 0.14247$



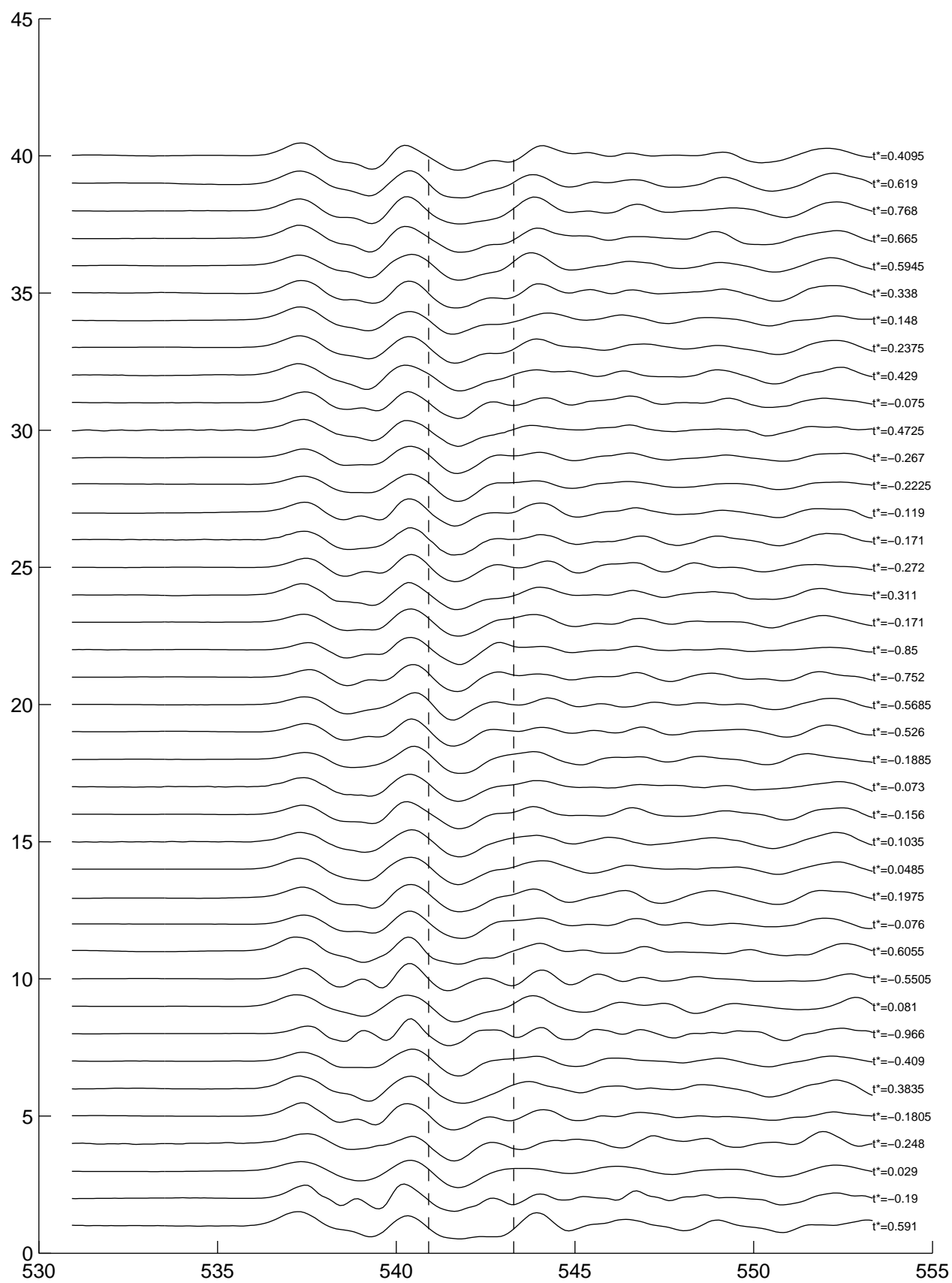
travel time residuals



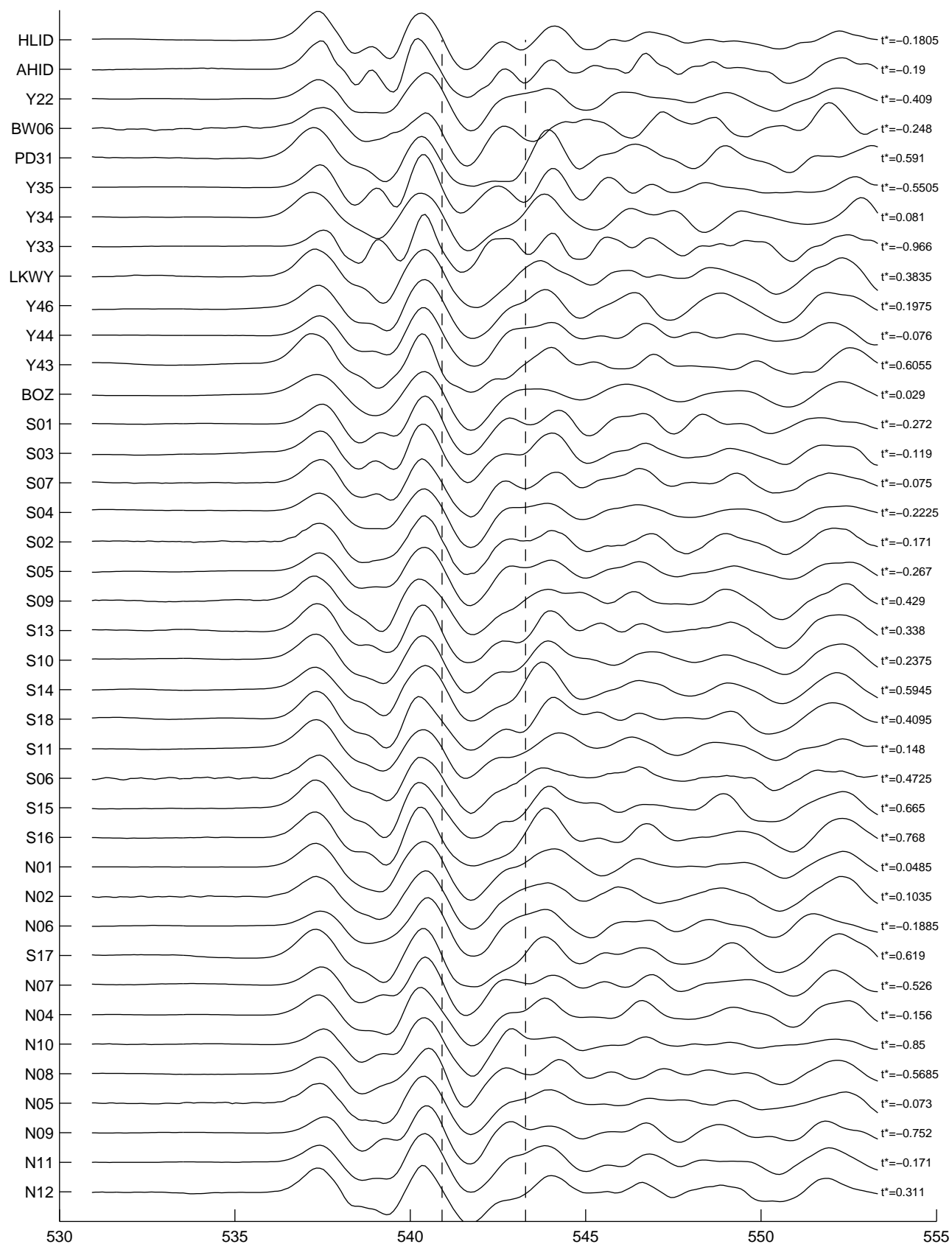
$t^*$  values



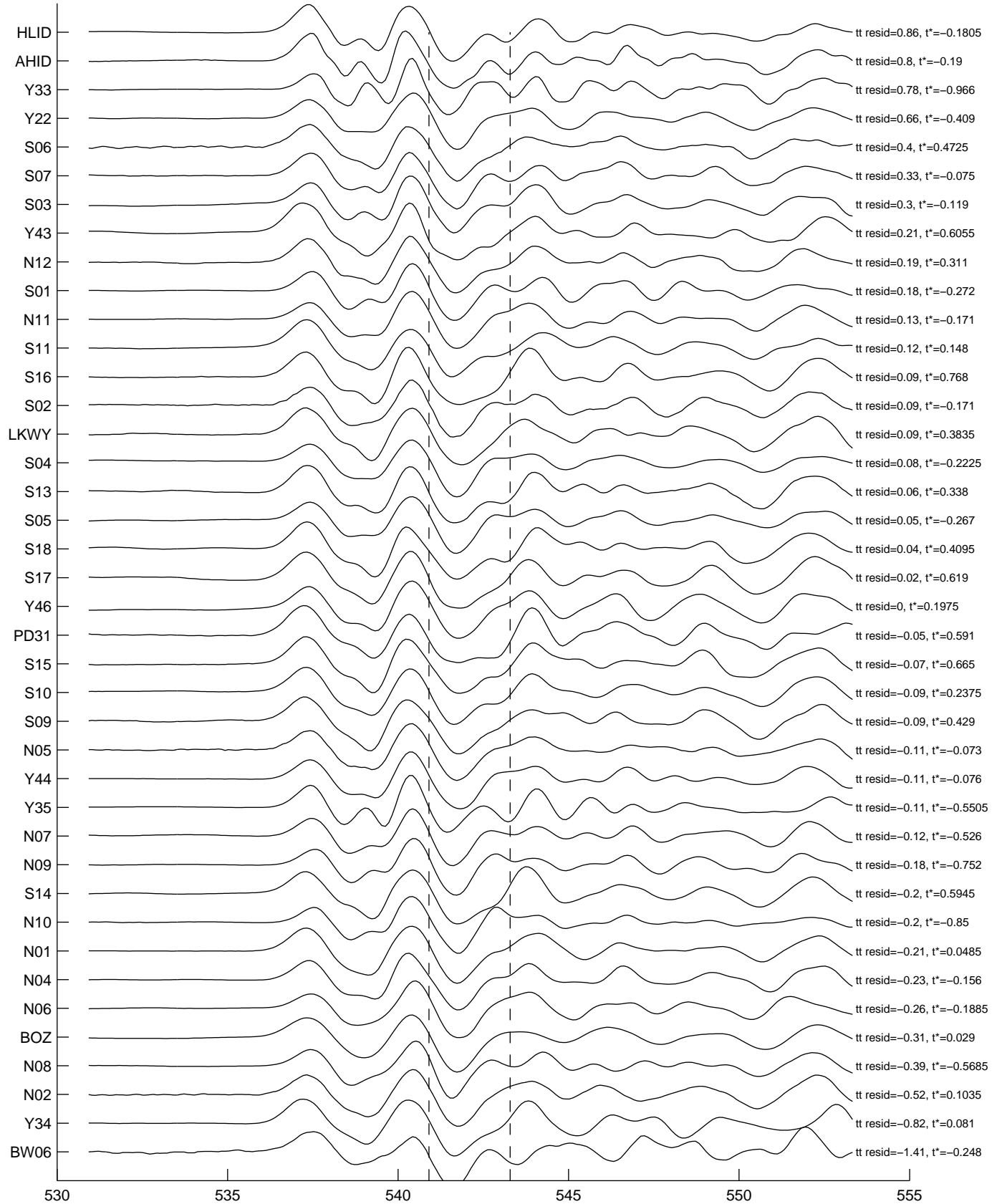
# Event\_2000\_173\_00\_51\_46



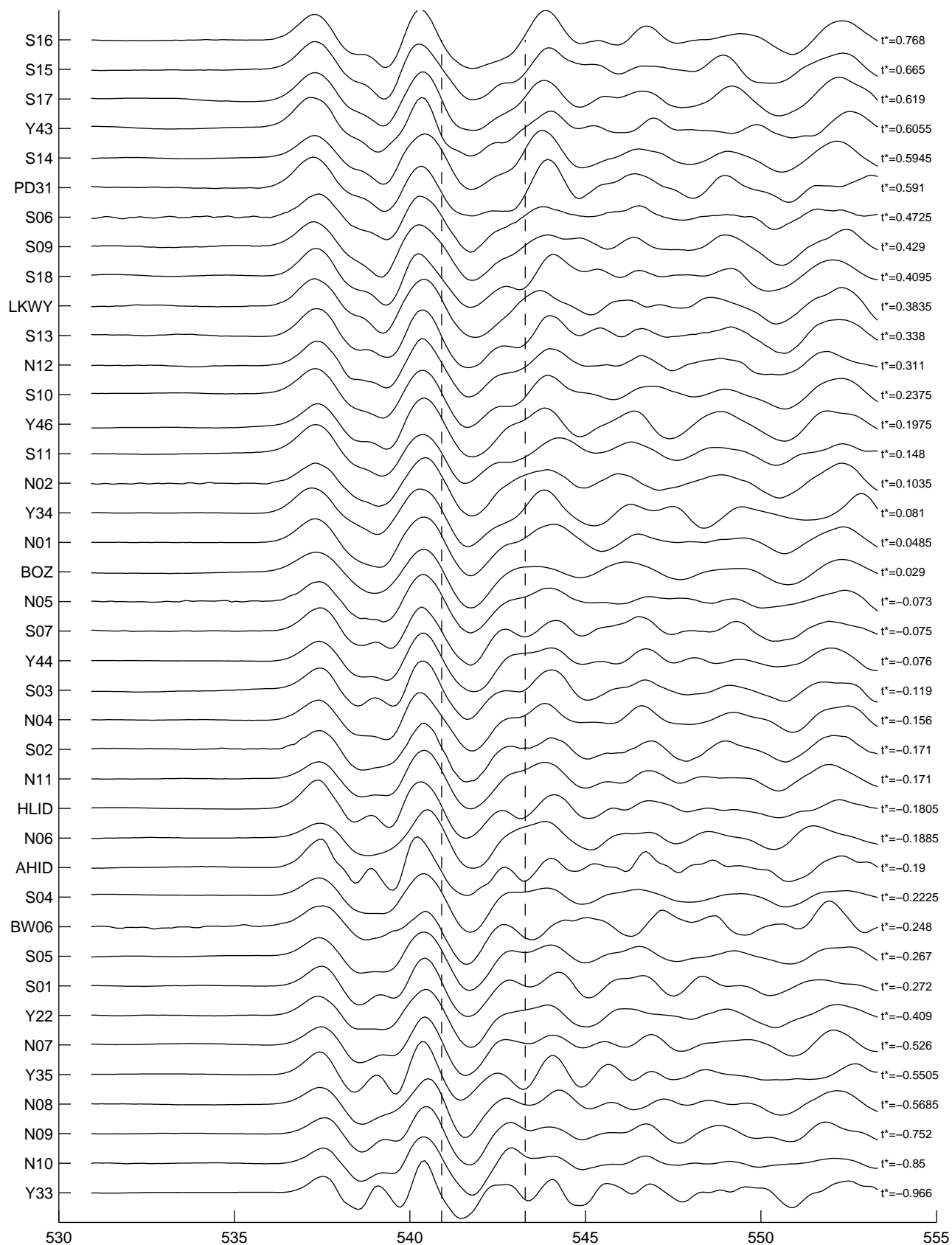
# Sorted by Delta:Event\_2000\_173\_00\_51\_46



# Sorted by travel time:Event\_2000\_173\_00\_51\_46

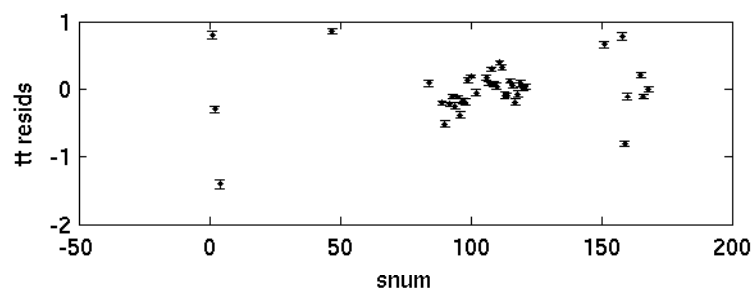
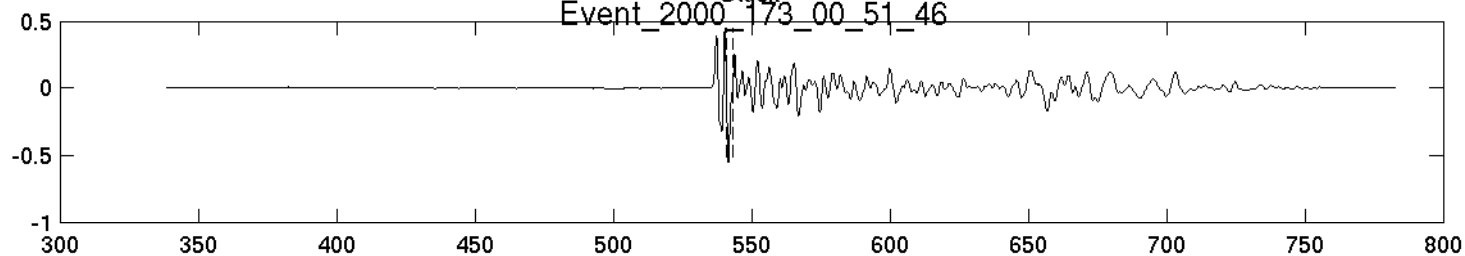


# Sorted by $t^*$ :Event\_2000\_173\_00\_51\_46

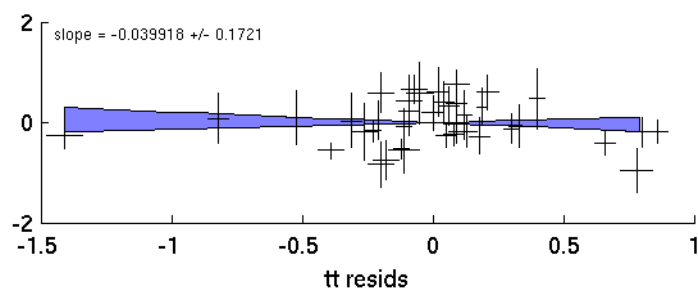
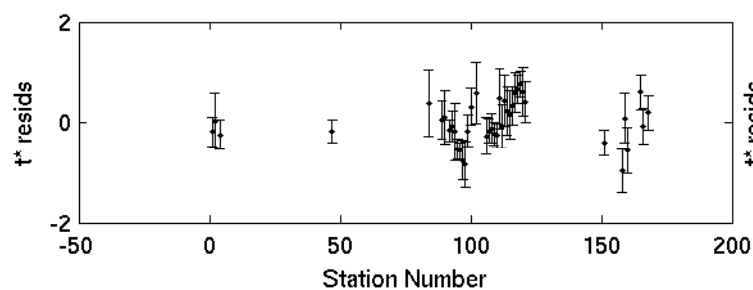


Event\_2000\_173\_00\_51\_46

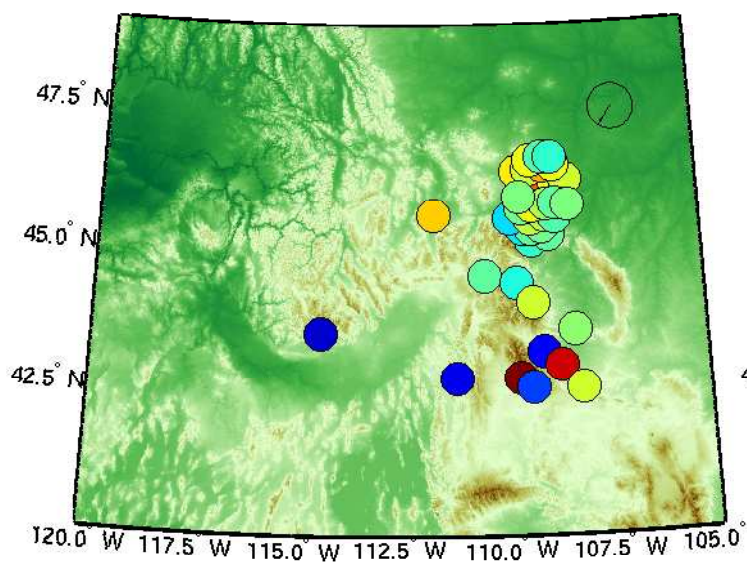
Stack



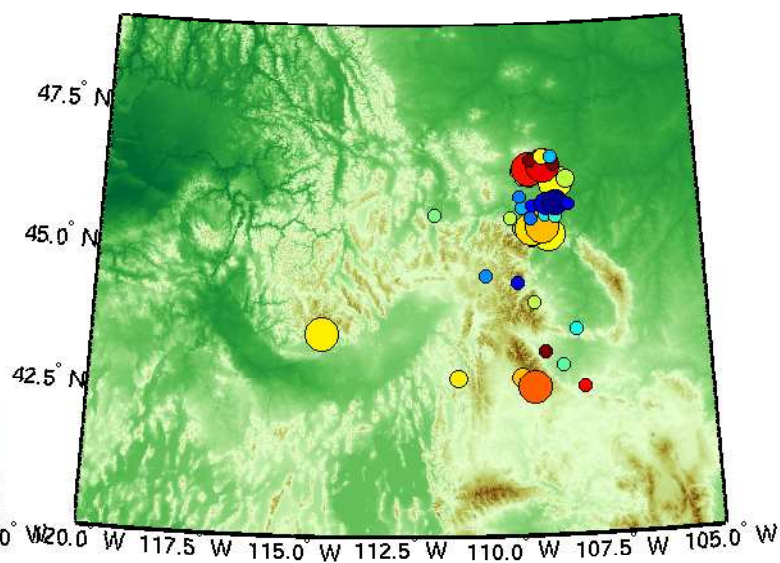
Baz = 35.0874  
Mean xcor value = 0.78725  
Range of  $t^*$  values is 1.734  
Median  $t^*$  err is 0.37814  
Slope =  $-0.039918 \pm 0.1721$



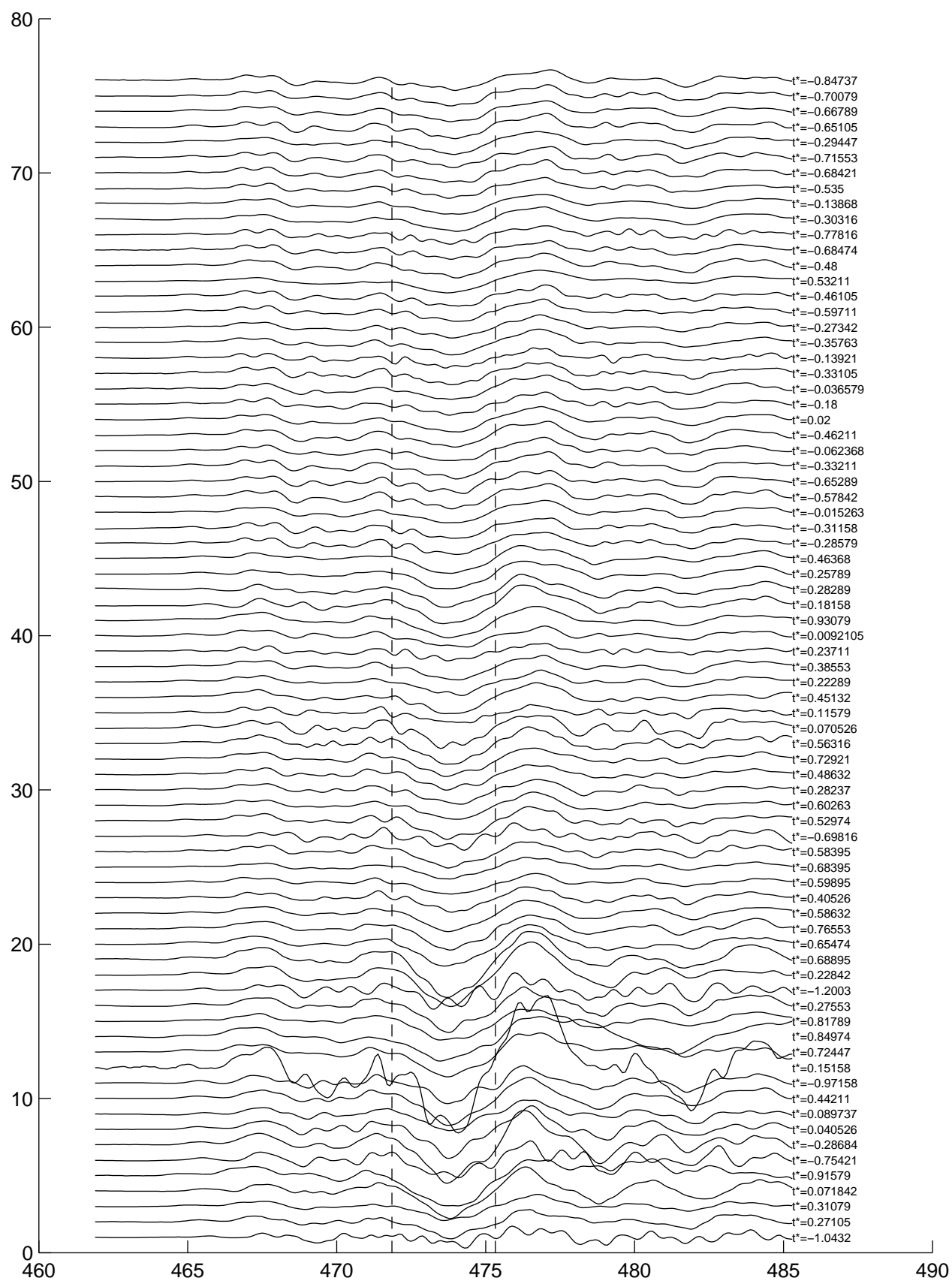
travel time residuals



$t^*$  values

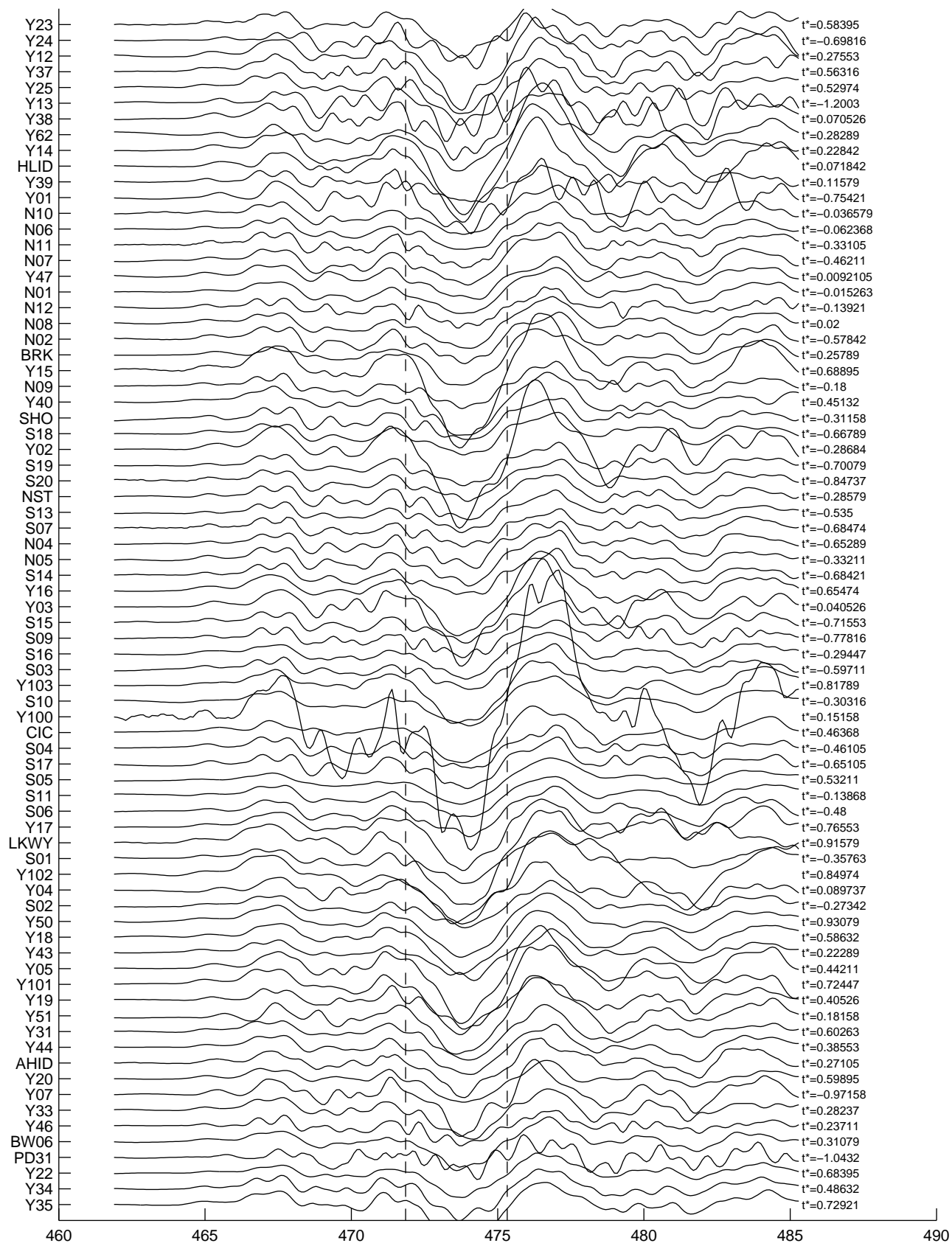


# Event\_2000\_203\_01\_53\_35

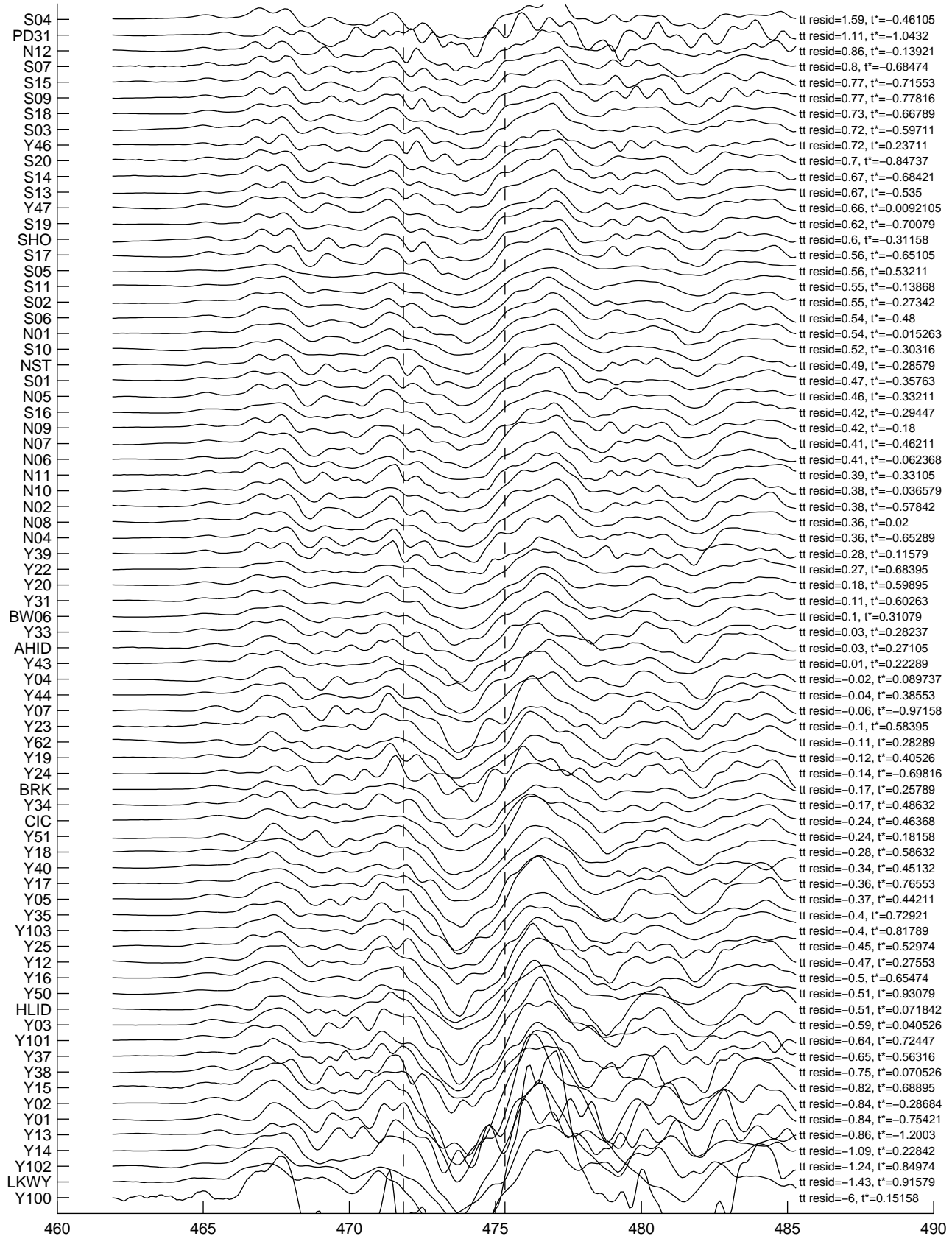




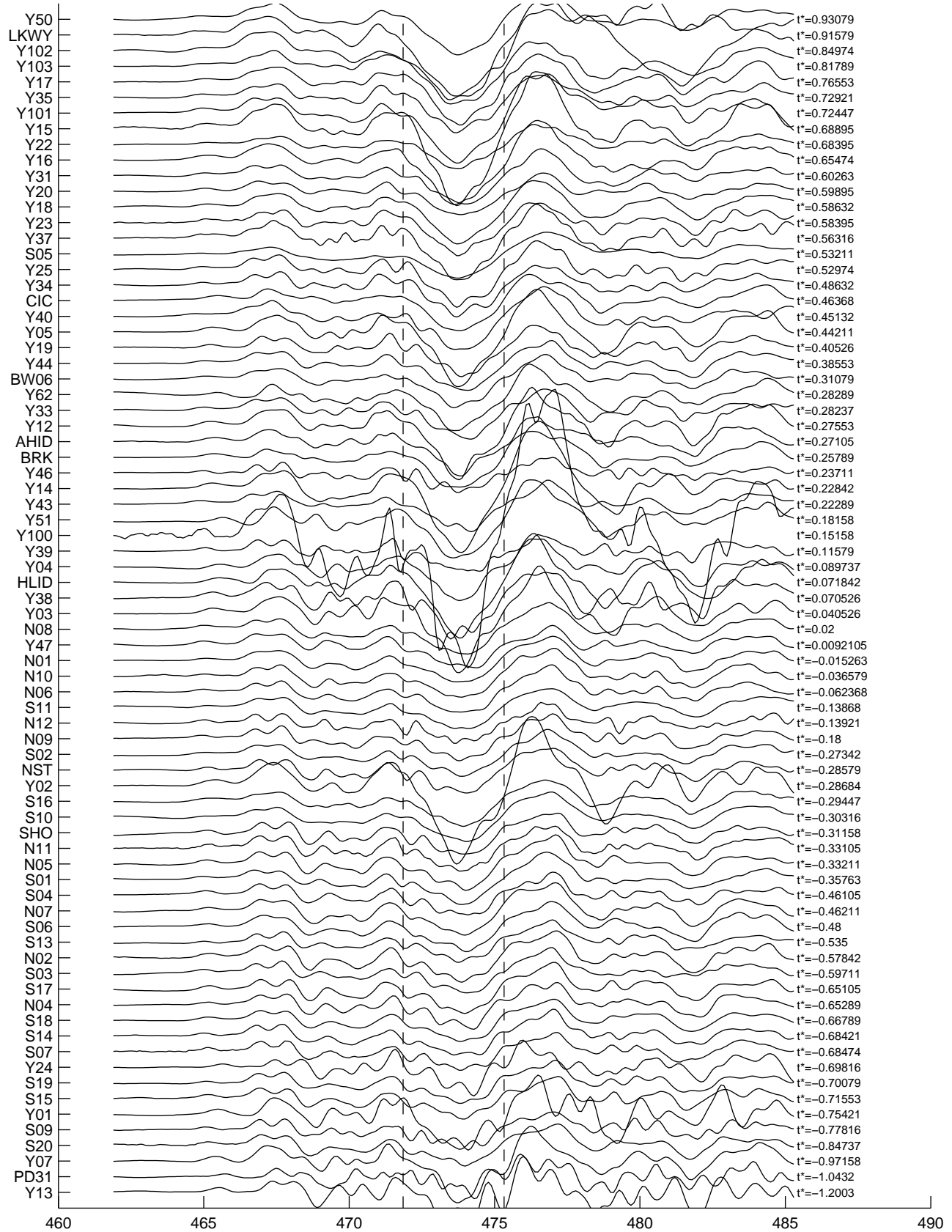
# Sorted by Delta:Event\_2000\_203\_01\_53\_35

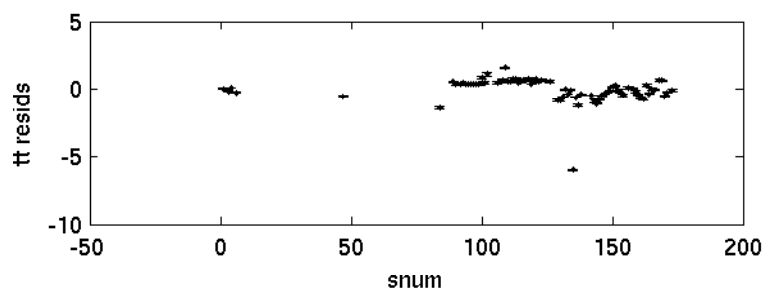
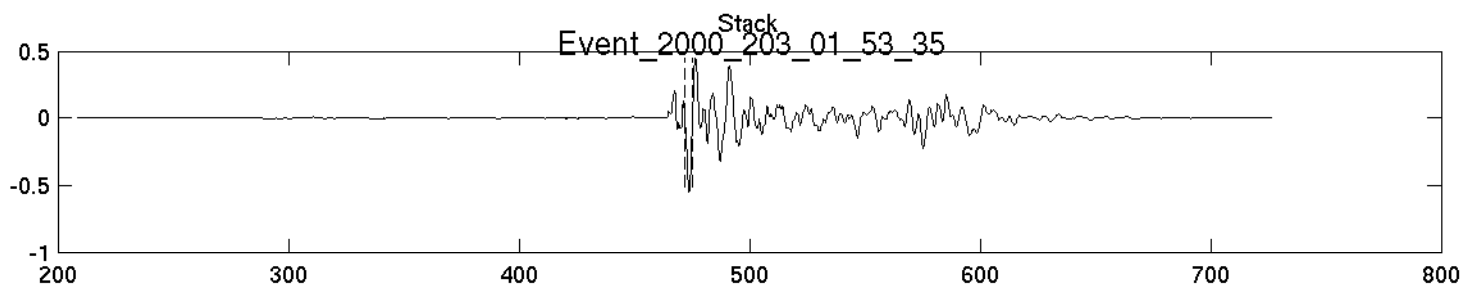


# Sorted by travel time:Event\_2000\_203\_01\_53\_35

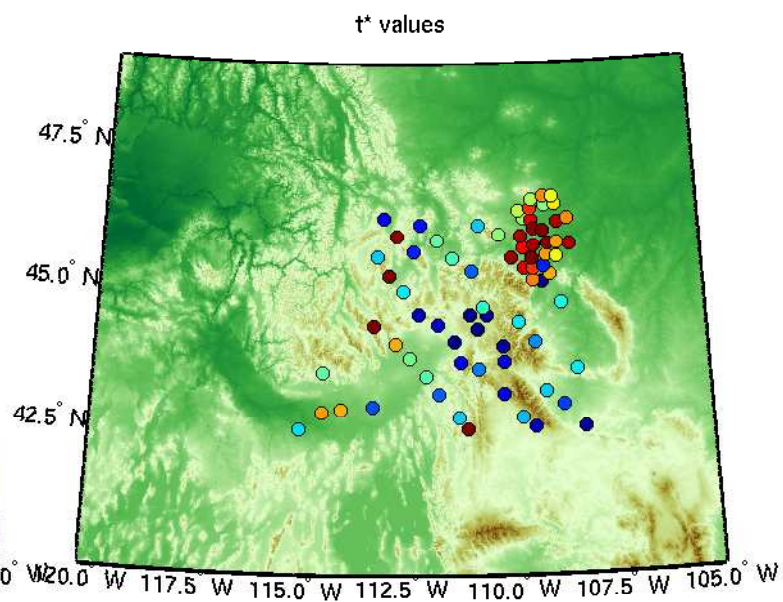
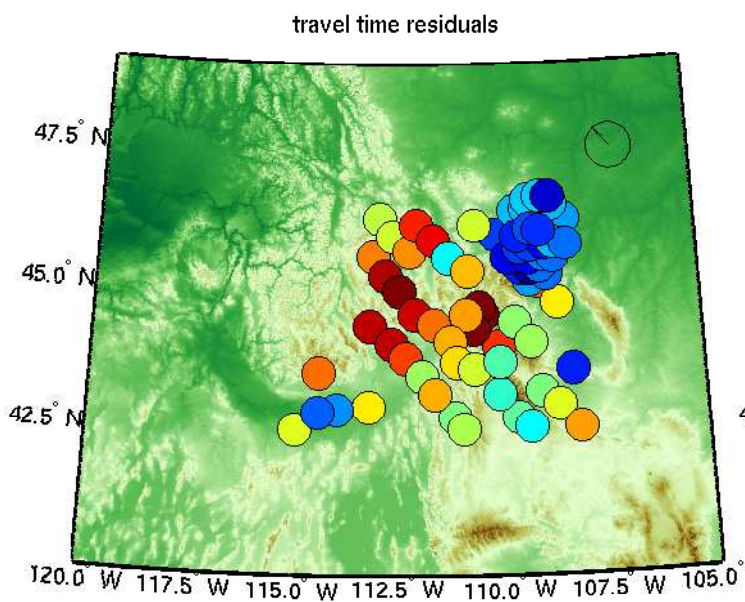
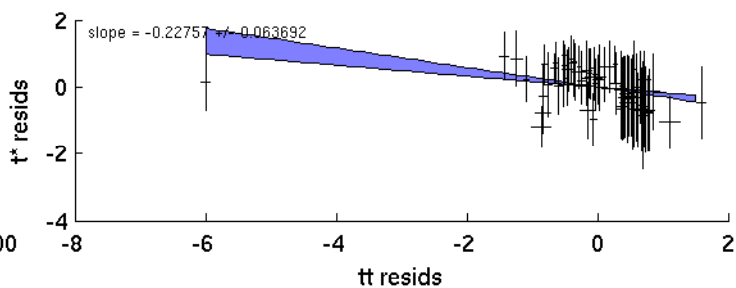
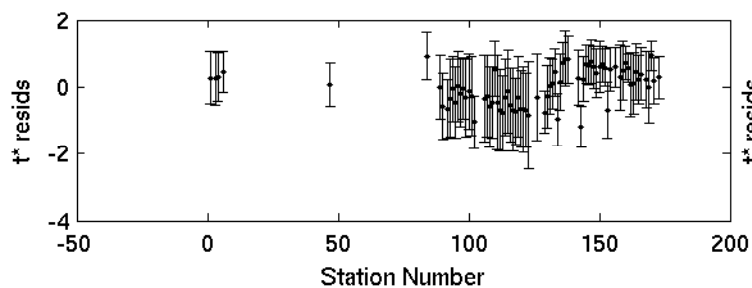


# Sorted by t\*:Event\_2000\_203\_01\_53\_35

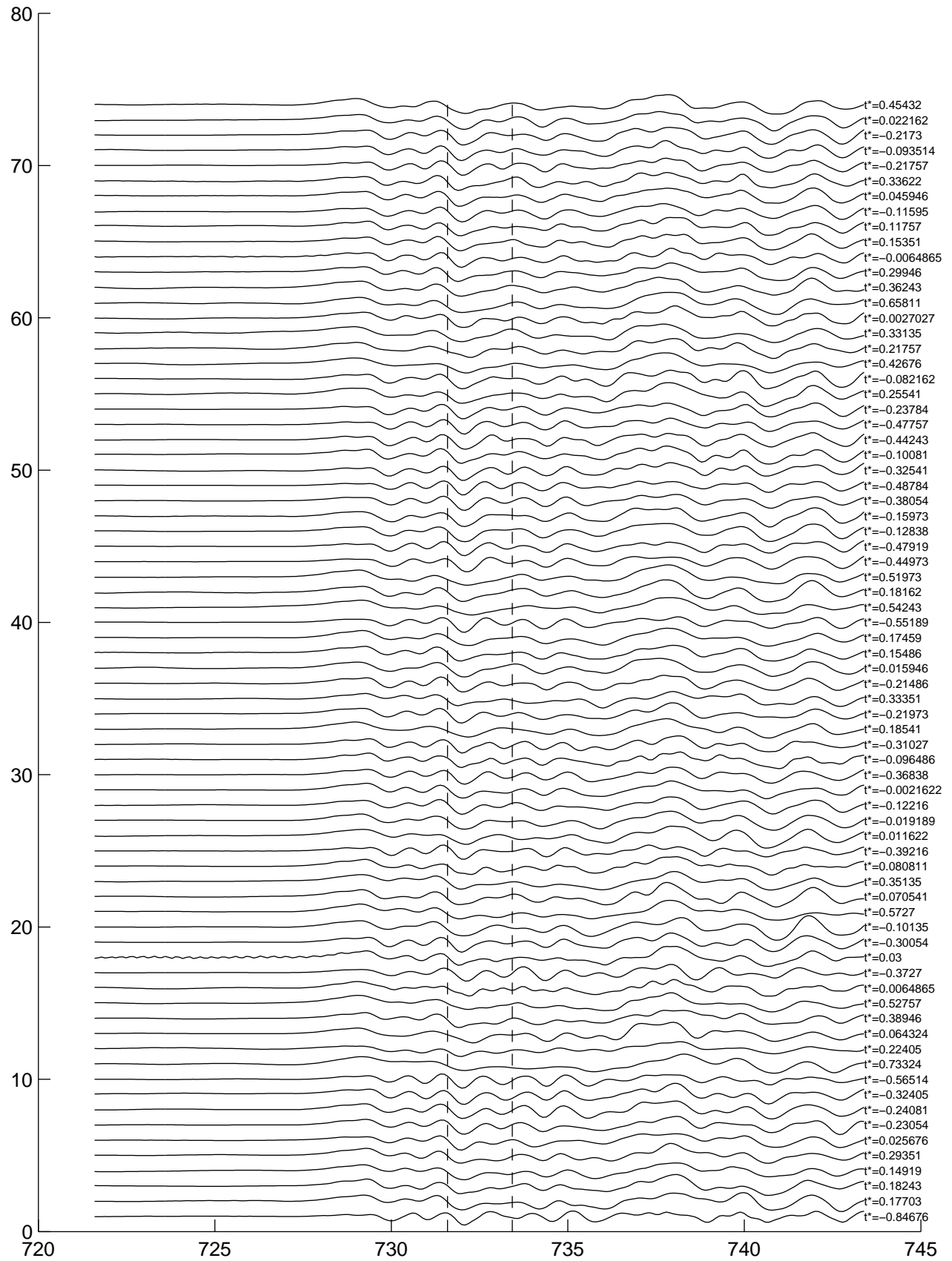




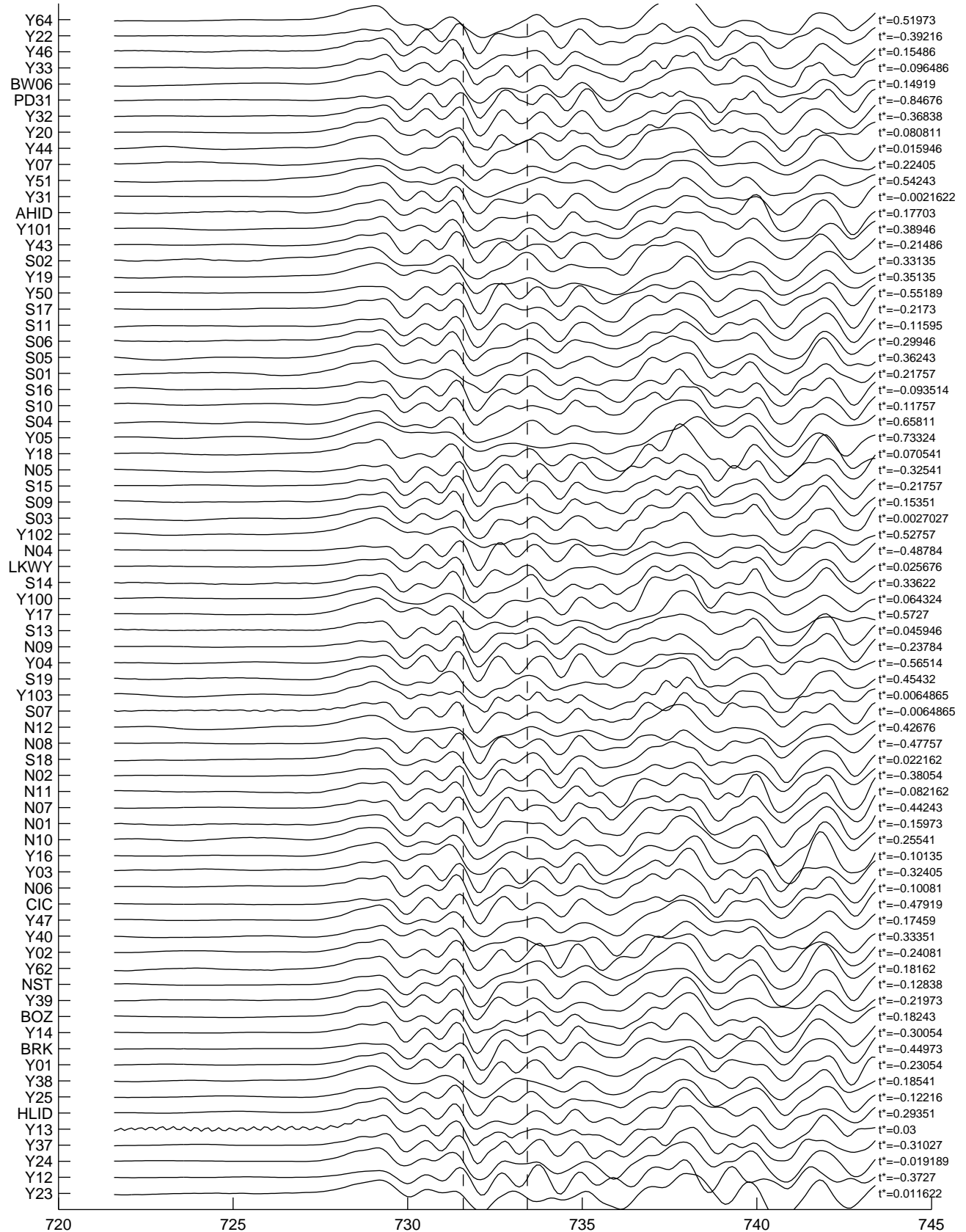
Baz = 141.0761  
Mean xcor value = 0.84921  
Range of  $t^*$  values is 2.1311  
Median  $t^*$  err is 0.83965  
Slope =  $-0.22757 \pm 0.063692$



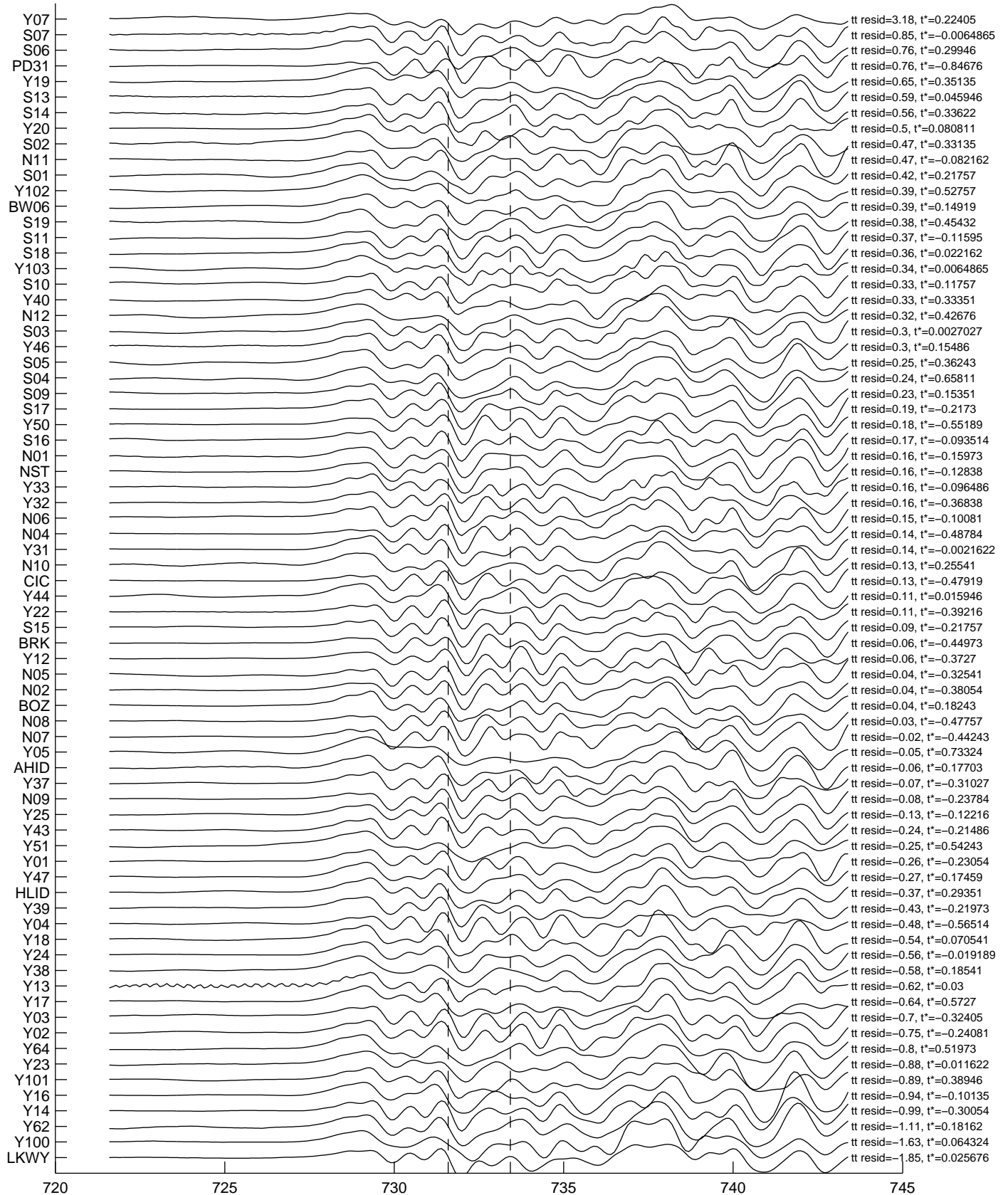
# Event\_2000\_212\_12\_25\_45



# Sorted by Delta:Event\_2000\_212\_12\_25\_45

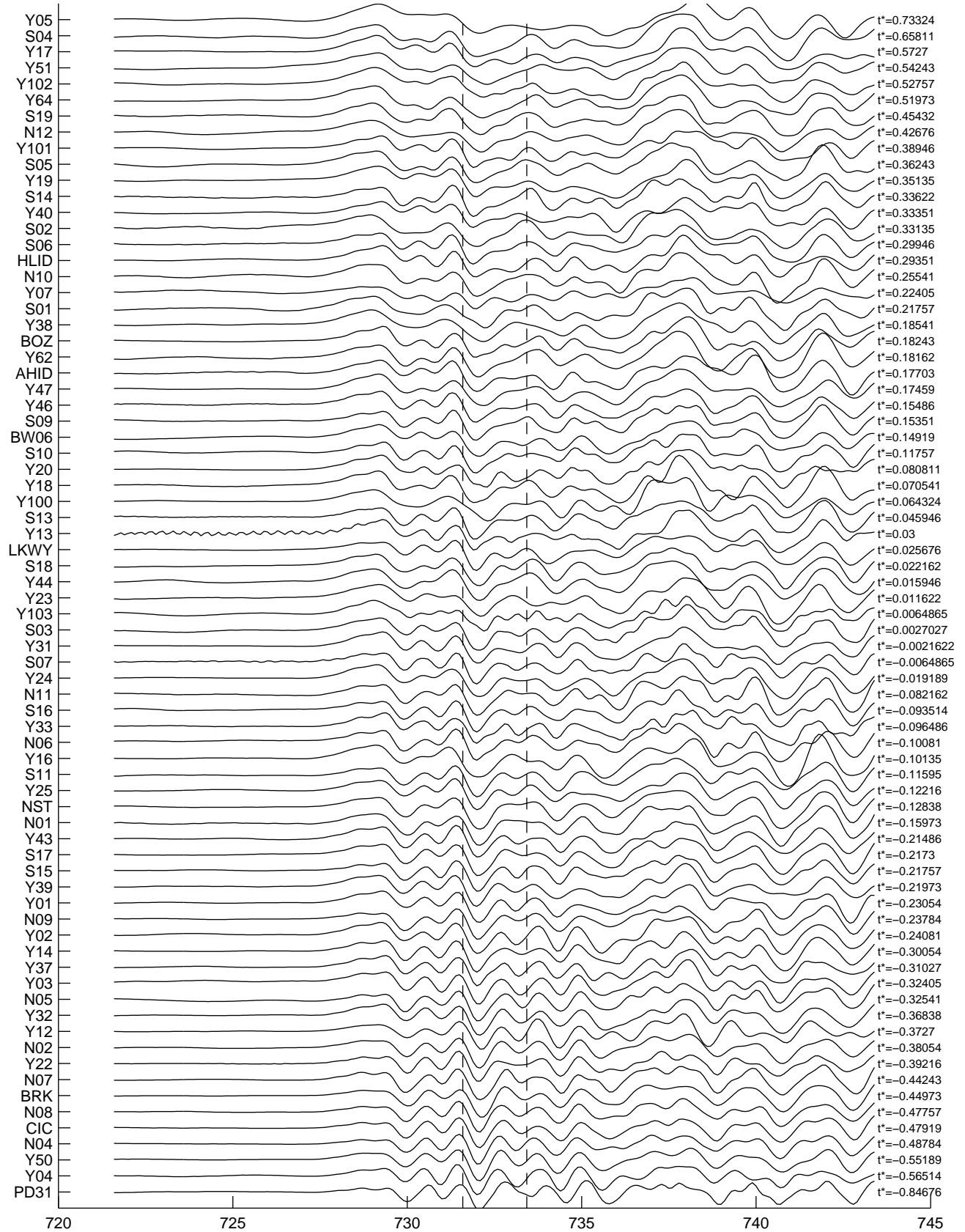


# Sorted by travel time:Event\_2000\_212\_12\_25\_45



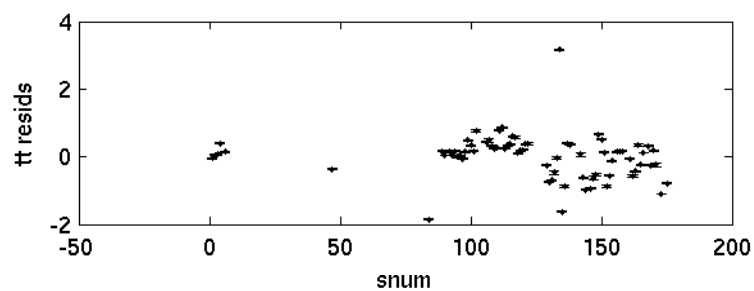
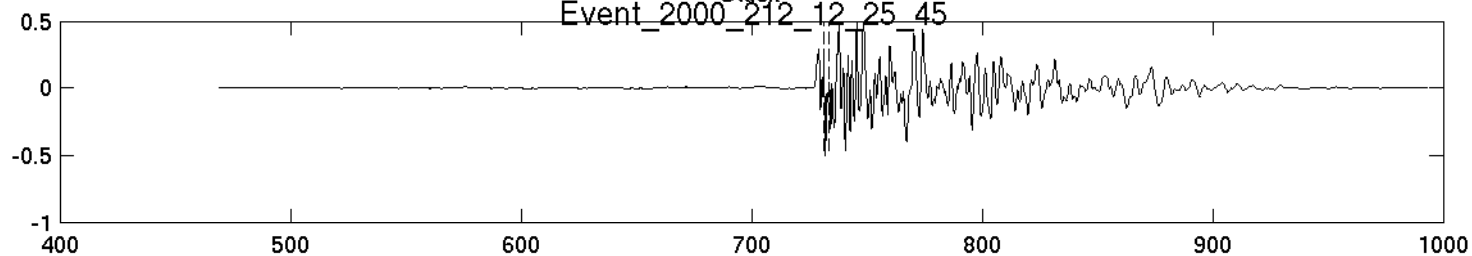


# Sorted by t\*:Event\_2000\_212\_12\_25\_45

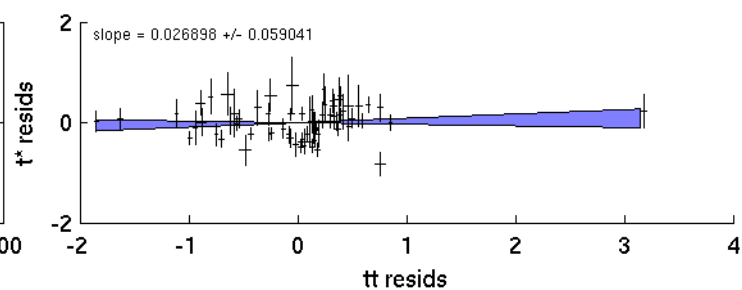
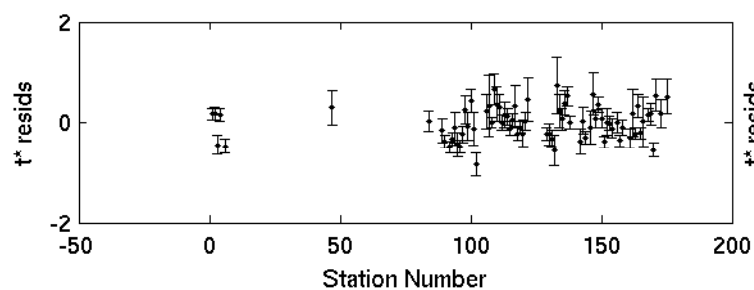


Event\_2000\_212\_12\_25\_45

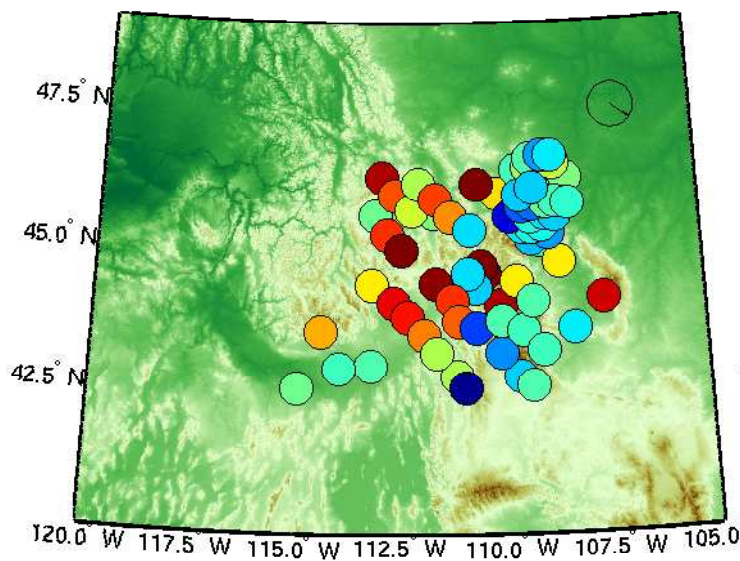
Stack



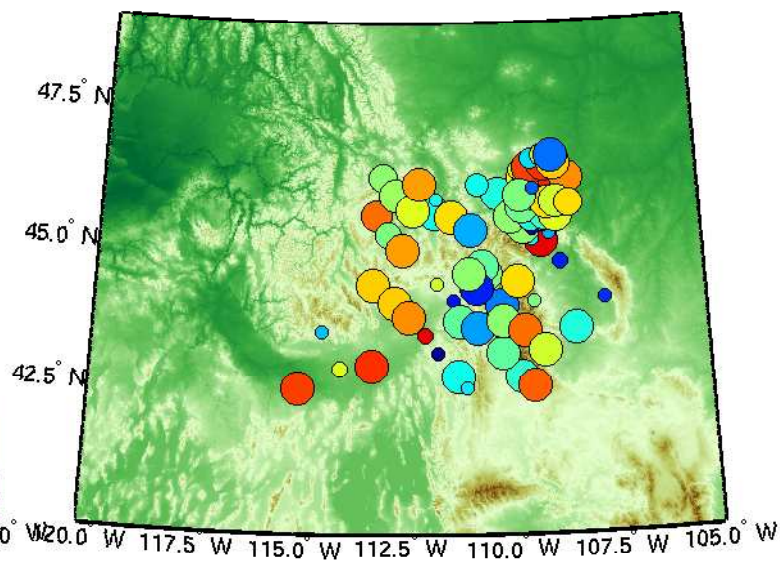
Baz = 307.6059  
Mean xcor value = 0.76784  
Range of t\* values is 1.58  
Median t\* err is 0.20992  
Slope = 0.026898 +/- 0.059041



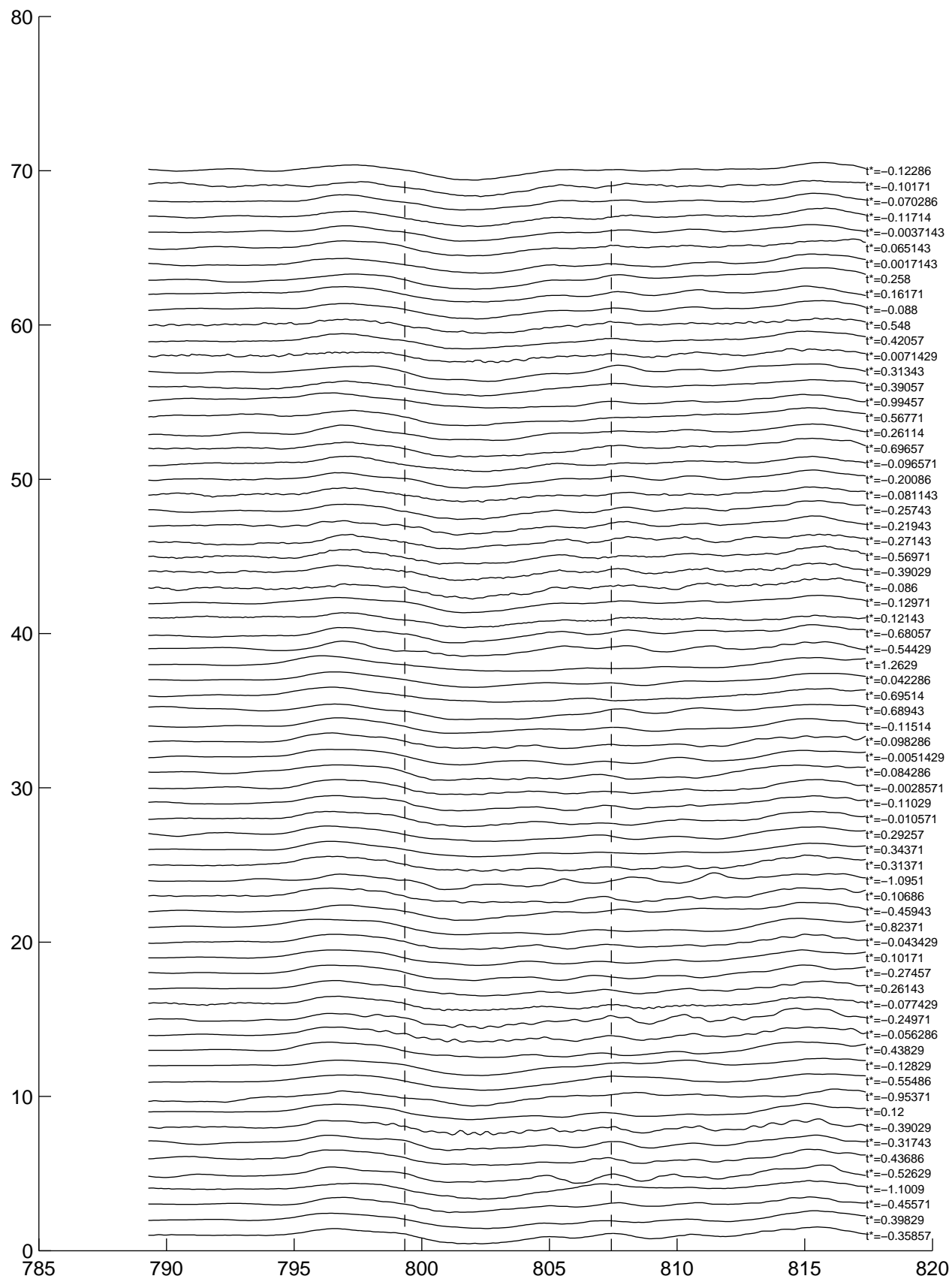
travel time residuals



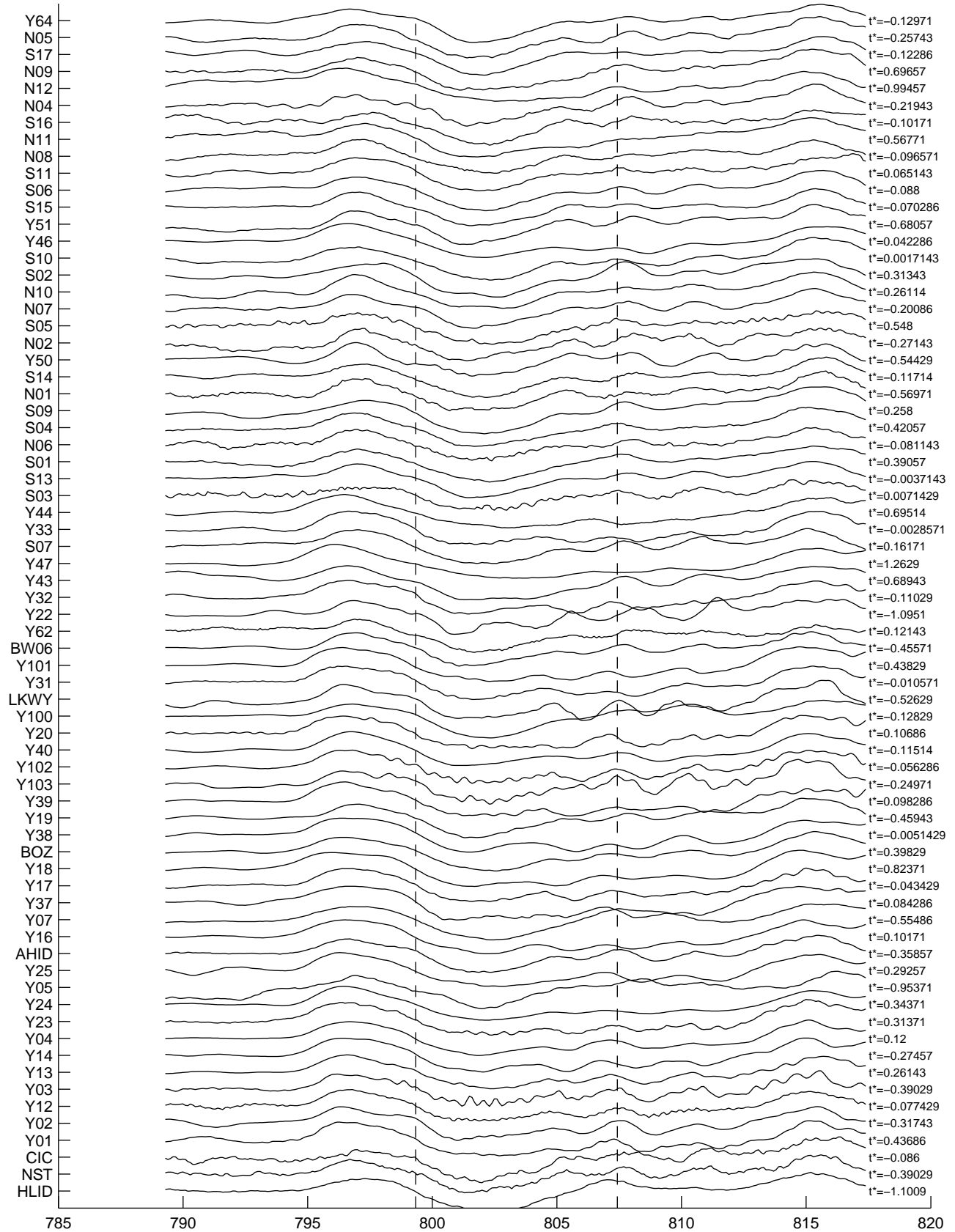
t\* values



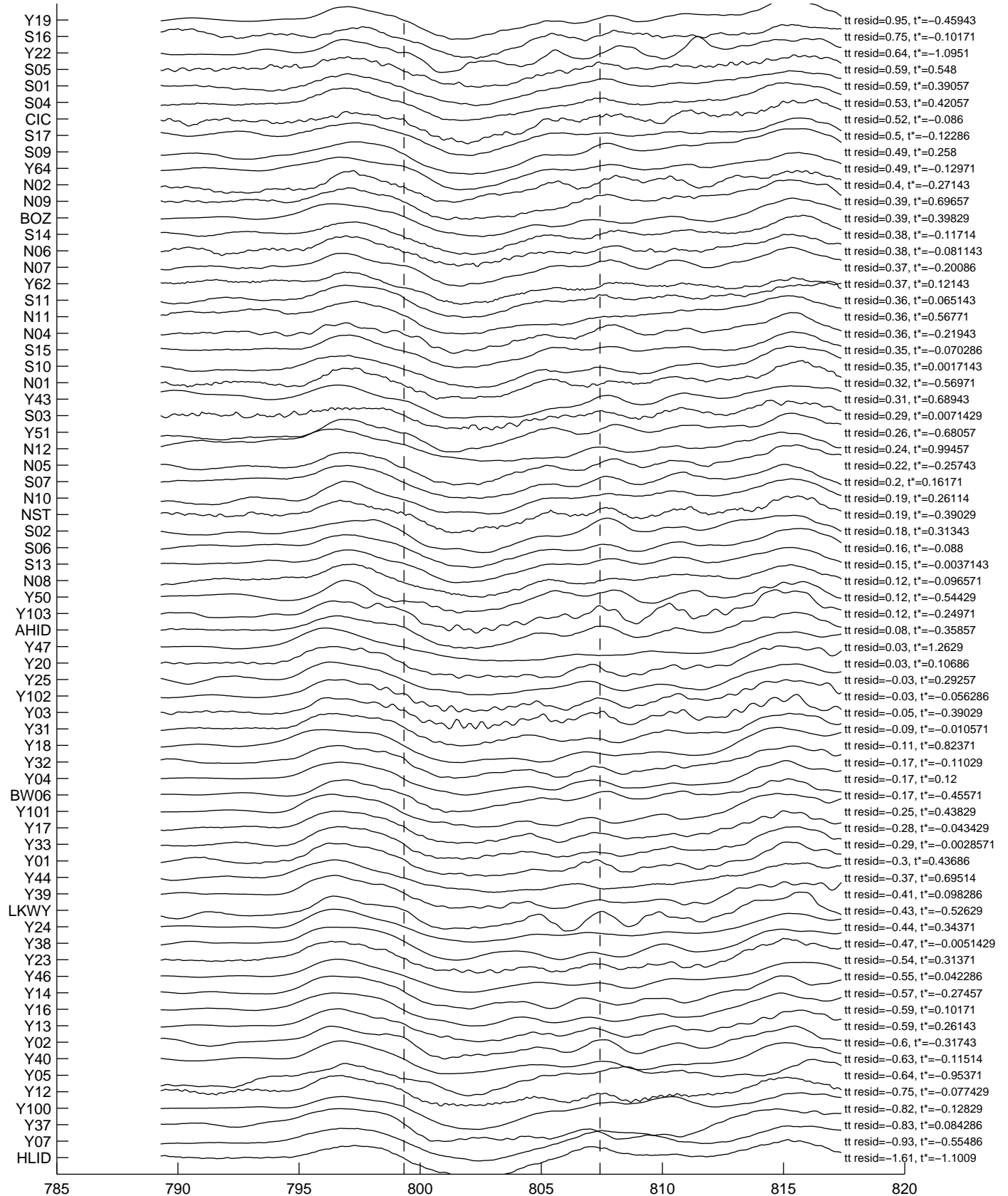
# Event\_2000\_216\_01\_09\_38



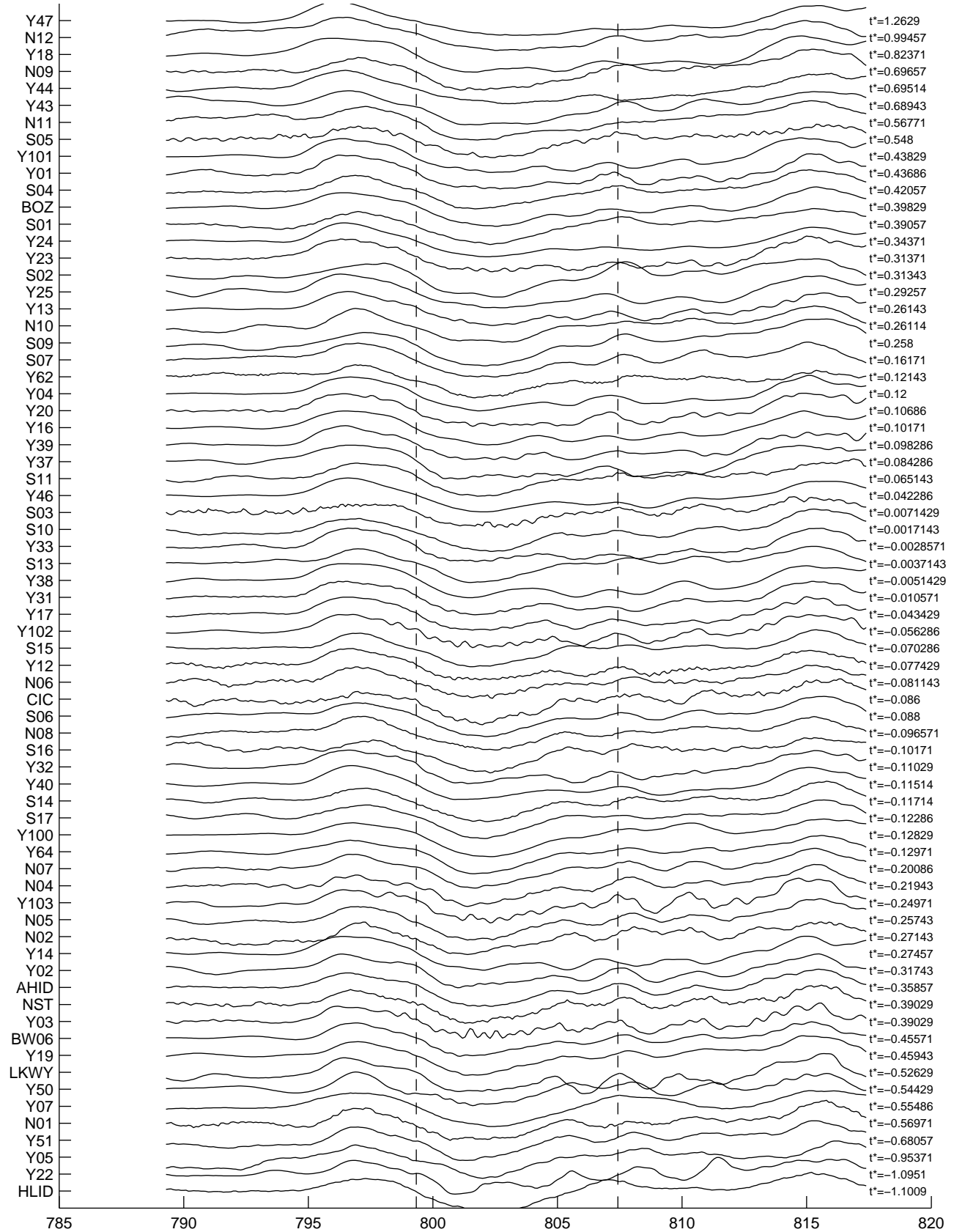
# Sorted by Delta:Event\_2000\_216\_01\_09\_38



# Sorted by travel time:Event\_2000\_216\_01\_09\_38



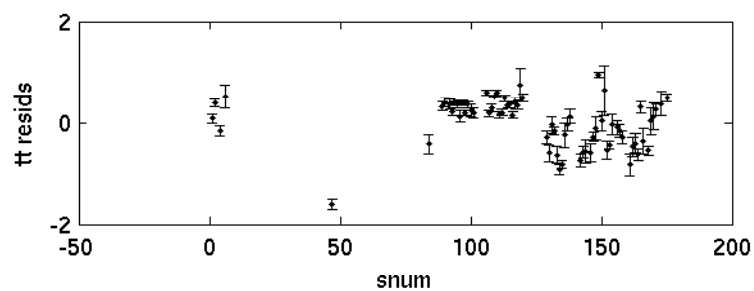
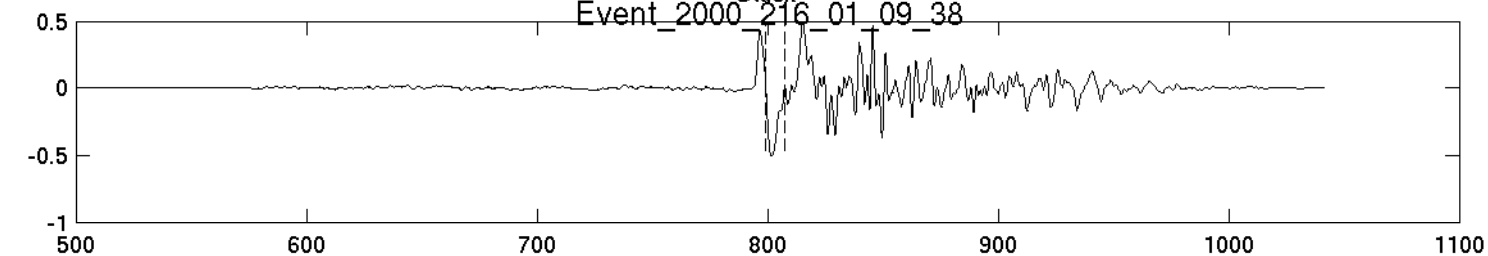
# Sorted by t\*:Event\_2000\_216\_01\_09\_38



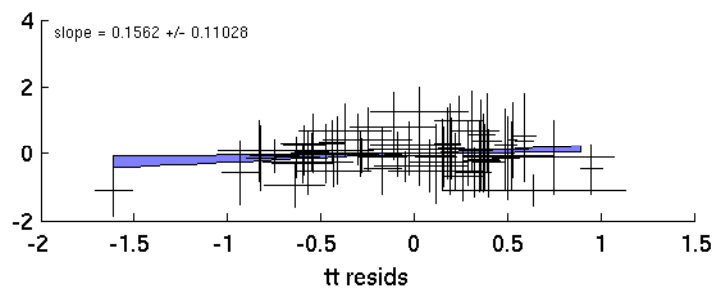
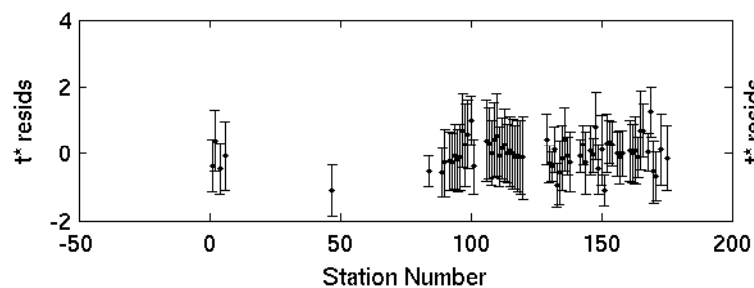


Event\_2000\_216\_01\_09\_38

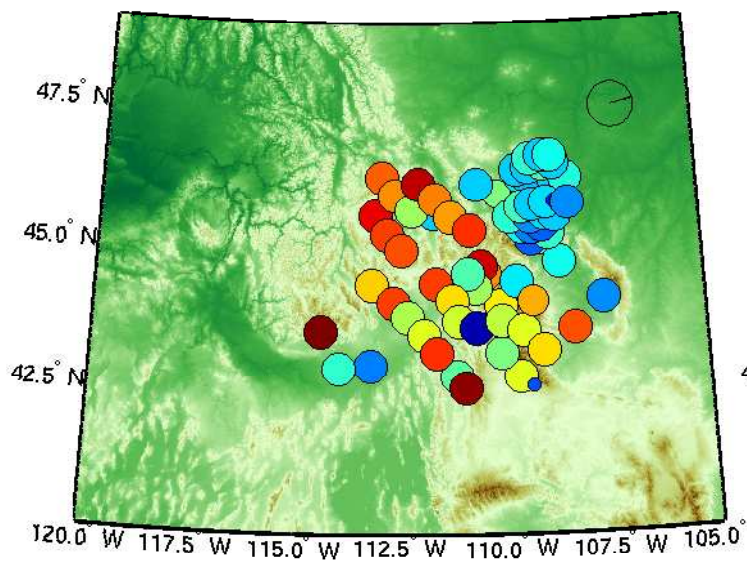
Stack



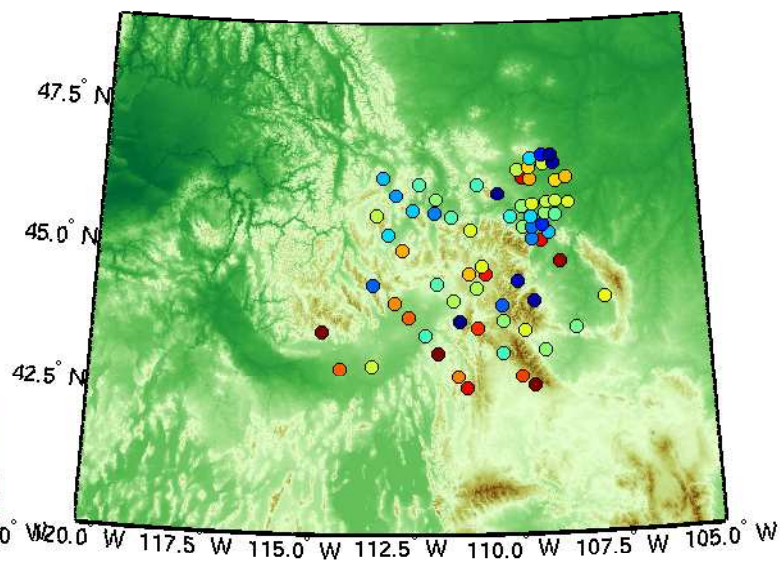
Baz = 256.8483  
Mean xcor value = 0.77343  
Range of  $t^*$  values is 2.3637  
Median  $t^*$  err is 0.88973  
Slope = 0.1562 +/- 0.11028



travel time residuals

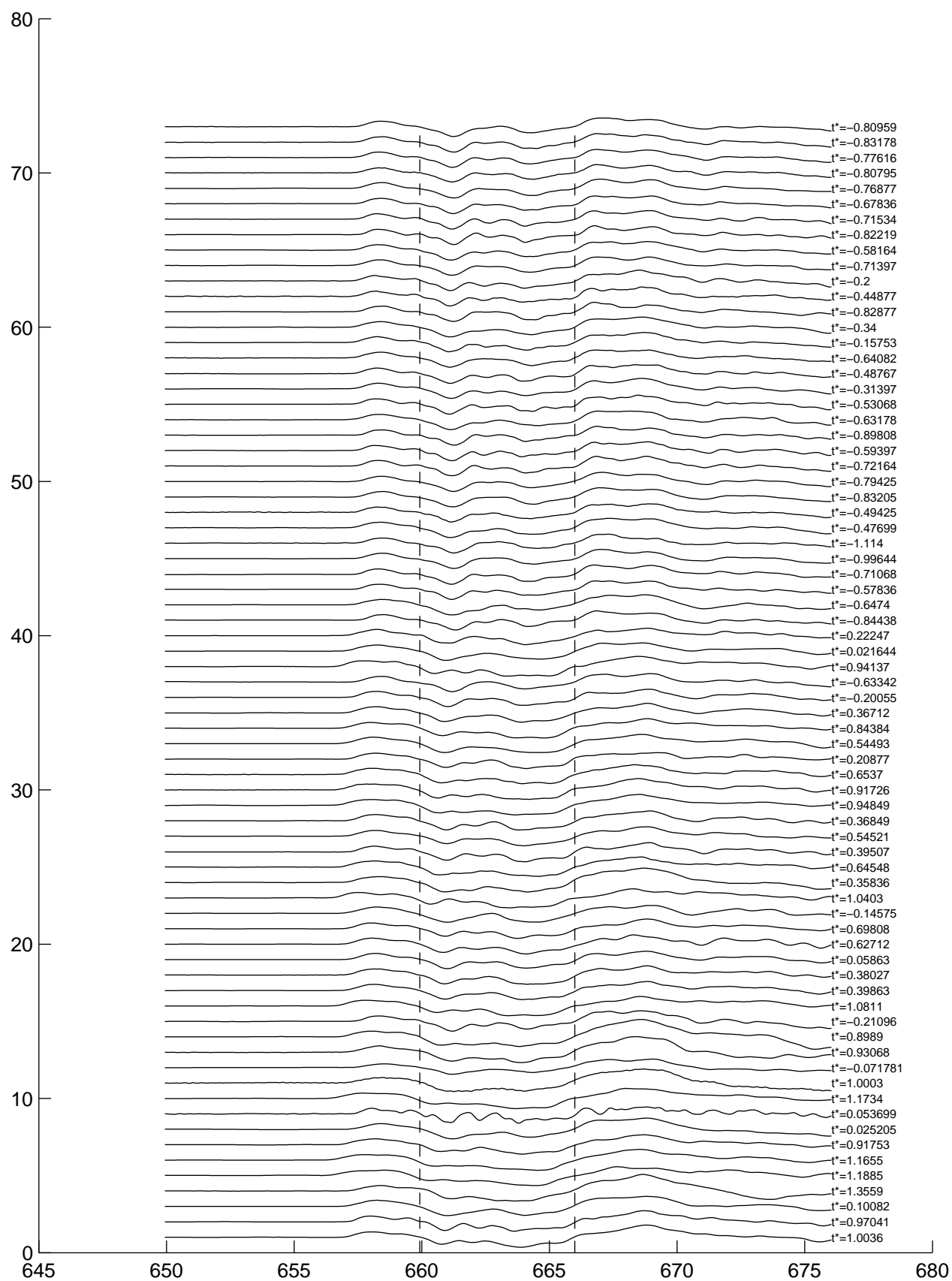


$t^*$  values

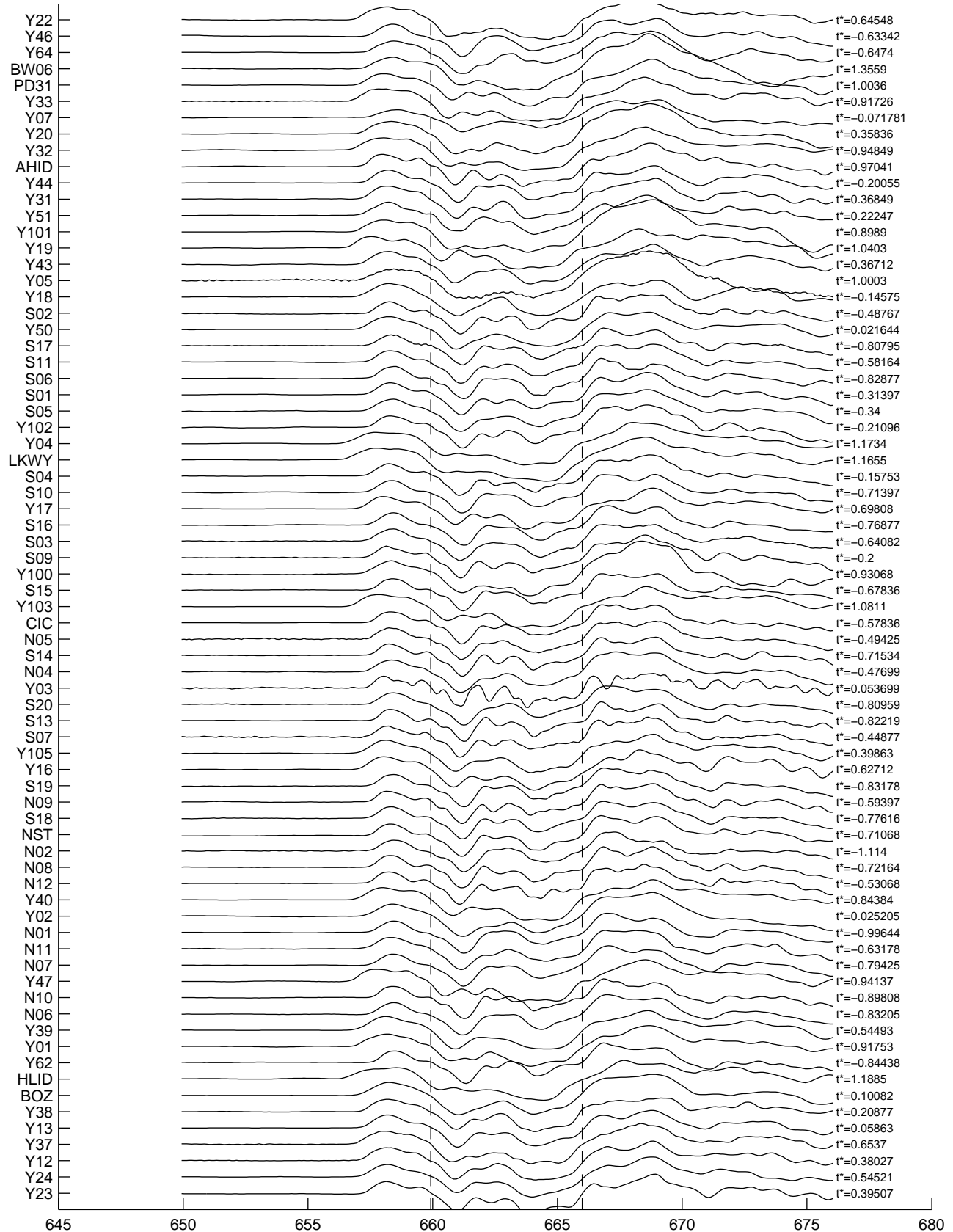




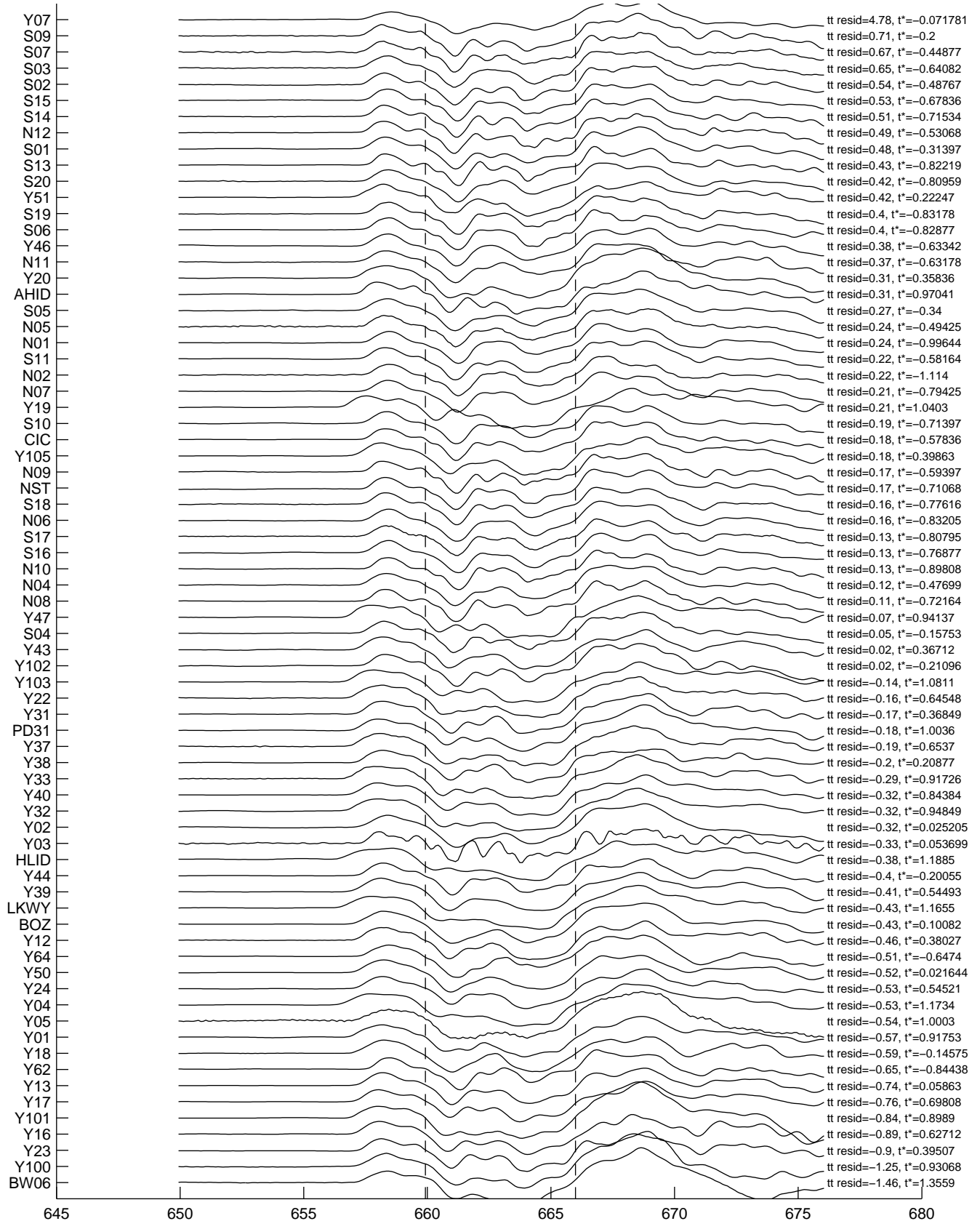
# Event\_2000\_217\_21\_13\_02



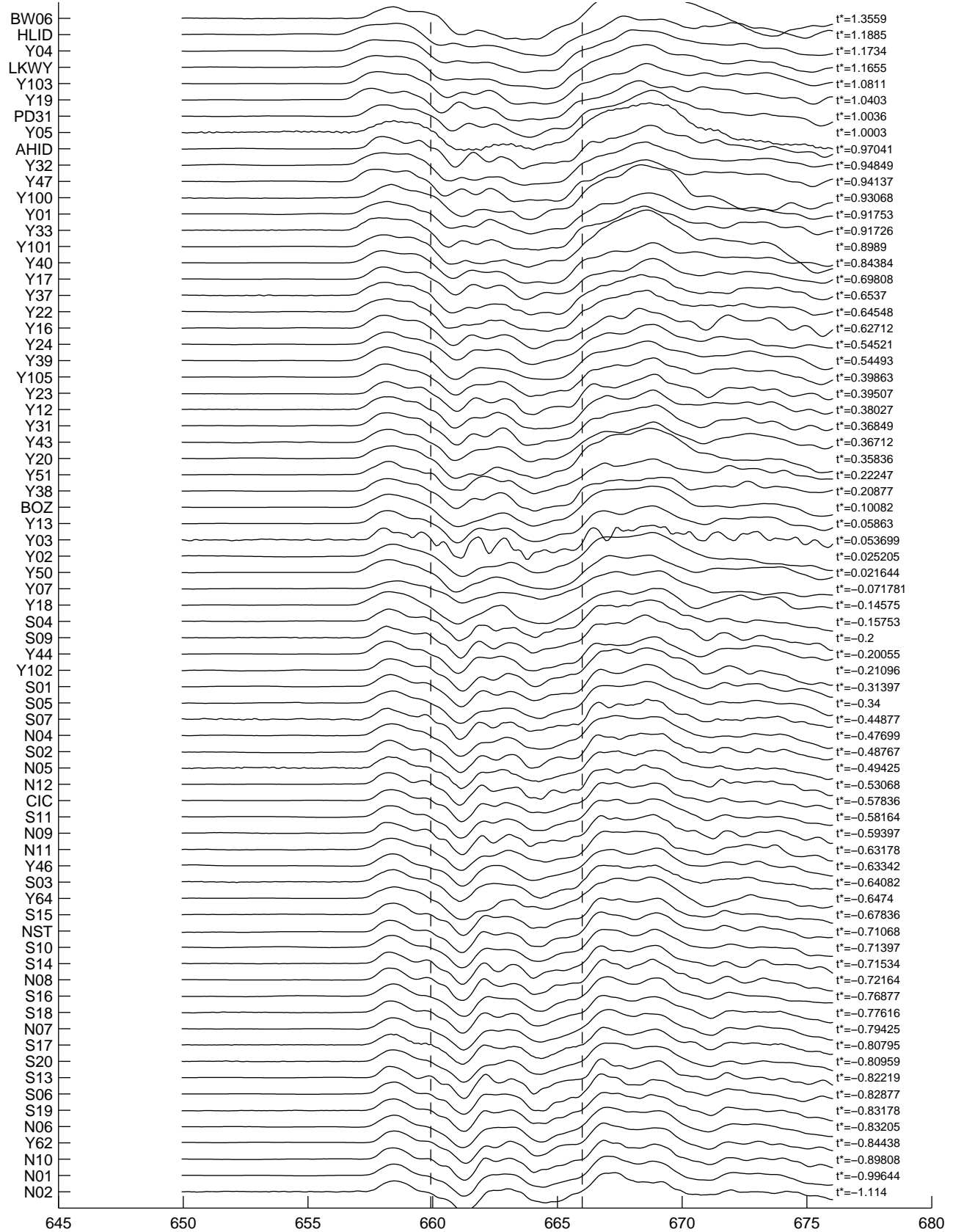
# Sorted by Delta:Event\_2000\_217\_21\_13\_02



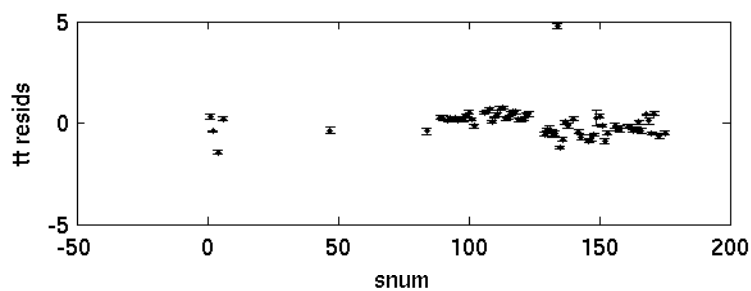
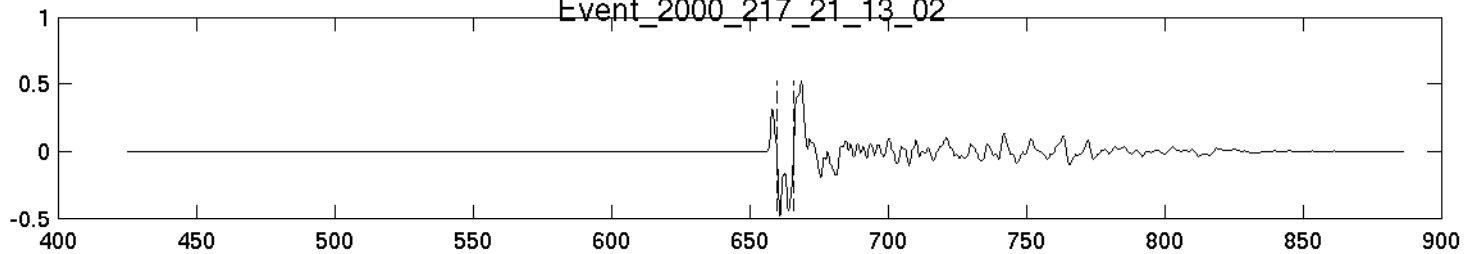
# Sorted by travel time:Event\_2000\_217\_21\_13\_02



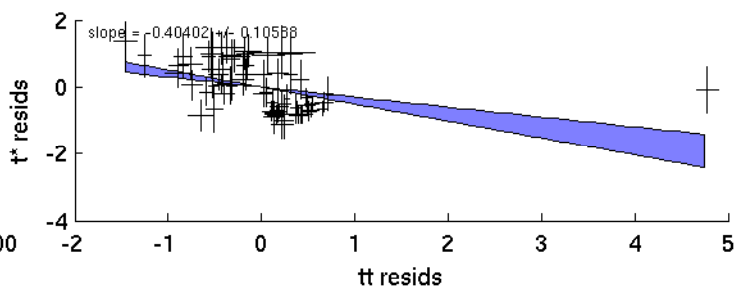
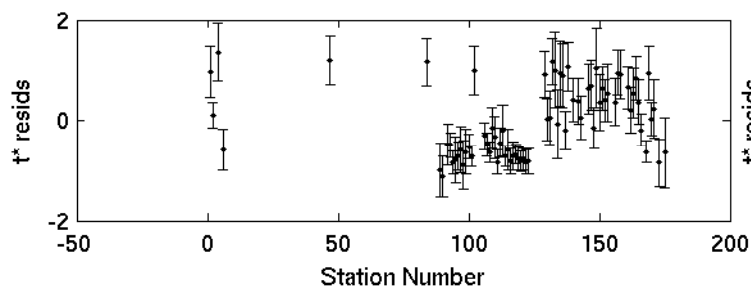
# Sorted by t\*:Event\_2000\_217\_21\_13\_02



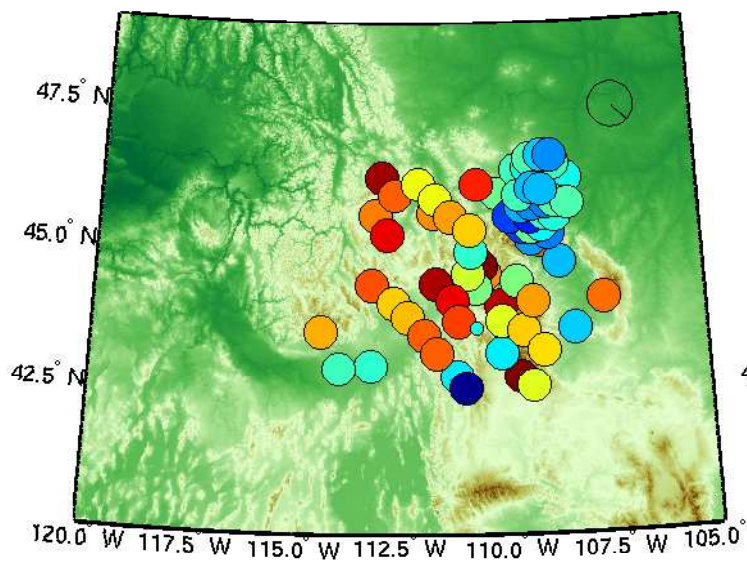
Stack  
Event\_2000\_217\_21\_13\_02



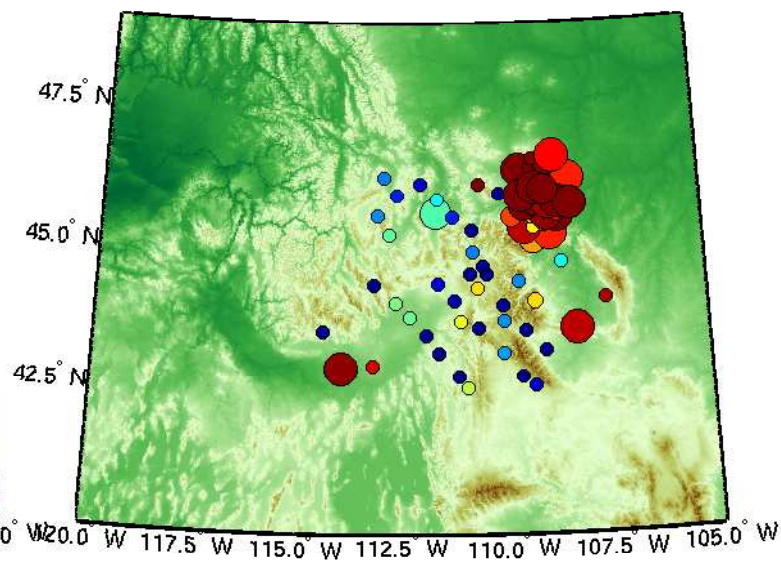
Baz = 317.0004  
Mean xcor value = 0.87973  
Range of  $t^*$  values is 2.4699  
Median  $t^*$  err is 0.43315  
Slope = -0.40402 +/- 0.10588



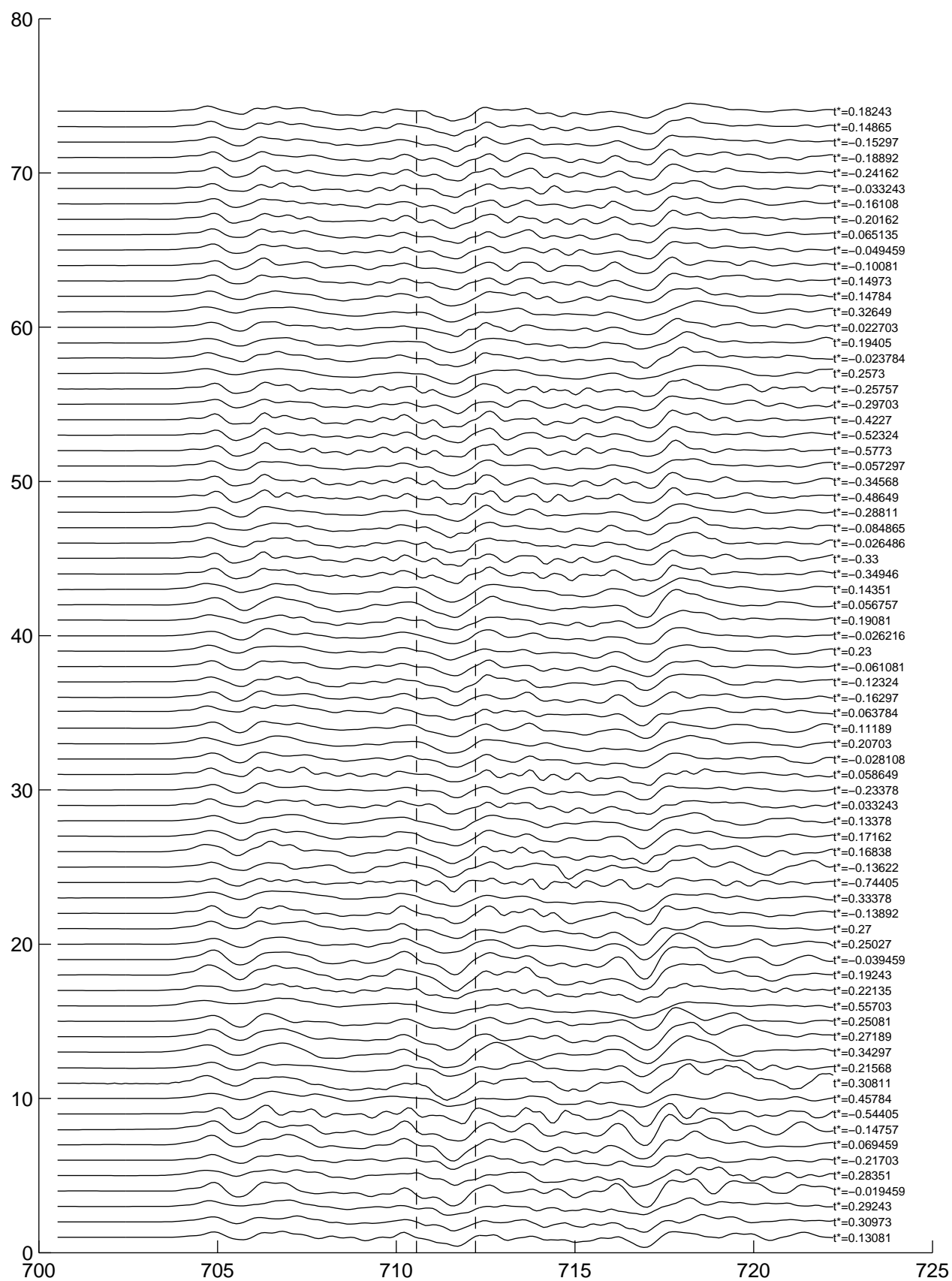
travel time residuals



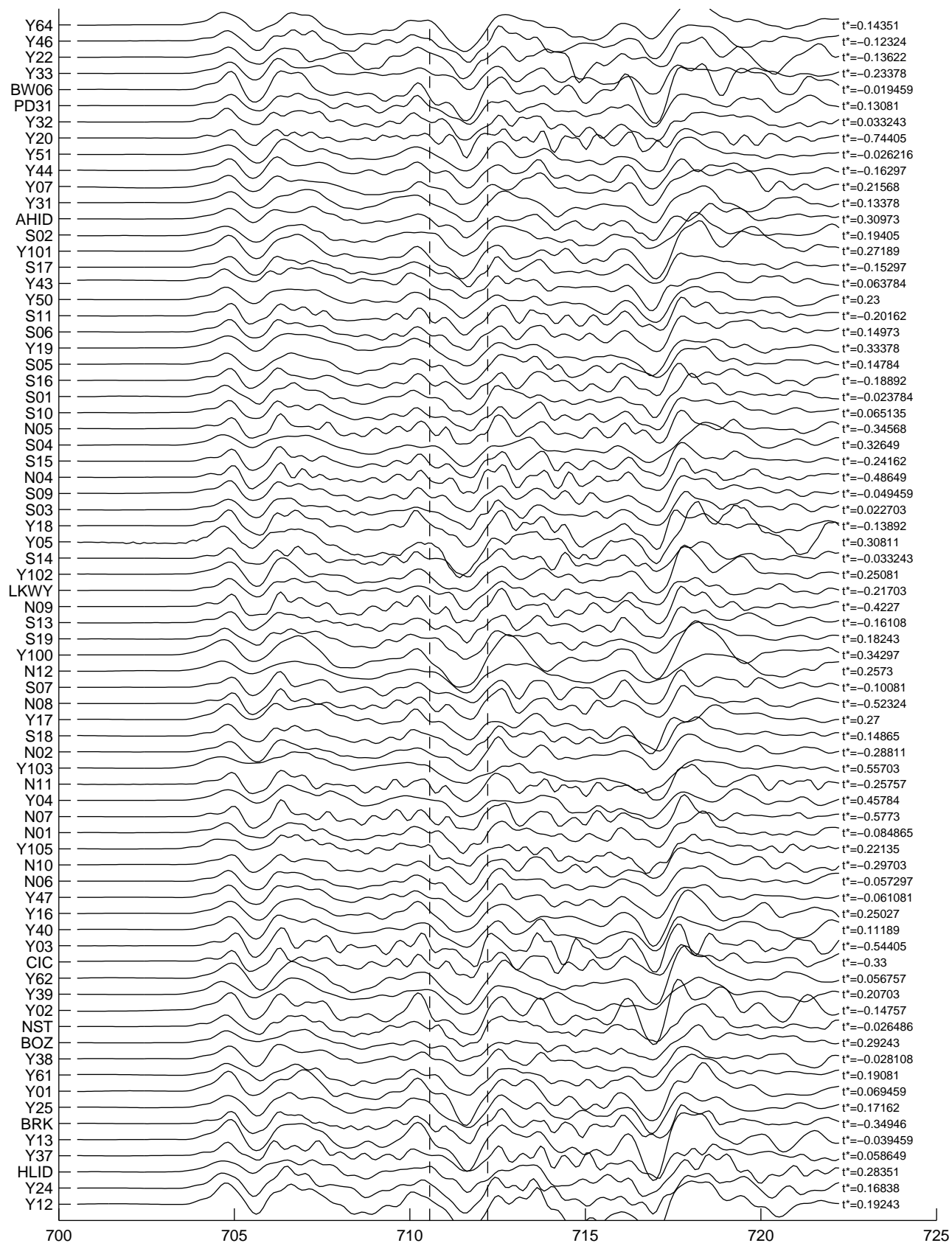
$t^*$  values



# Event\_2000\_219\_07\_27\_12

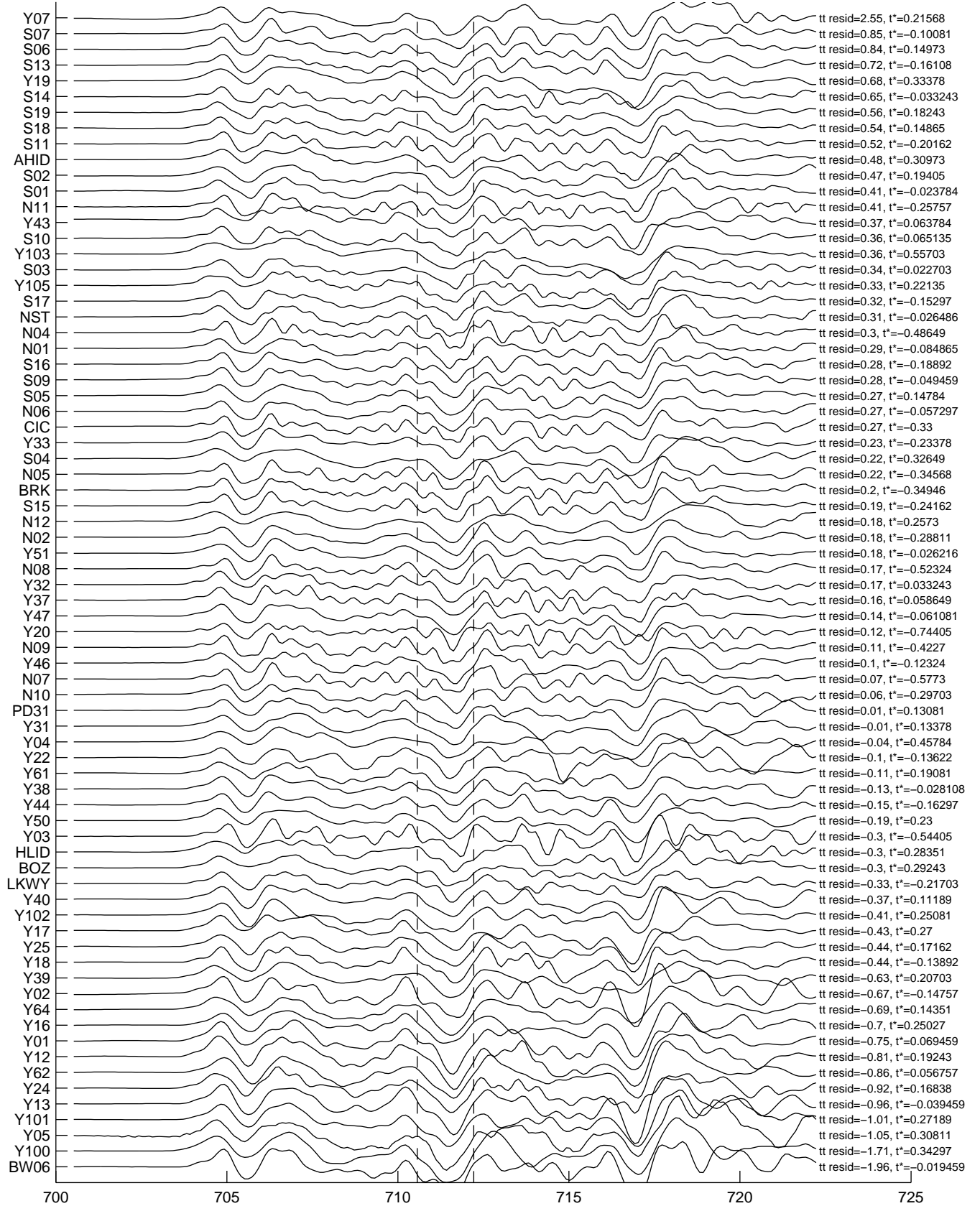


# Sorted by Delta:Event\_2000\_219\_07\_27\_12

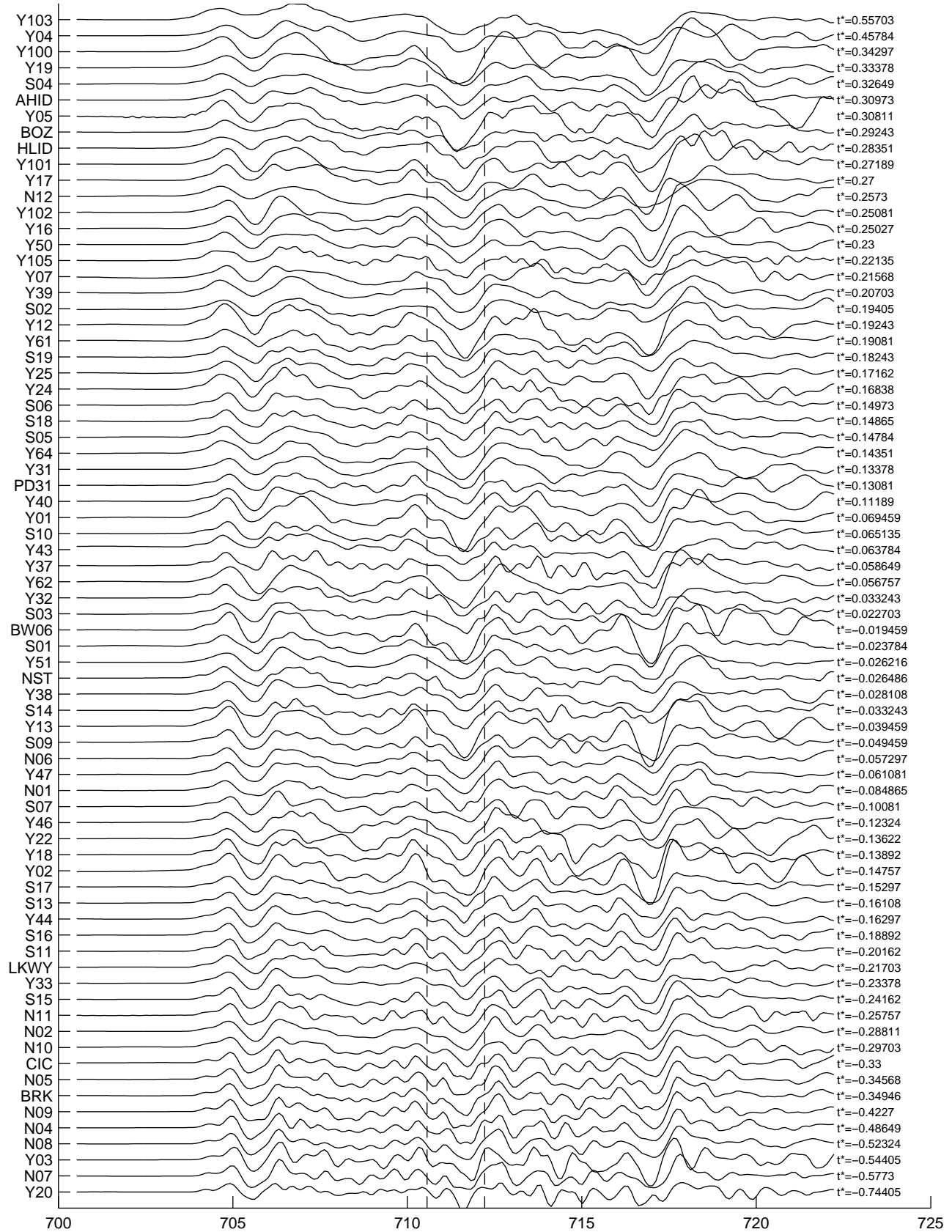




# Sorted by travel time:Event\_2000\_219\_07\_27\_12

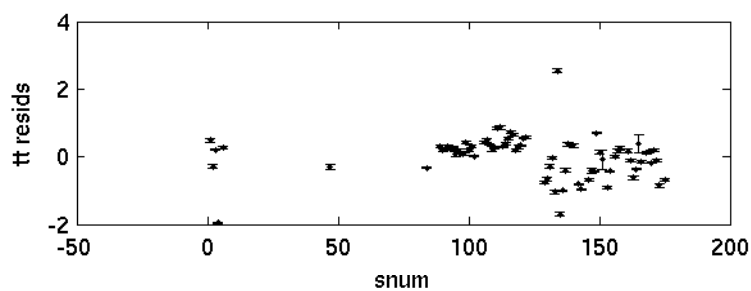
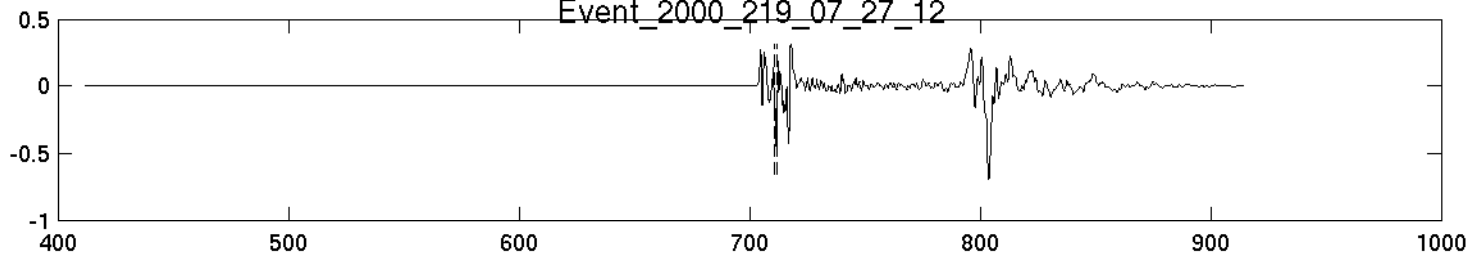


# Sorted by $t^*$ :Event\_2000\_219\_07\_27\_12

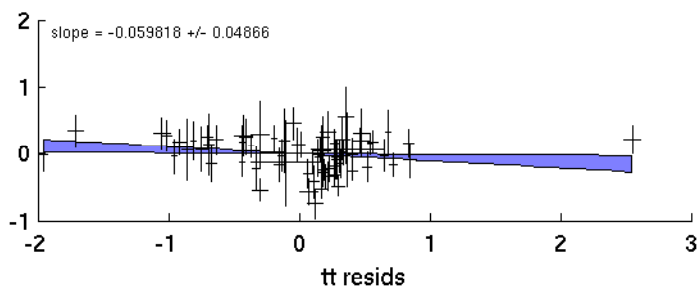
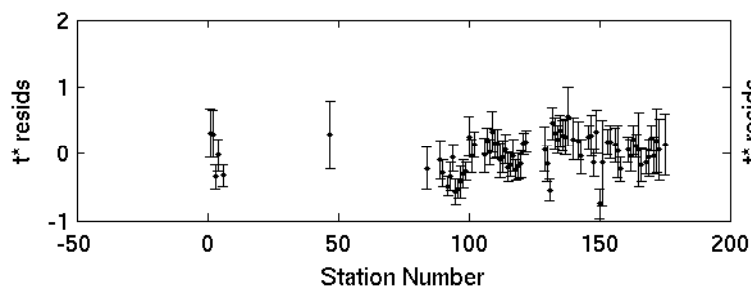


# Event\_2000\_219\_07\_27\_12

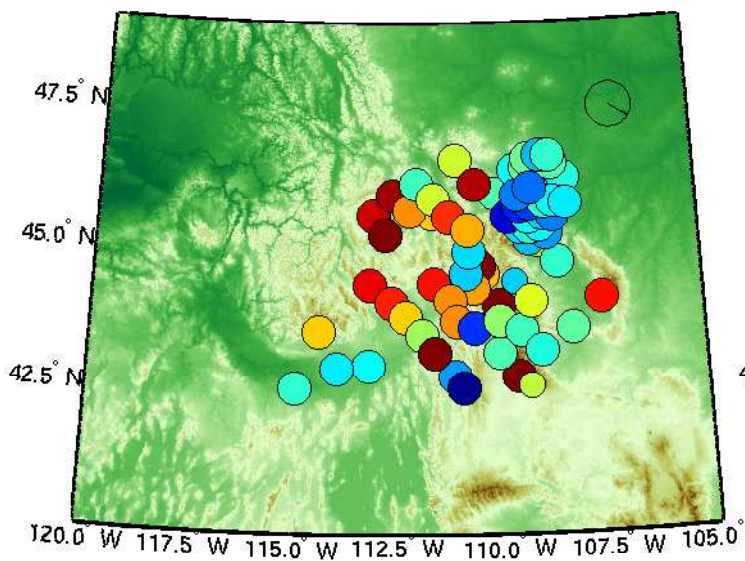
Stack



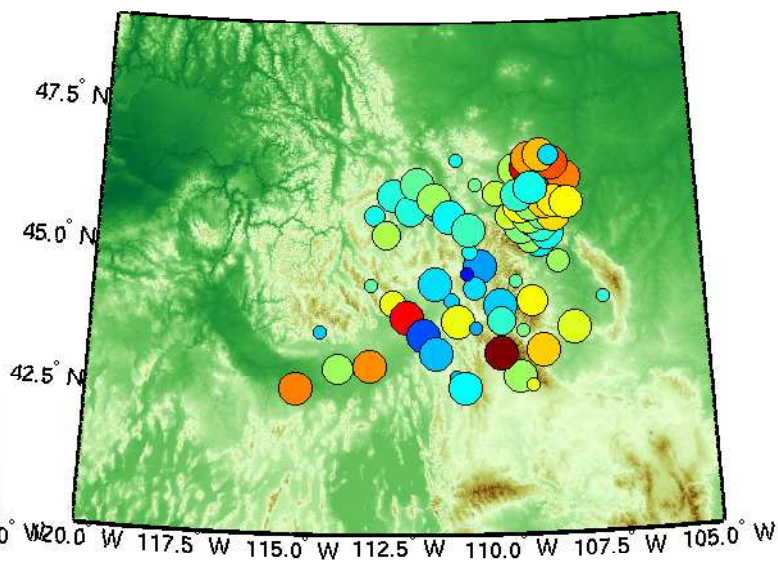
Baz = 304.0866  
Mean xcor value = 0.75568  
Range of t\* values is 1.3011  
Median t\* err is 0.23563  
Slope = -0.059818 +/- 0.04866



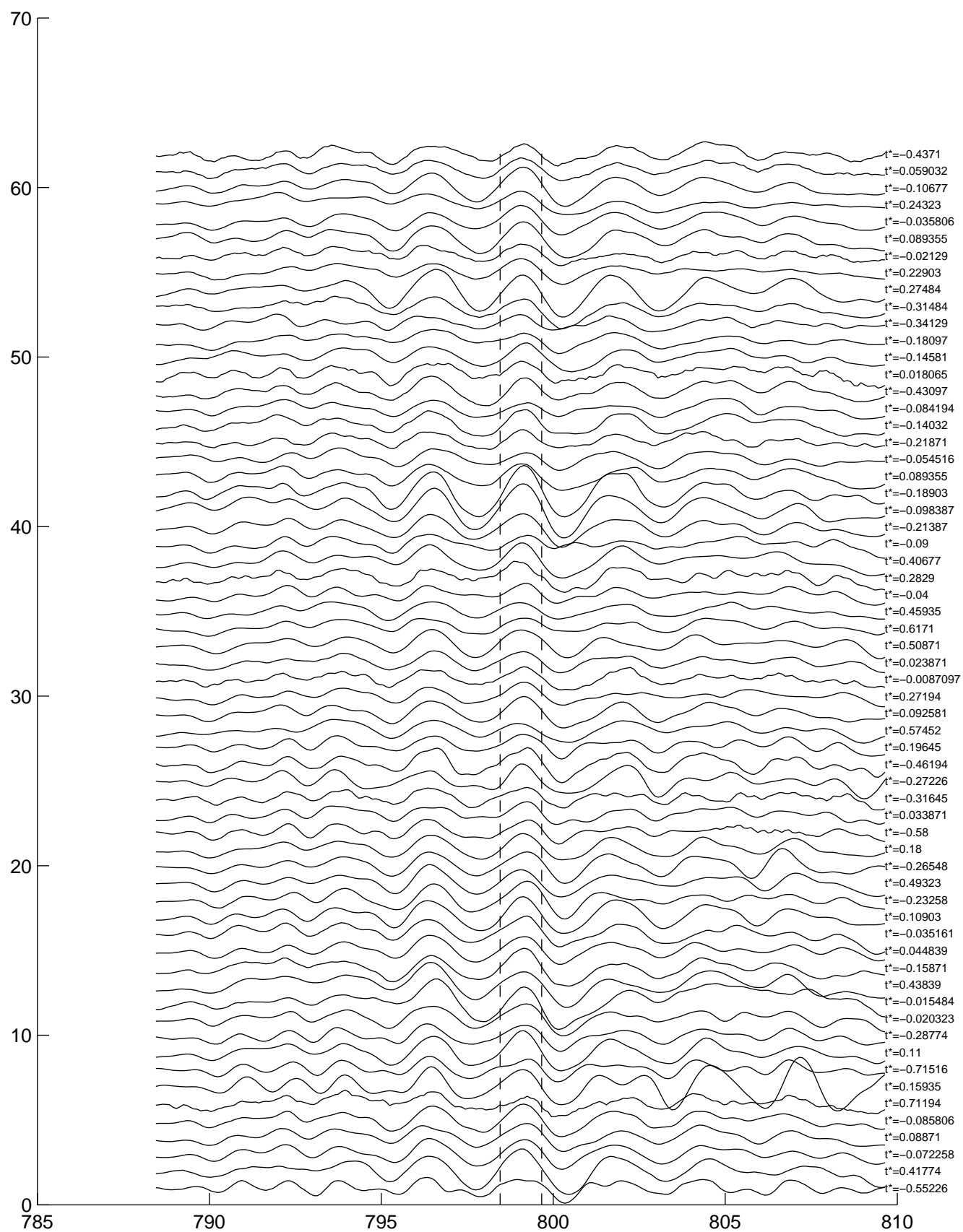
travel time residuals



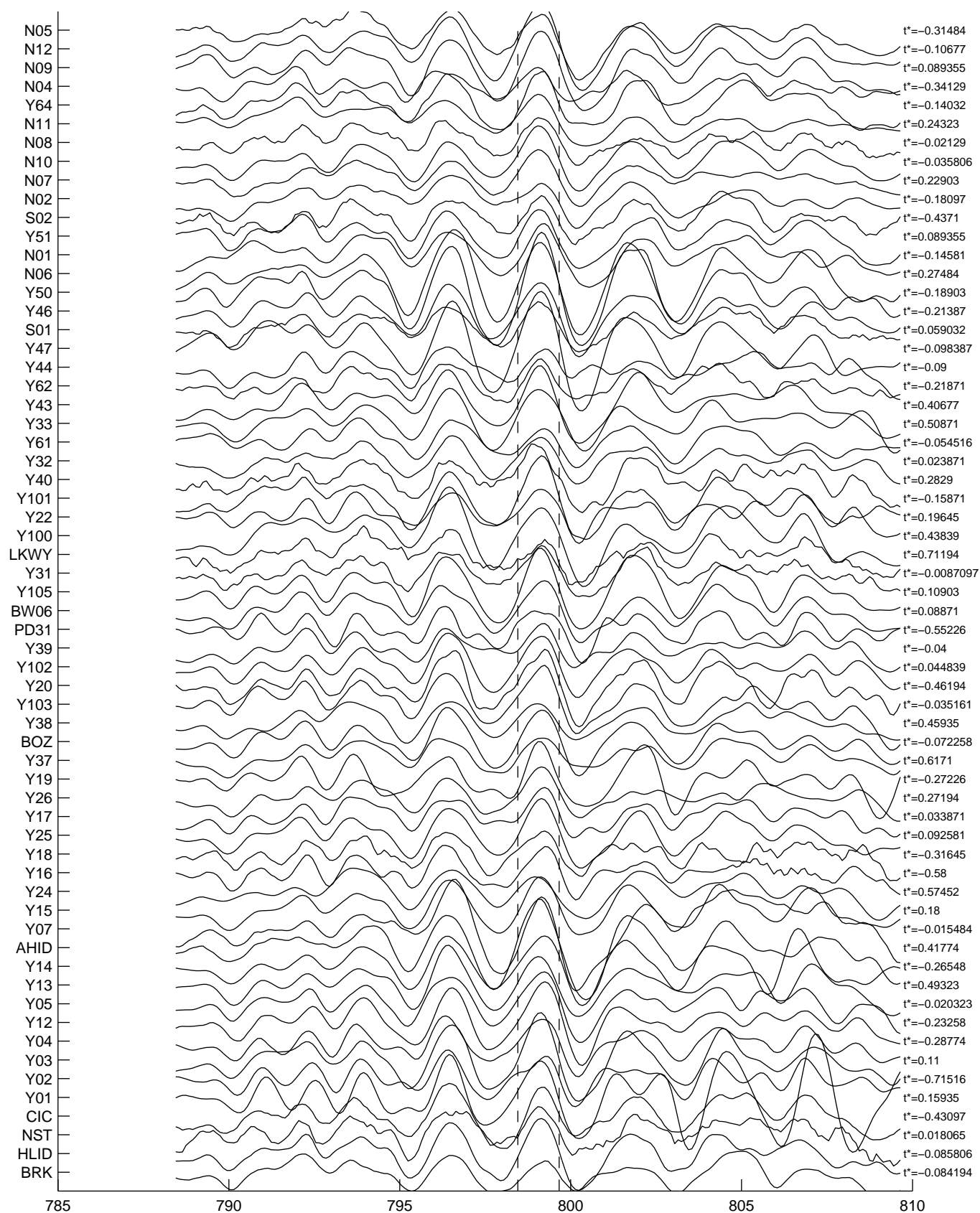
t\* values



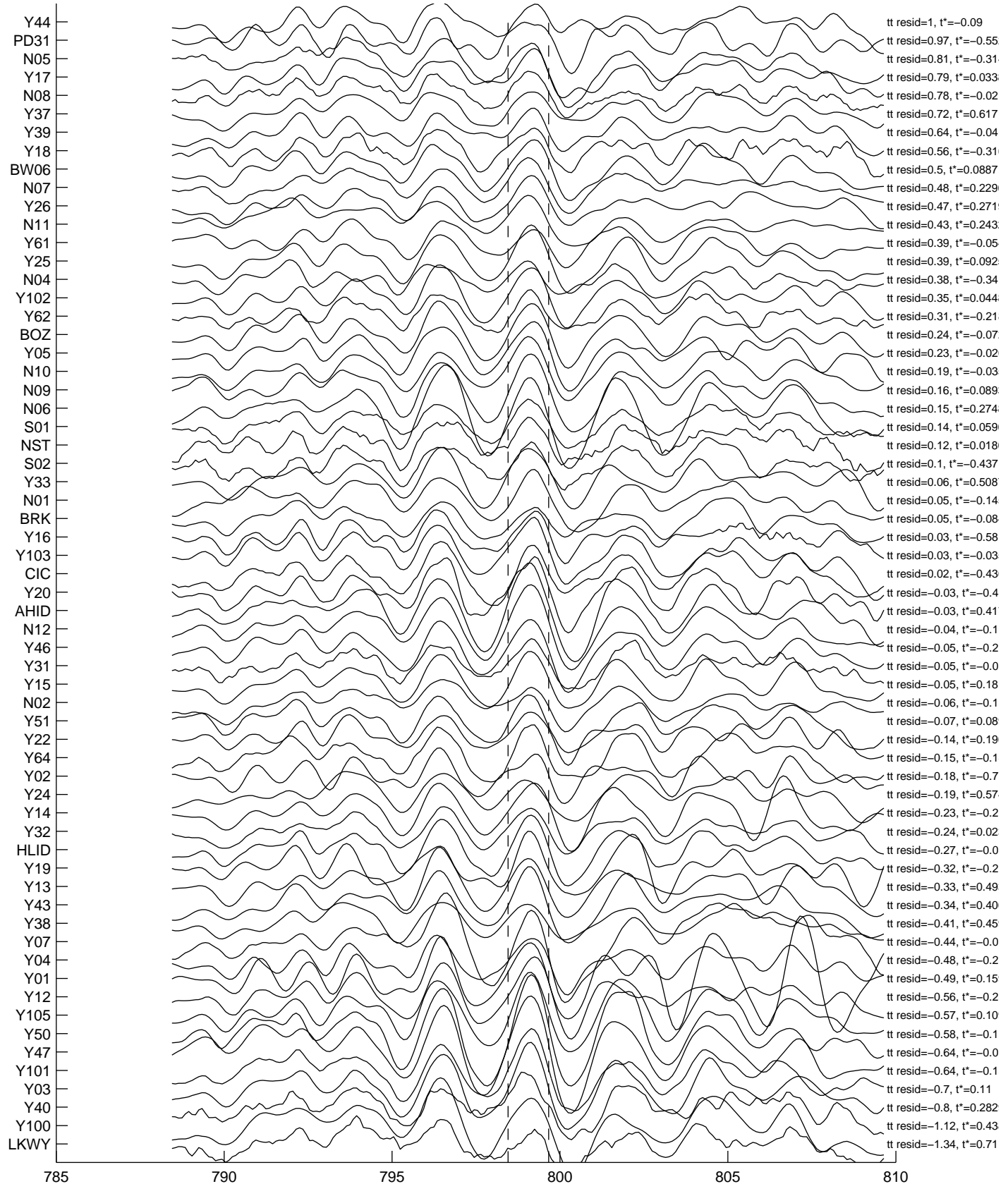
# Event\_2000\_222\_22\_55\_59



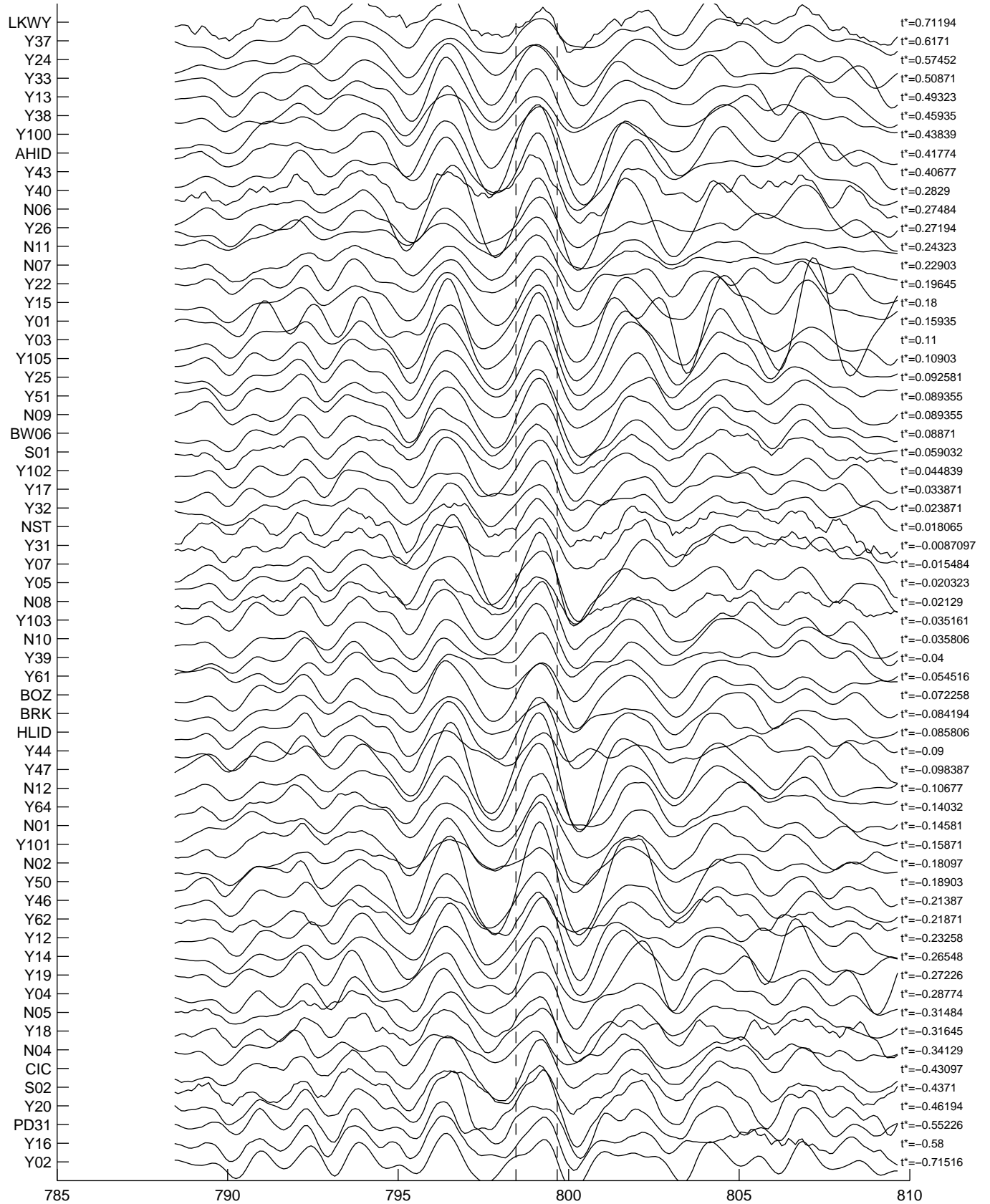
# Sorted by Delta:Event\_2000\_222\_22\_55\_59



# Sorted by travel time:Event\_2000\_222\_22\_55\_59



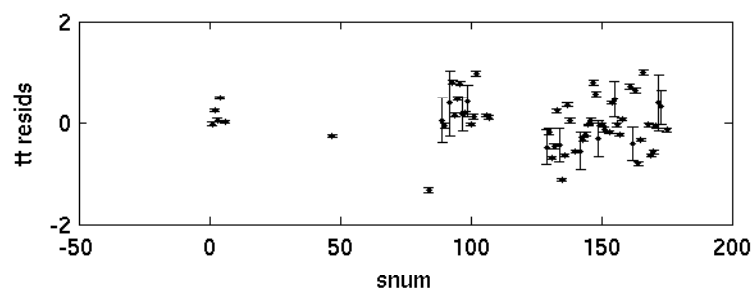
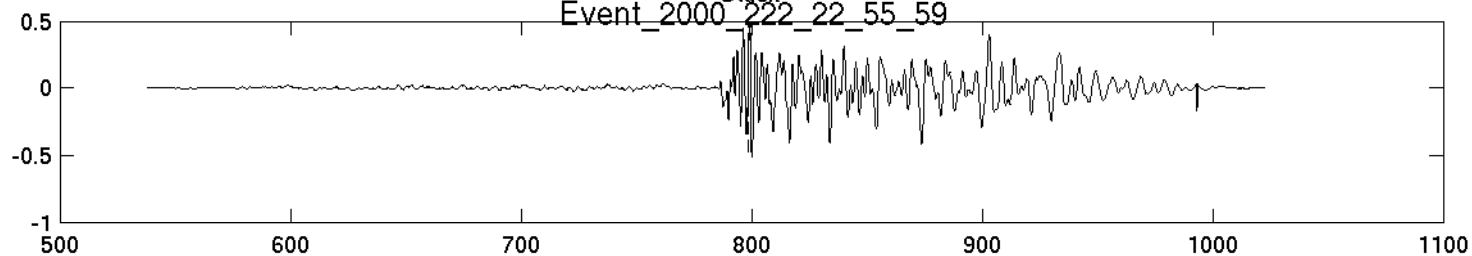
# Sorted by t\*:Event\_2000\_222\_22\_55\_59



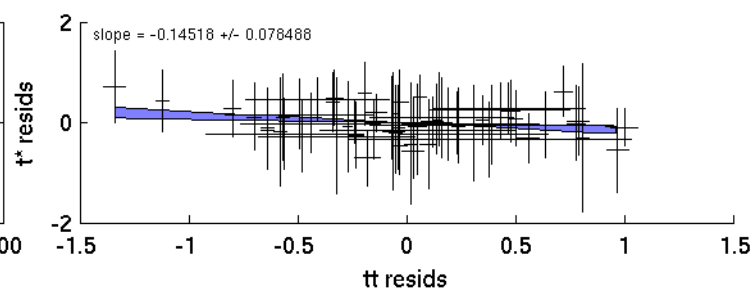
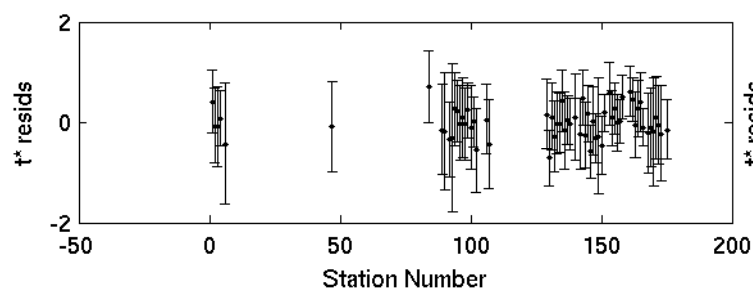


Event\_2000\_222\_22\_55\_59

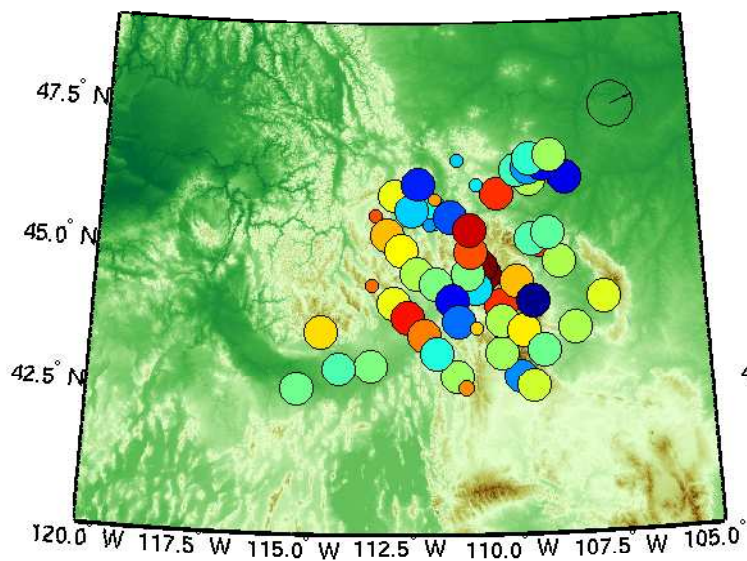
Stack



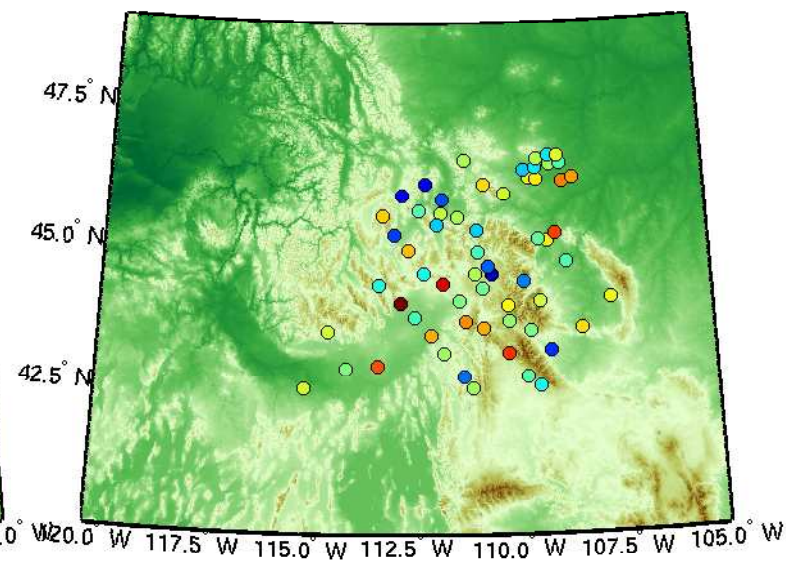
Baz = 247.9847  
Mean xcor value = 0.71097  
Range of t\* values is 1.4271  
Median t\* err is 0.66673  
Slope = -0.14518 +/- 0.078488



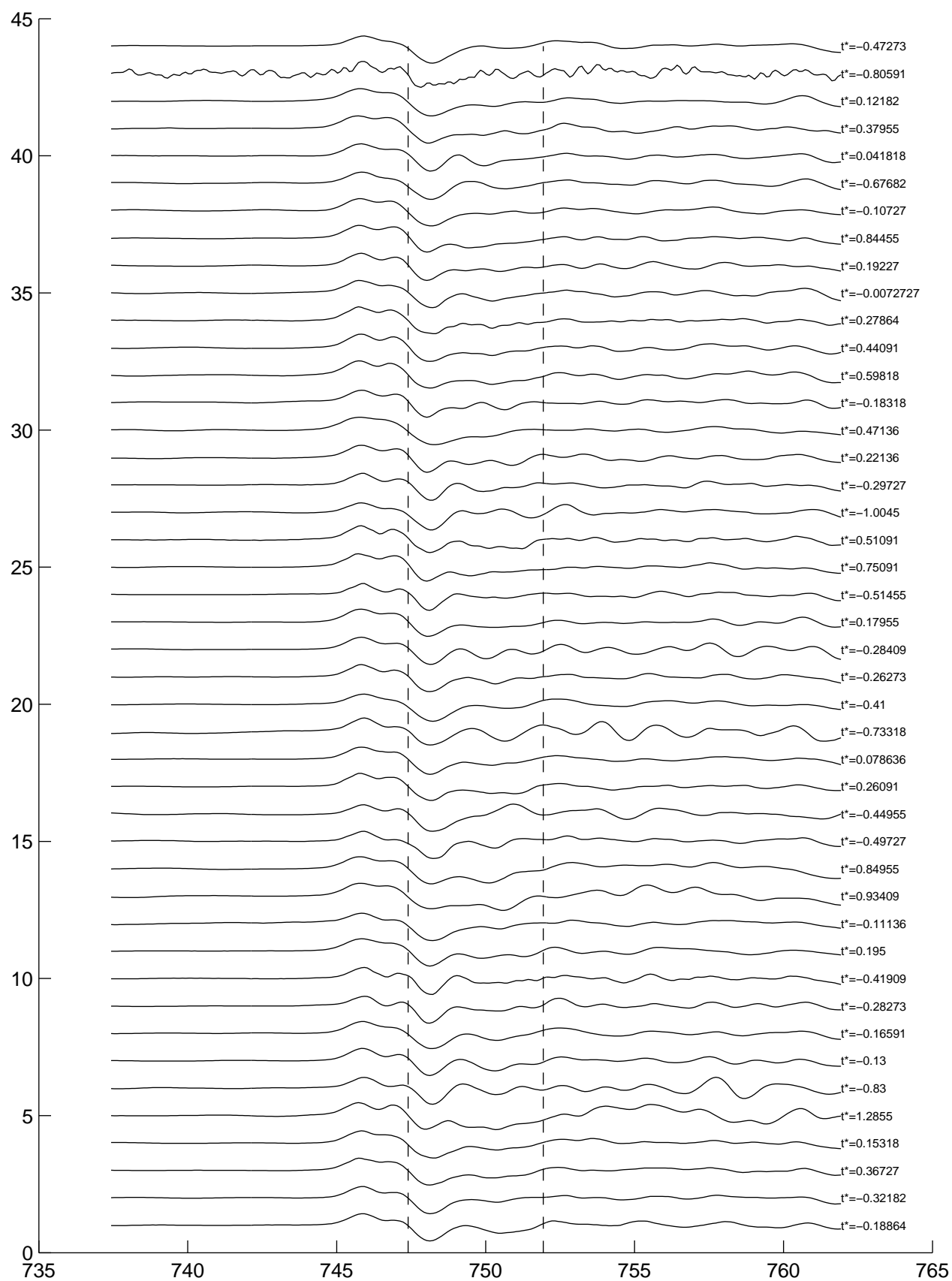
travel time residuals



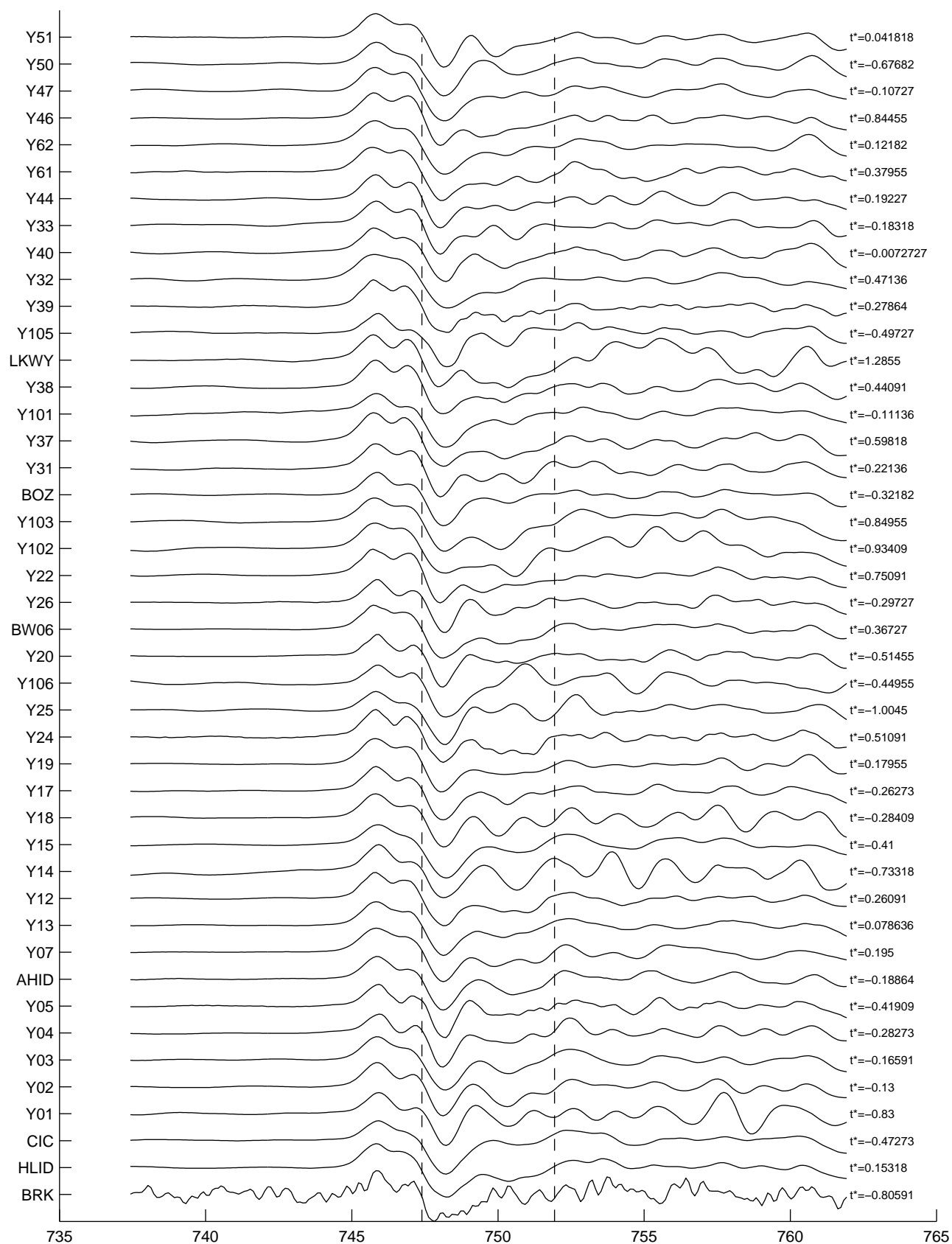
t\* values



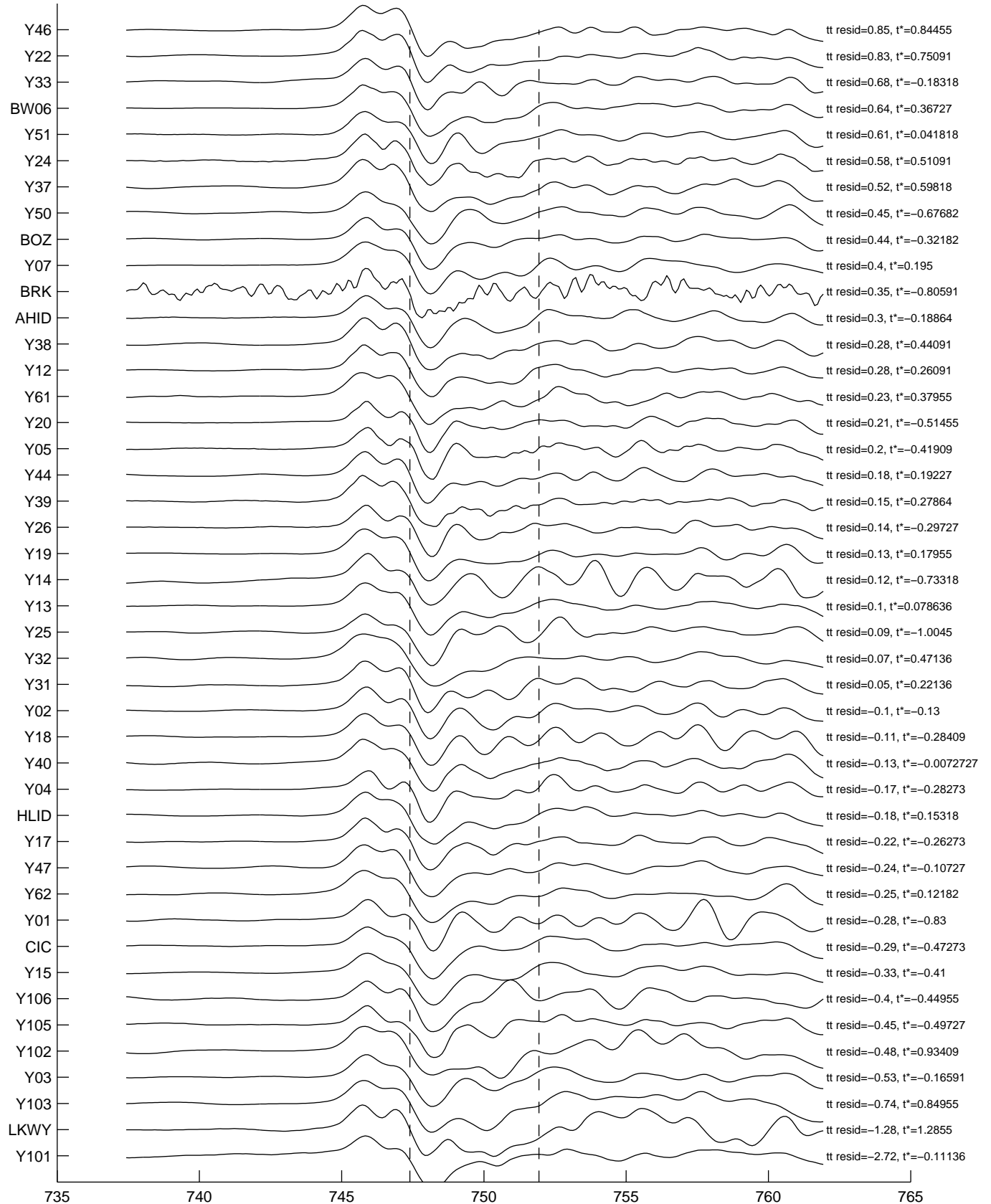
# Event\_2000\_270\_06\_17\_52



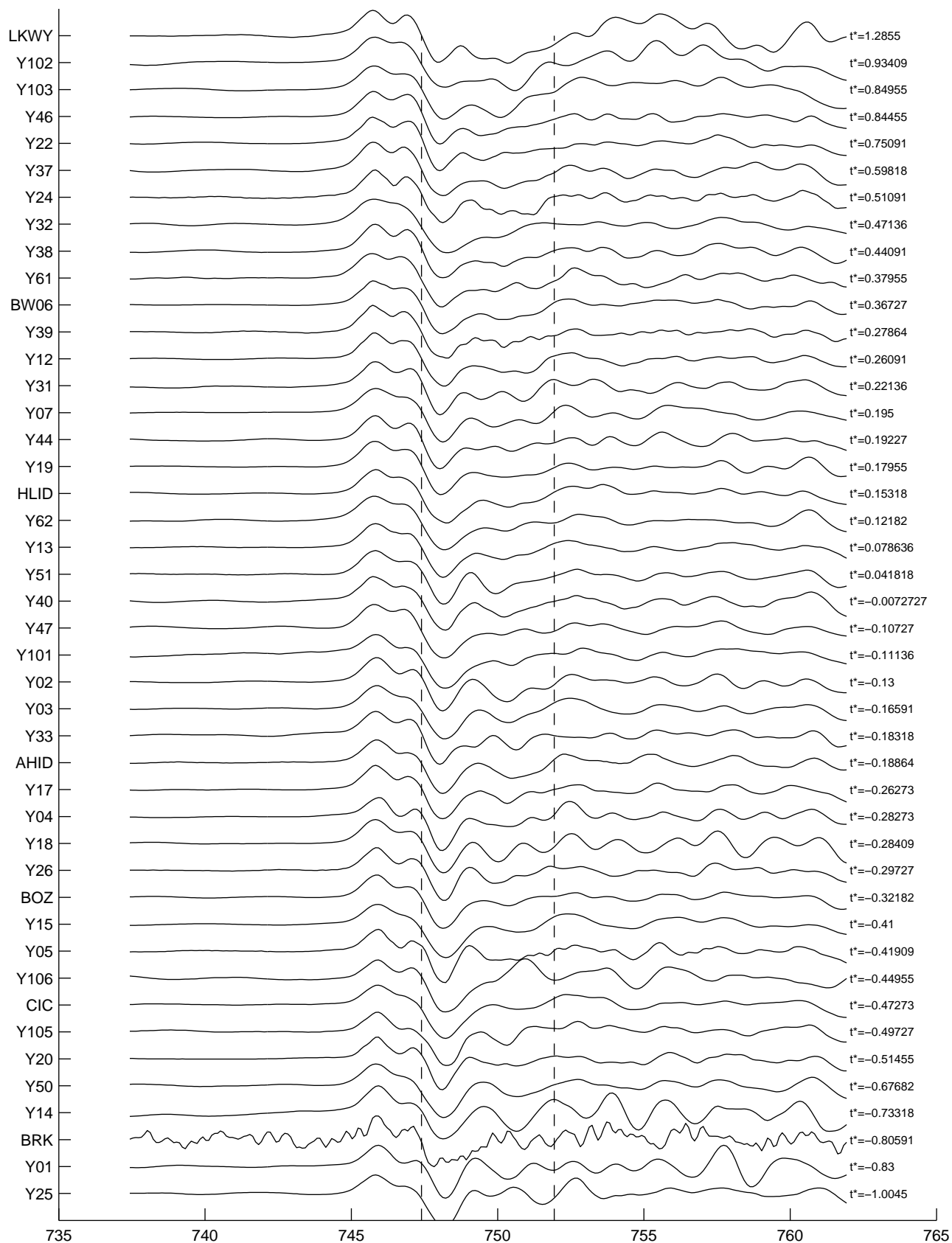
# Sorted by Delta:Event\_2000\_270\_06\_17\_52



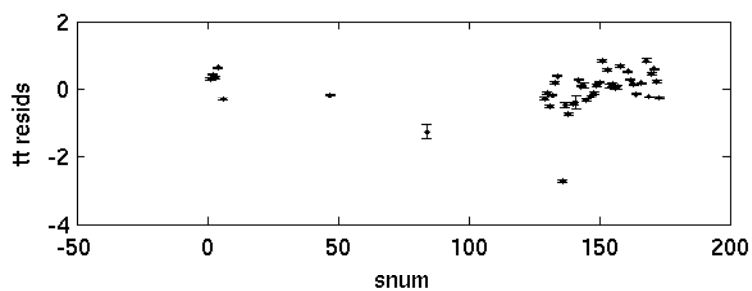
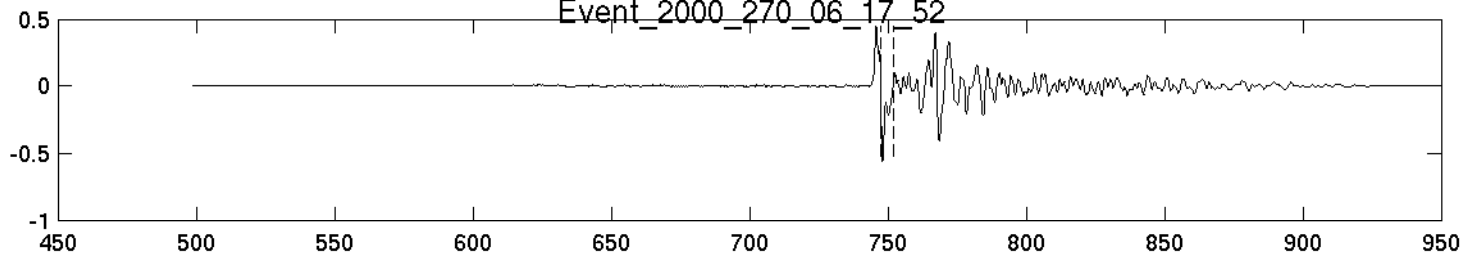
# Sorted by travel time:Event\_2000\_270\_06\_17\_52



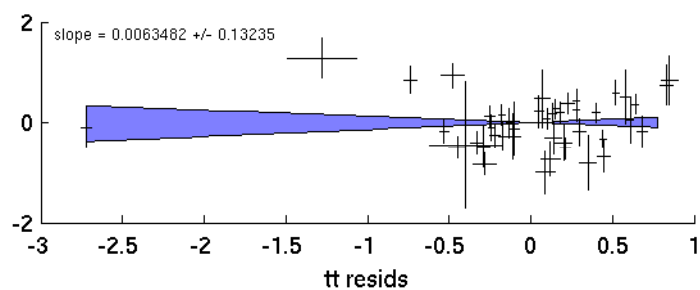
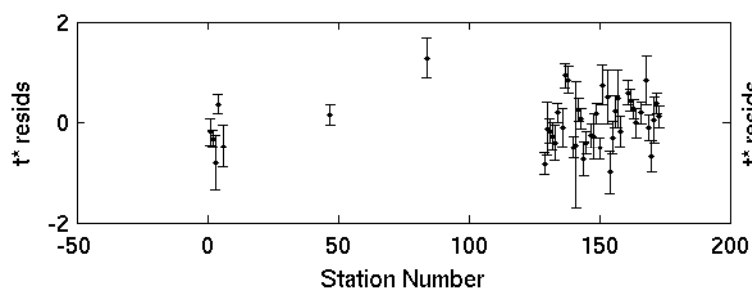
# Sorted by $t^*$ :Event\_2000\_270\_06\_17\_52



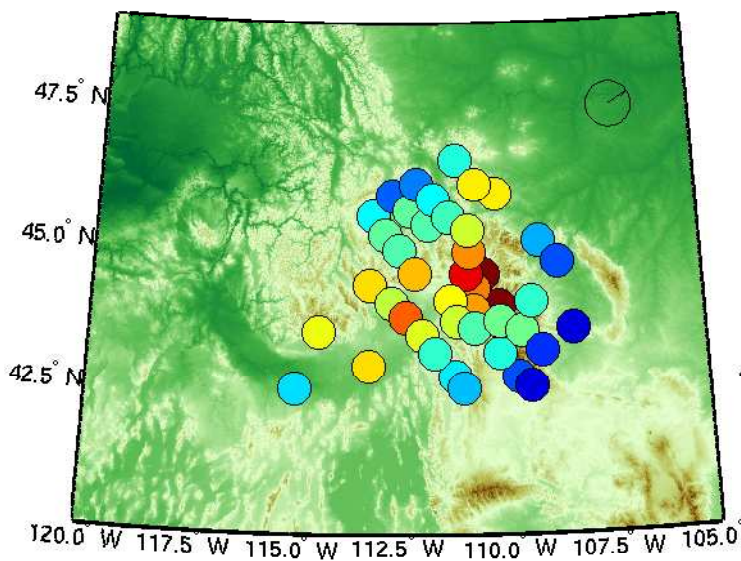
Stack  
Event\_2000\_270\_06\_17\_52



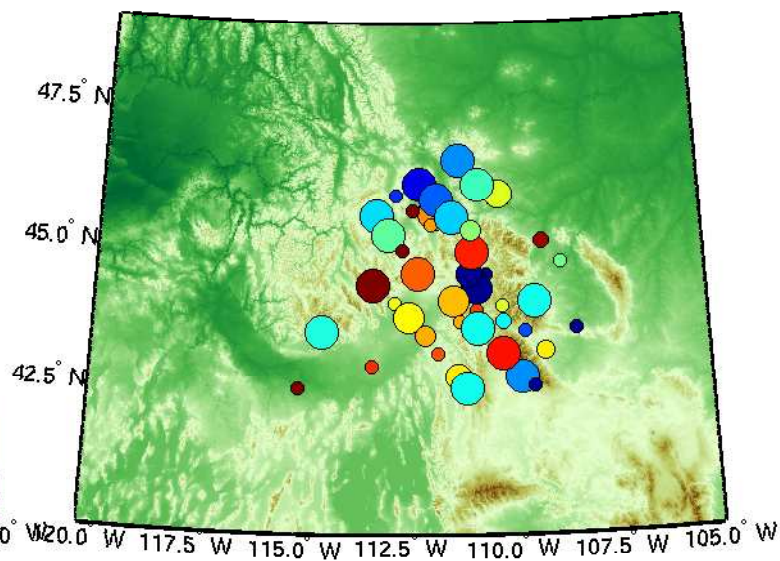
Baz = 238.6518  
Mean xcor value = 0.82159  
Range of  $t^*$  values is 2.29  
Median  $t^*$  err is 0.26861  
Slope = 0.0063482 +/- 0.13235



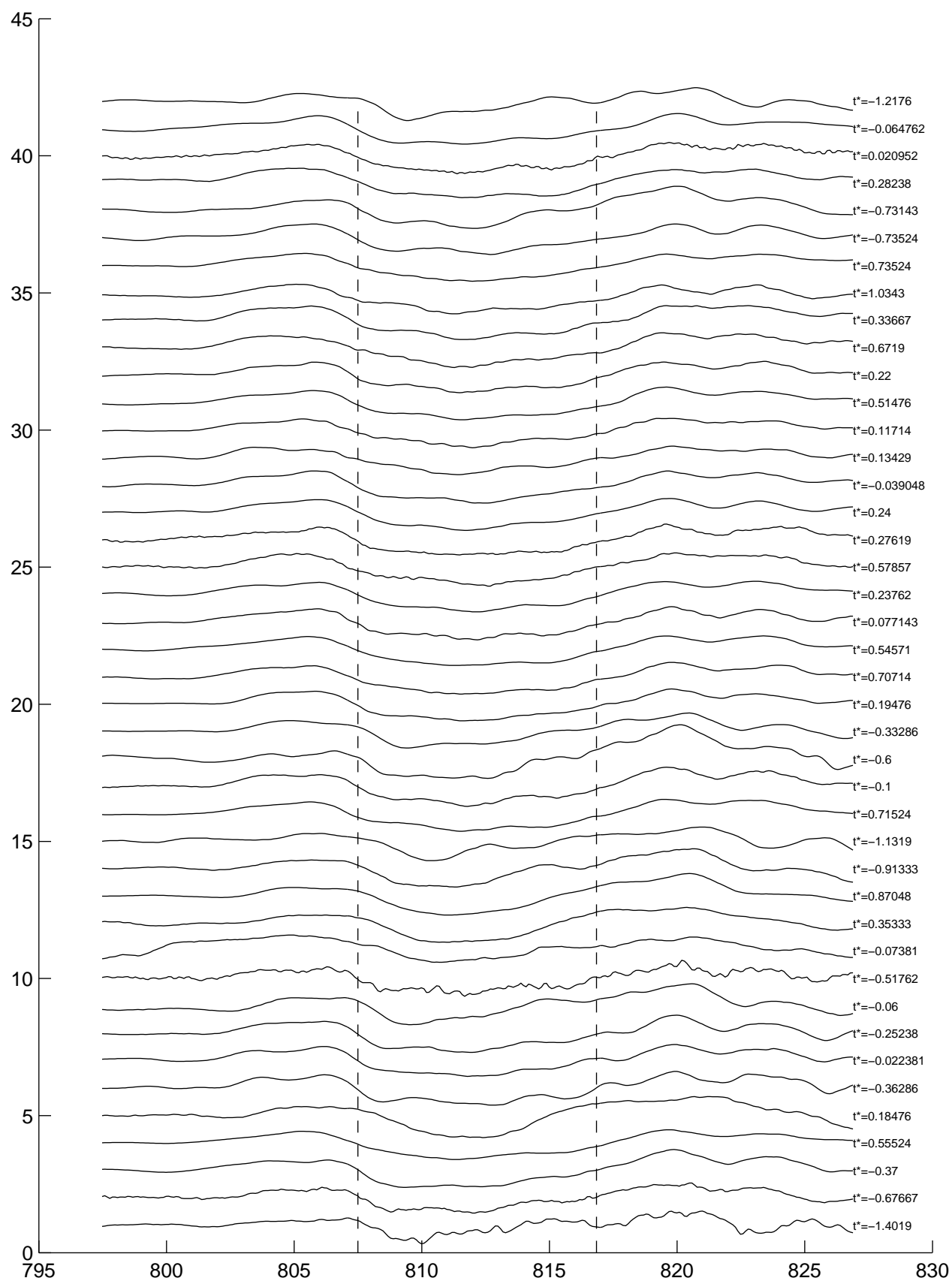
travel time residuals



$t^*$  values

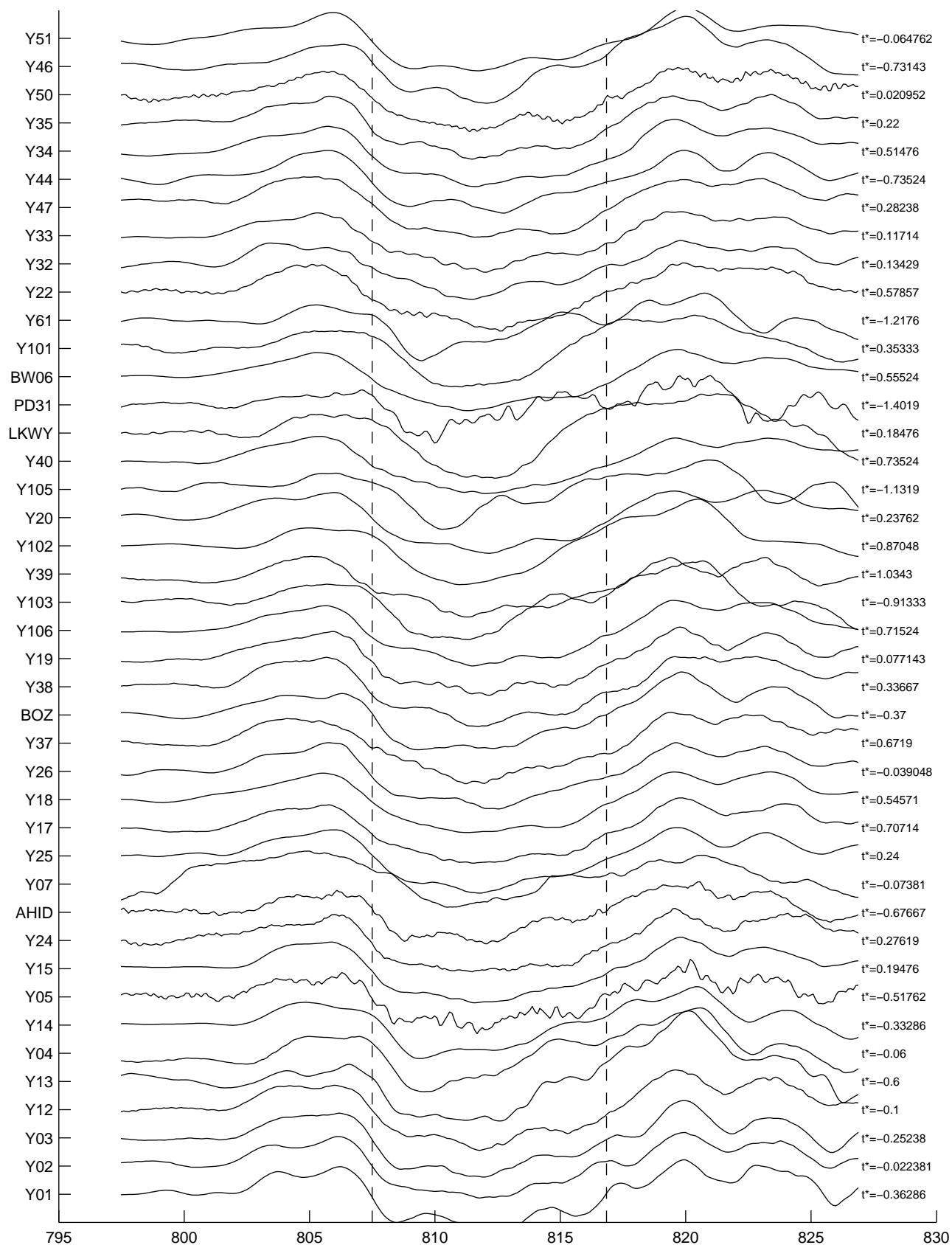


# Event\_2000\_278\_16\_58\_44

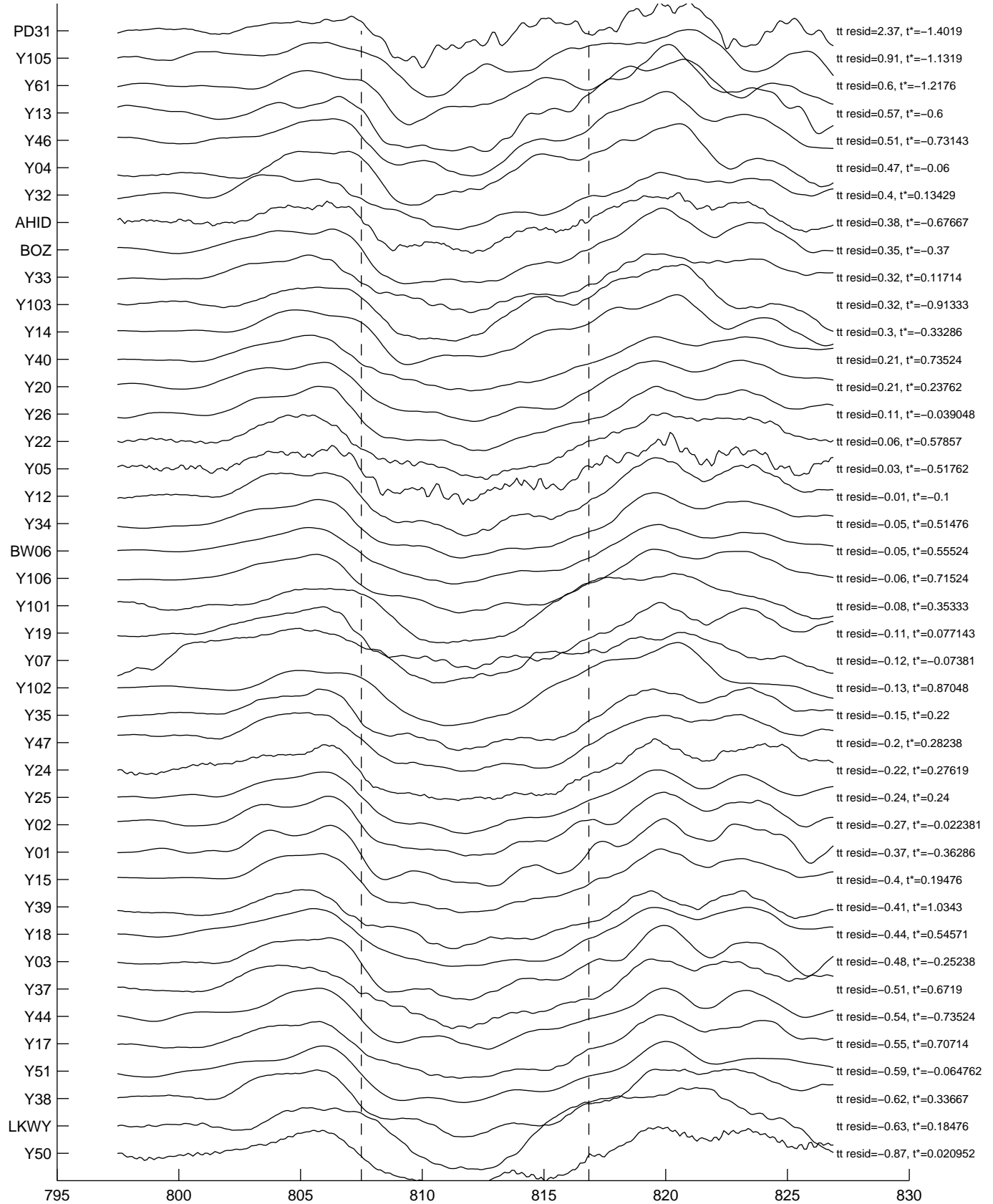




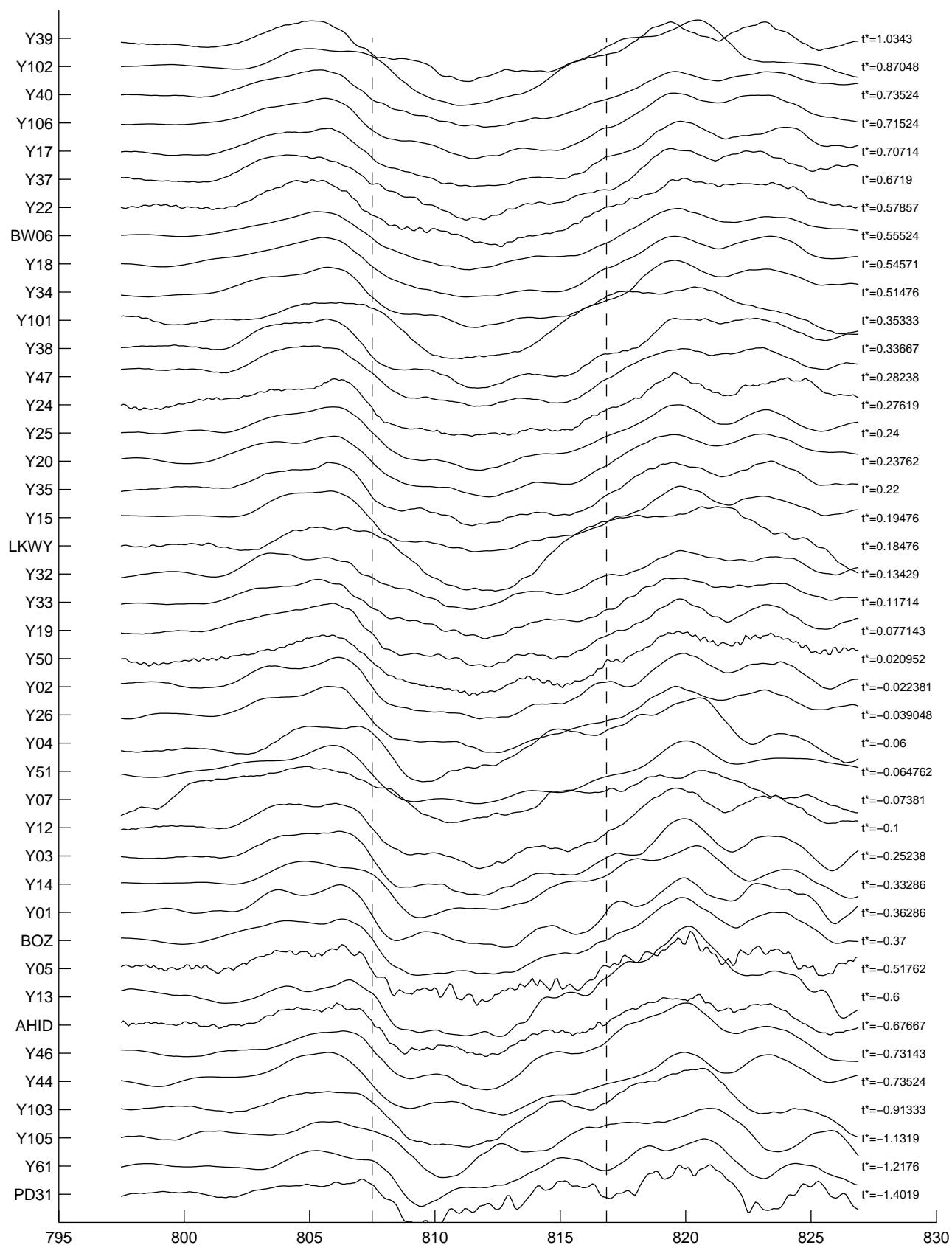
# Sorted by Delta:Event\_2000\_278\_16\_58\_44



# Sorted by travel time:Event\_2000\_278\_16\_58\_44

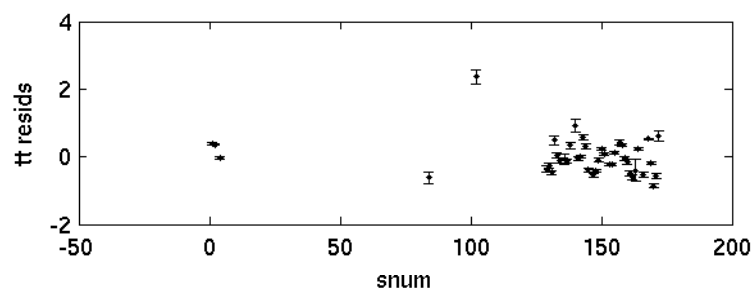
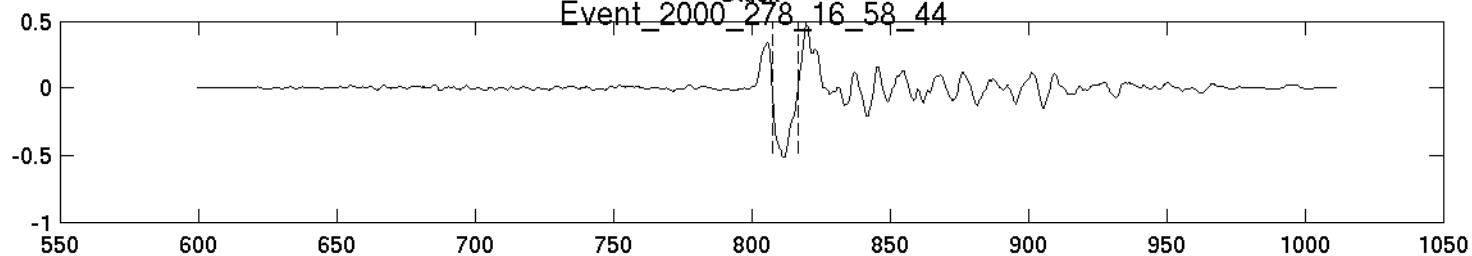


# Sorted by $t^*$ :Event\_2000\_278\_16\_58\_44

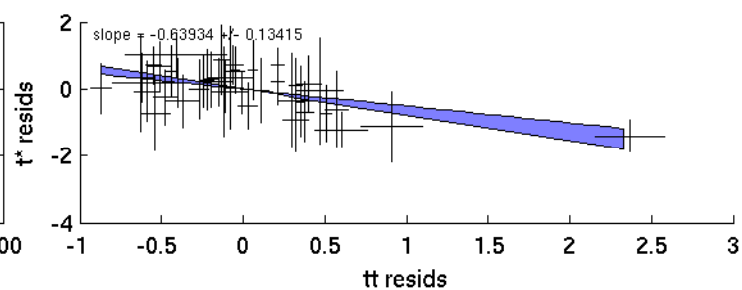
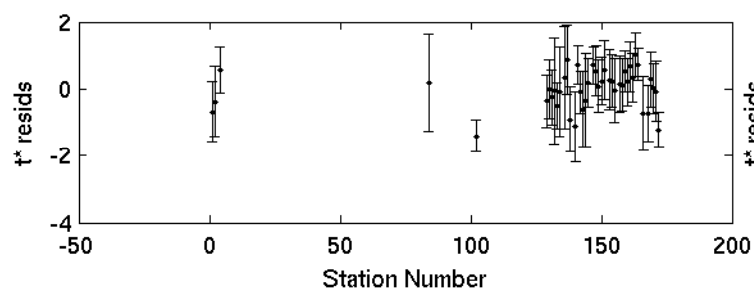


Event\_2000\_278\_16\_58\_44

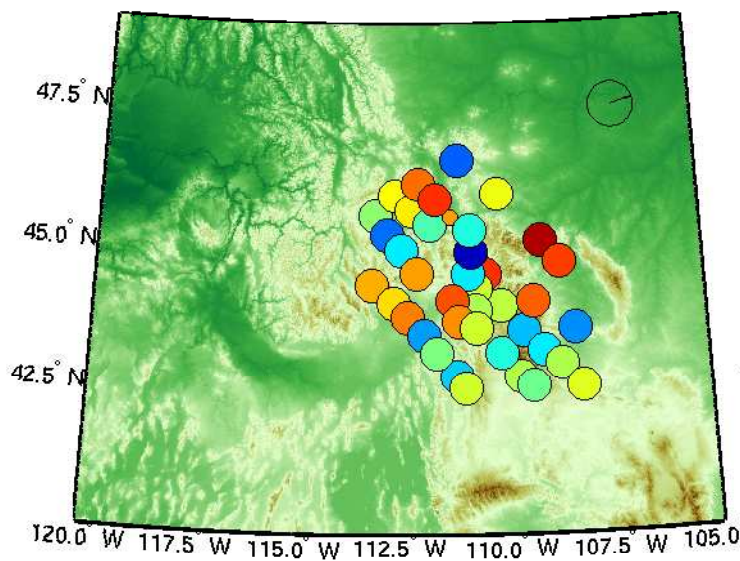
Stack



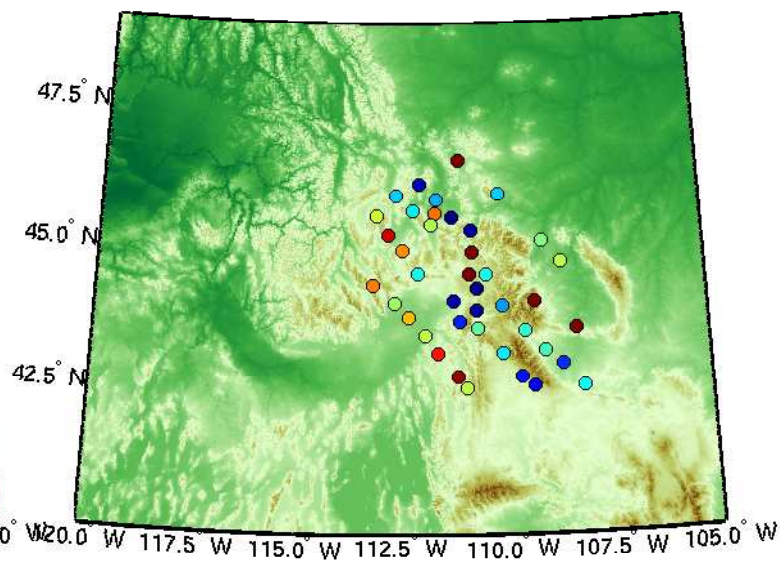
Baz = 253.4899  
Mean xcor value = 0.8219  
Range of  $t^*$  values is 2.4362  
Median  $t^*$  err is 0.79978  
Slope = -0.63934 +/- 0.13415



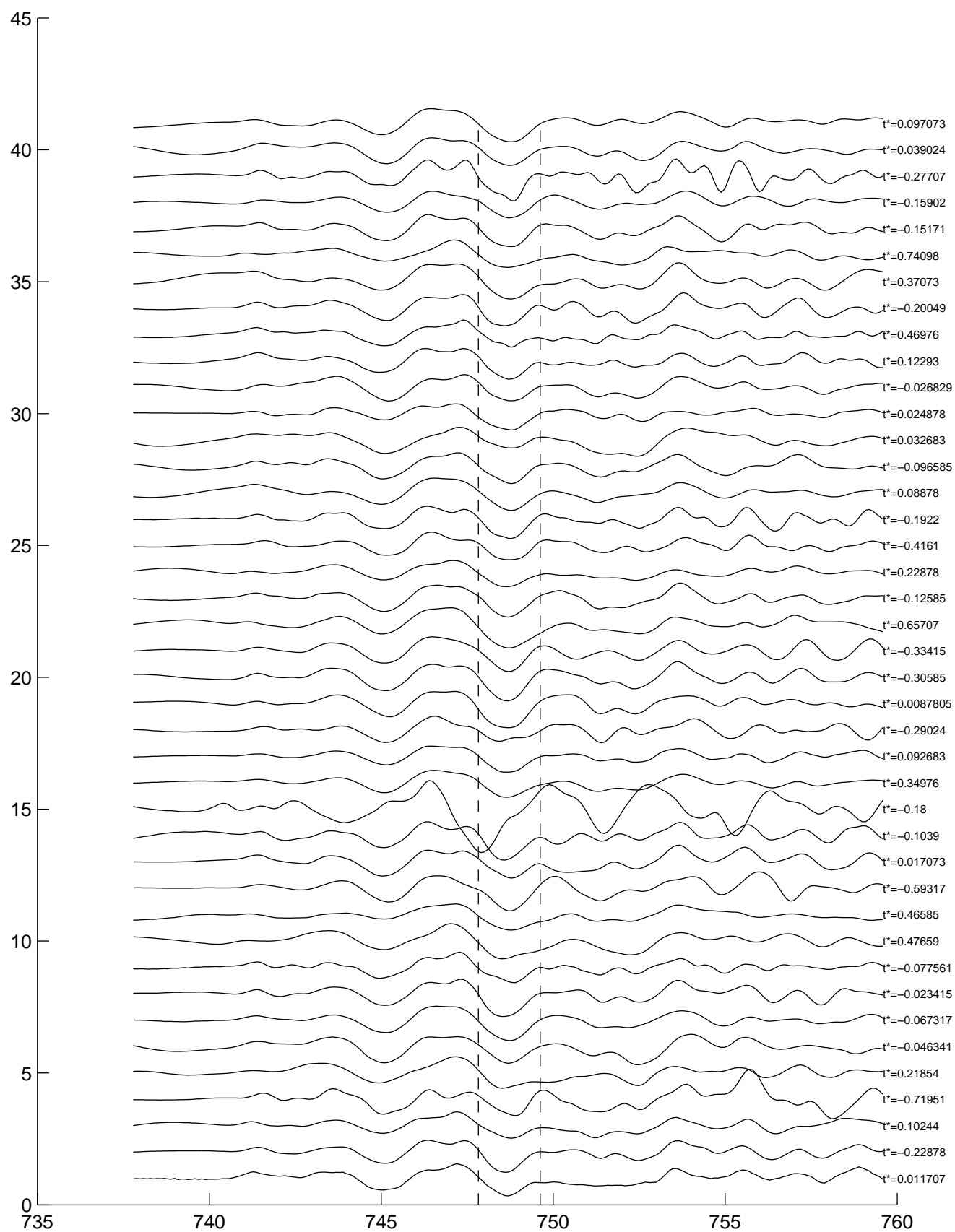
travel time residuals



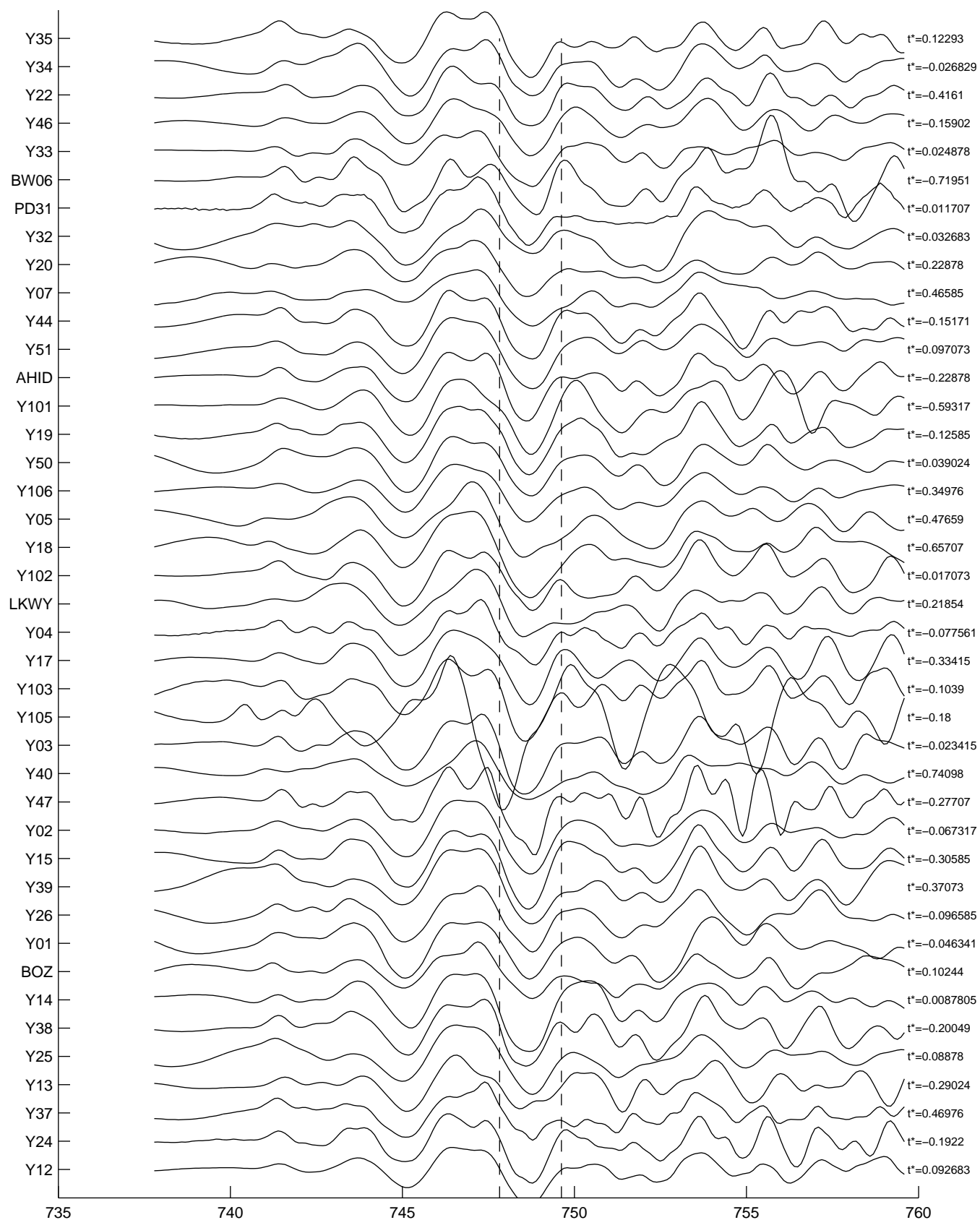
$t^*$  values



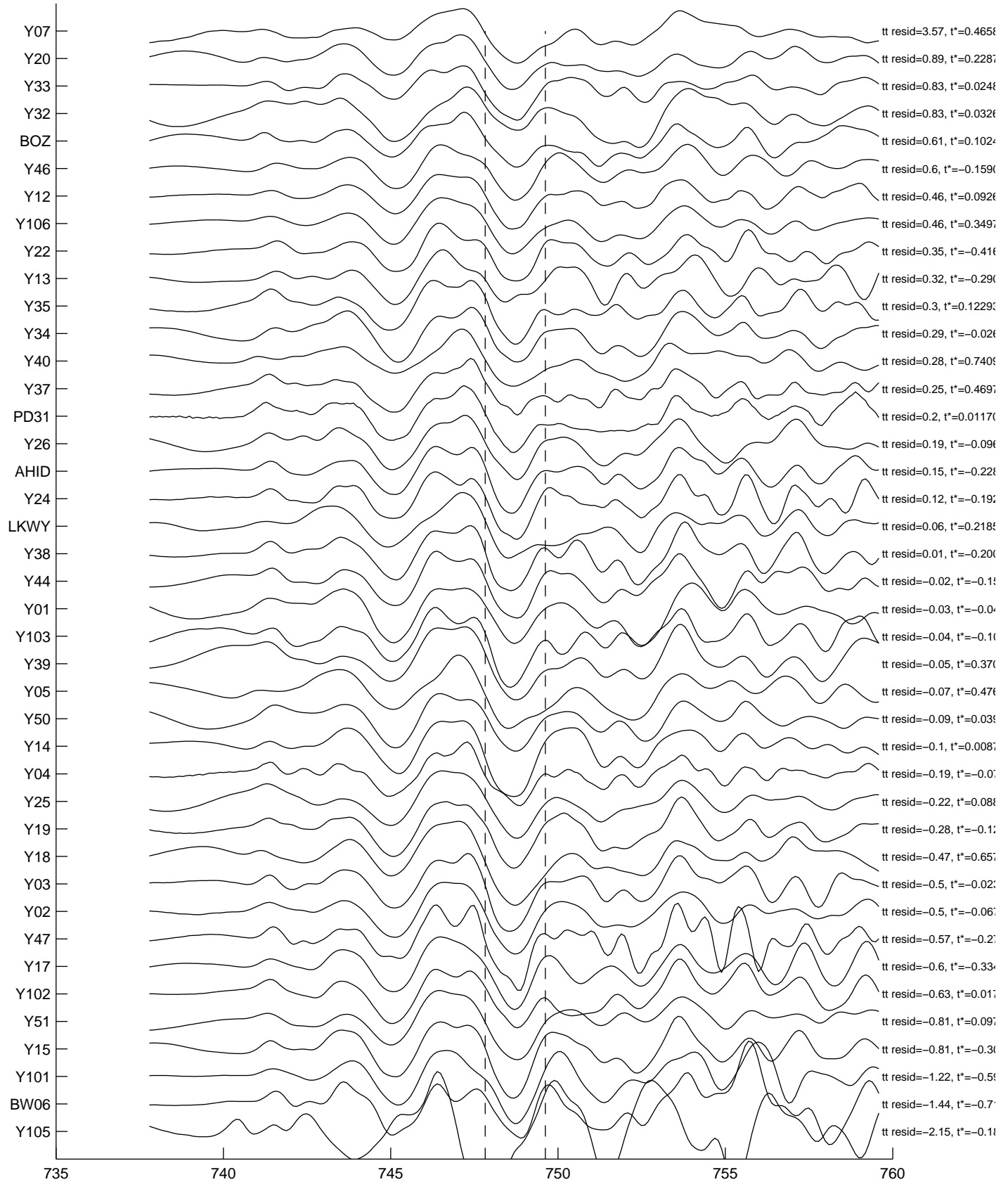
# Event\_2000\_280\_04\_30\_19



# Sorted by Delta:Event\_2000\_280\_04\_30\_19

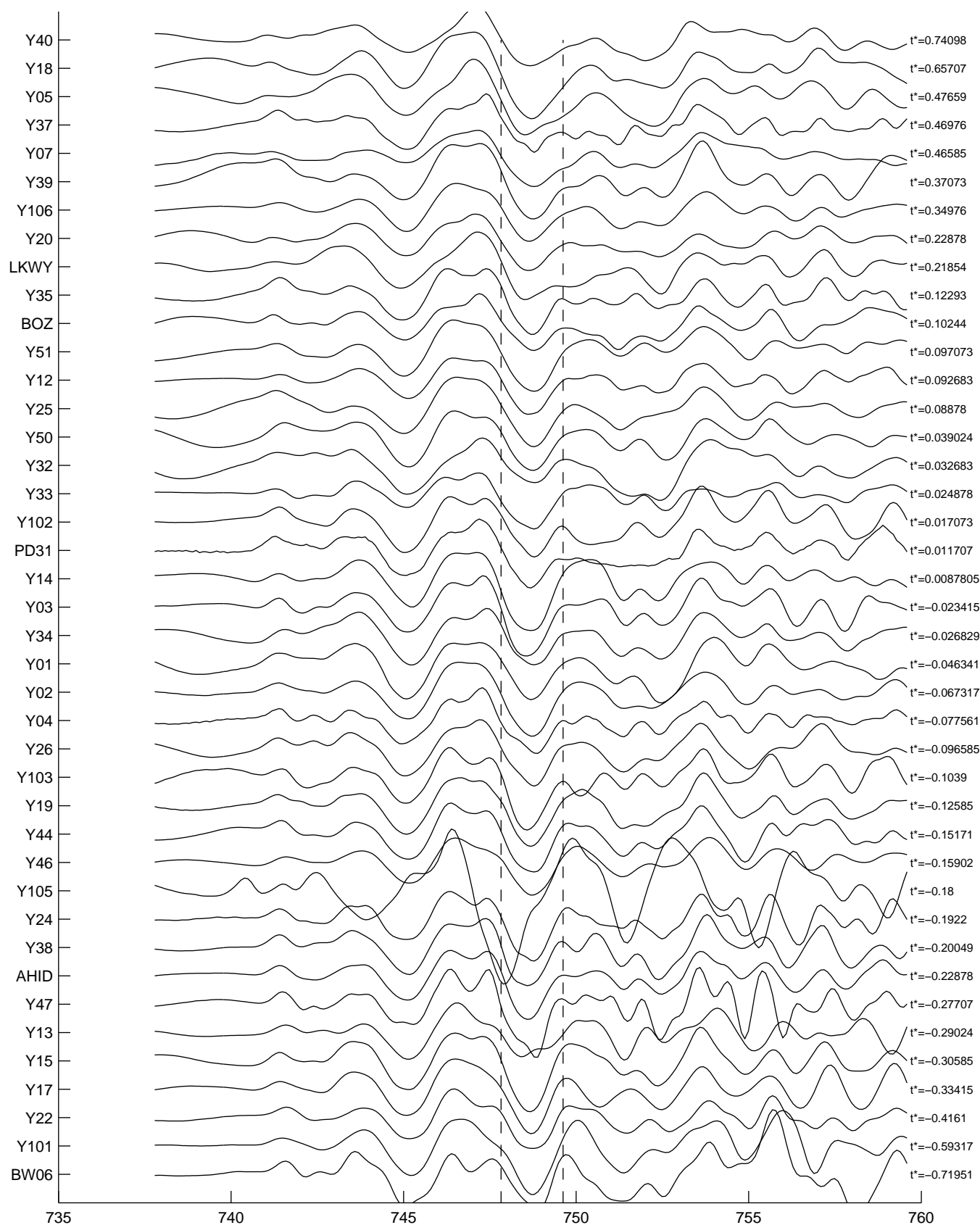


# Sorted by travel time:Event\_2000\_280\_04\_30\_19

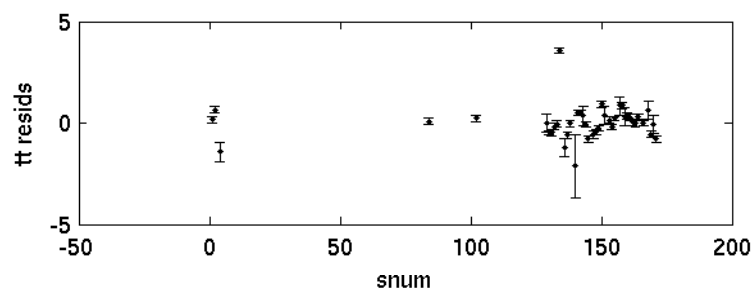
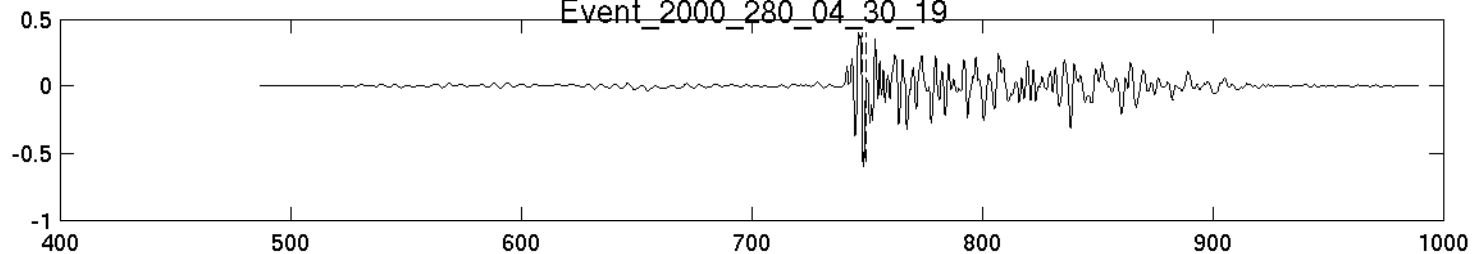




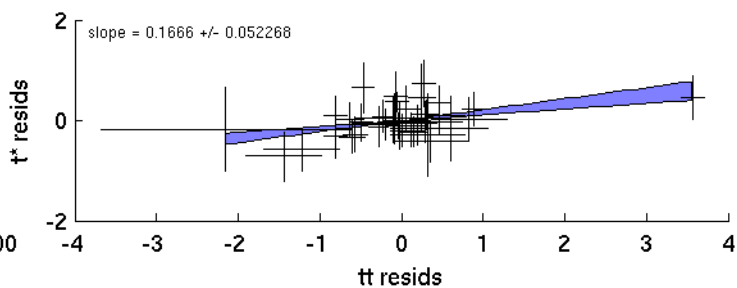
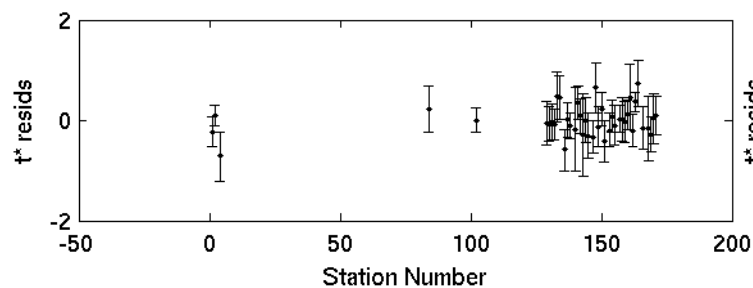
# Sorted by $t^*$ :Event\_2000\_280\_04\_30\_19



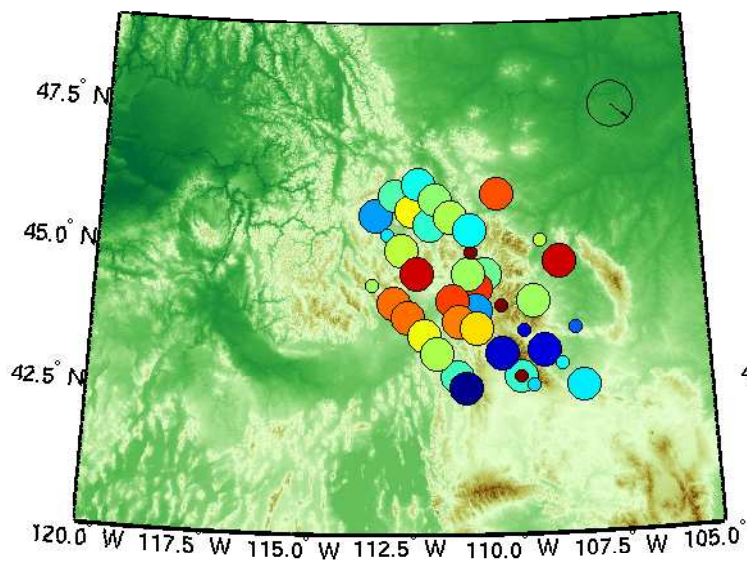
Stack  
Event\_2000\_280\_04\_30\_19



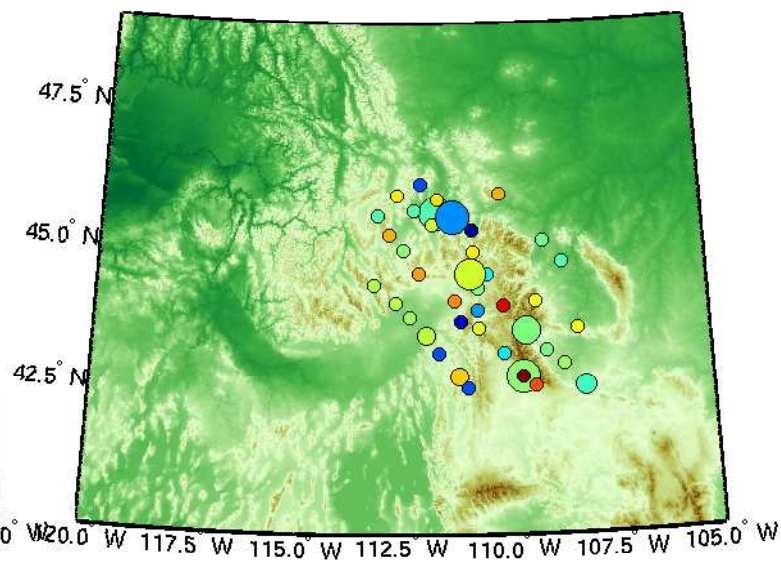
Baz = 312.1458  
Mean xcor value = 0.7278  
Range of  $t^*$  values is 1.4605  
Median  $t^*$  err is 0.39678  
Slope = 0.1666 +/- 0.052268



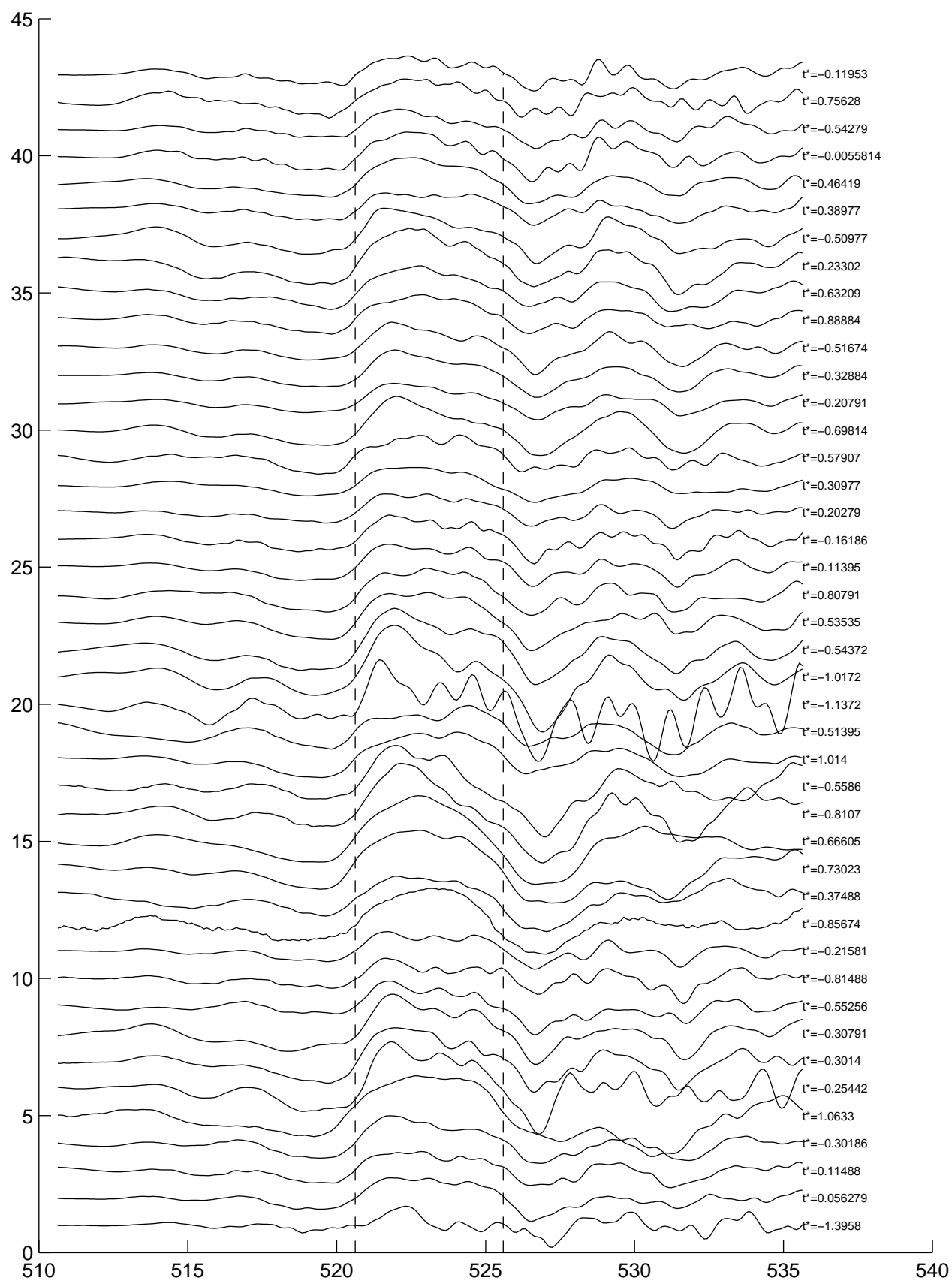
travel time residuals



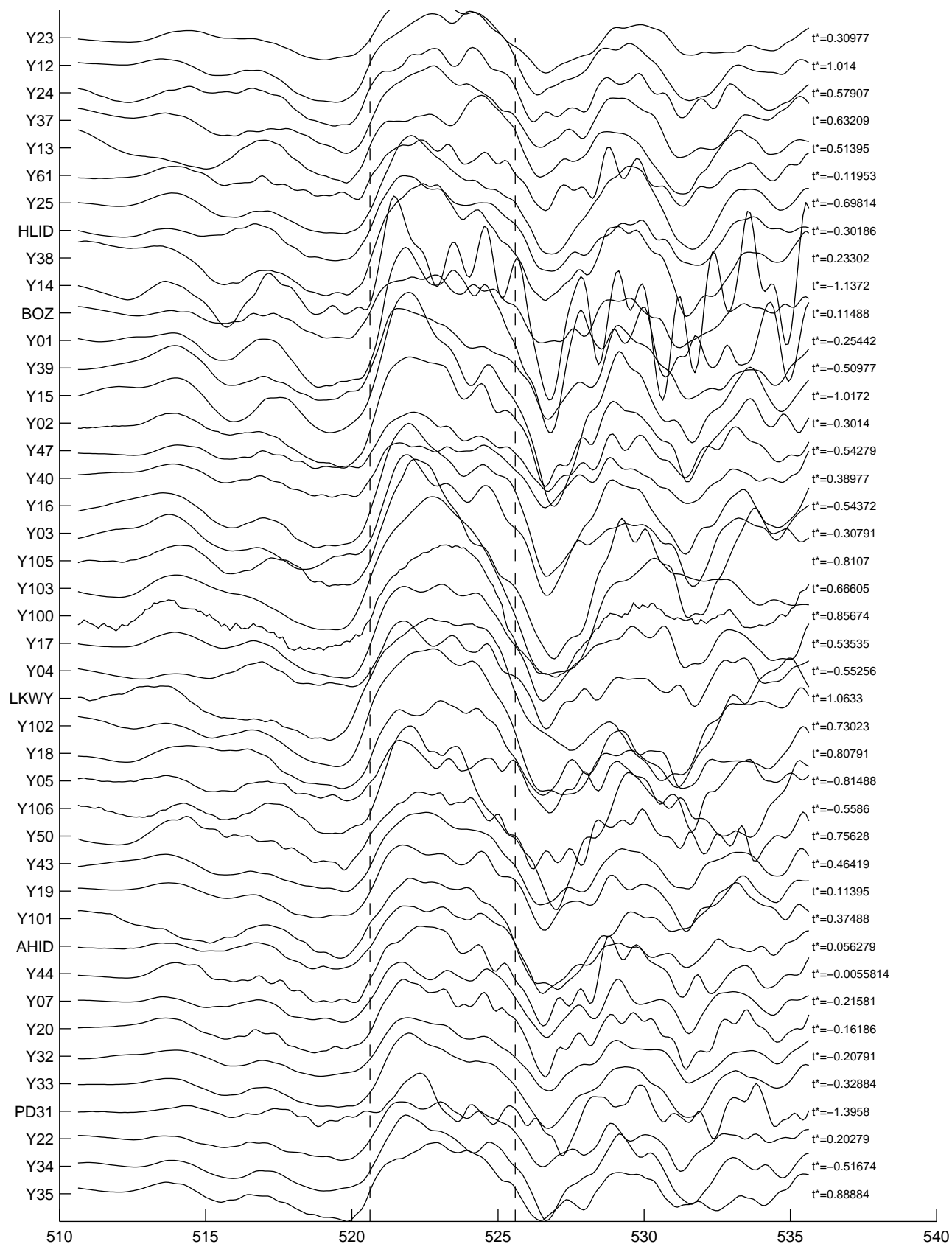
$t^*$  values



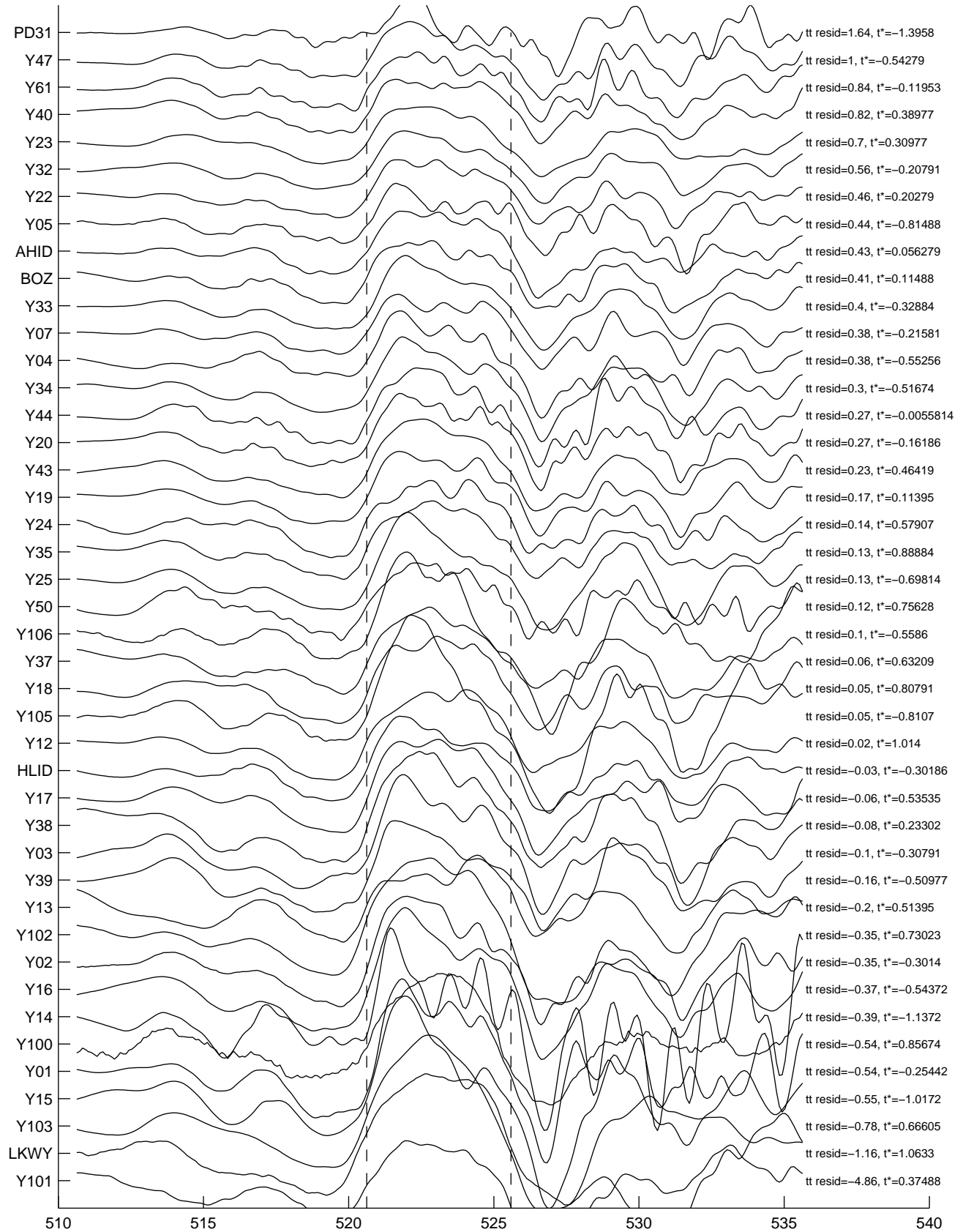
# Event\_2000\_313\_06\_59\_58



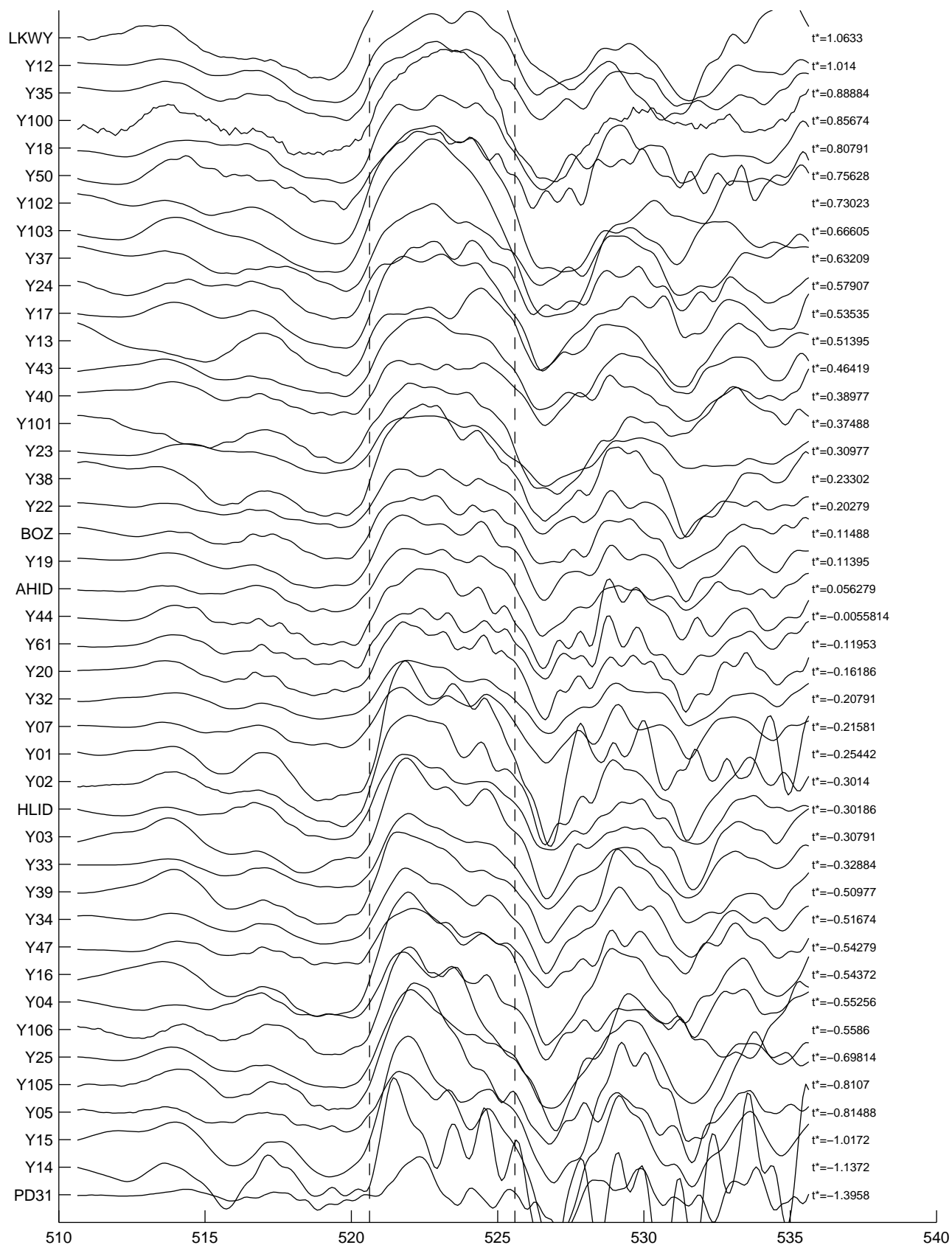
# Sorted by Delta:Event\_2000\_313\_06\_59\_58



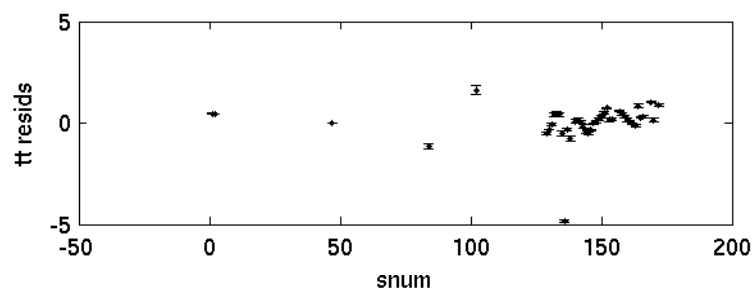
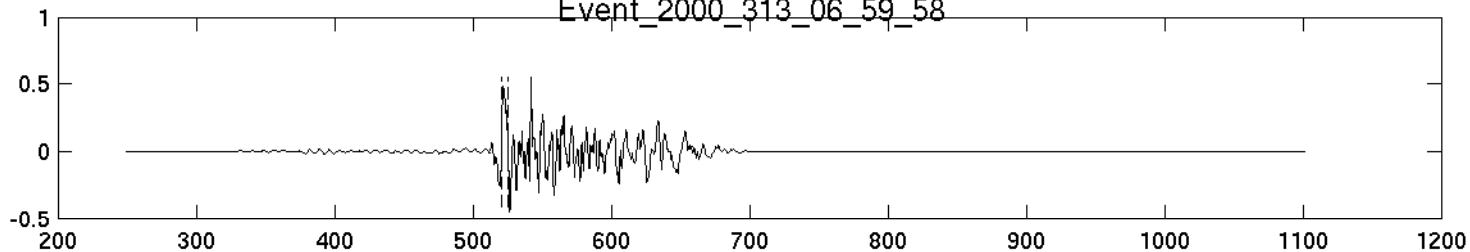
# Sorted by travel time:Event\_2000\_313\_06\_59\_58



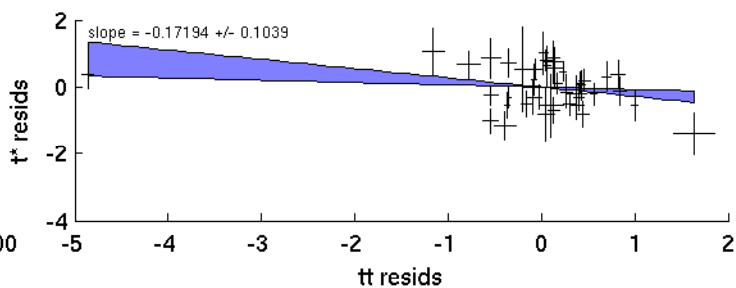
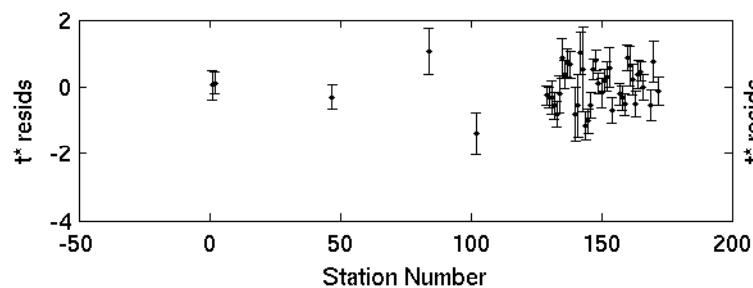
Sorted by  $t^*$ :Event\_2000\_313\_06\_59\_58



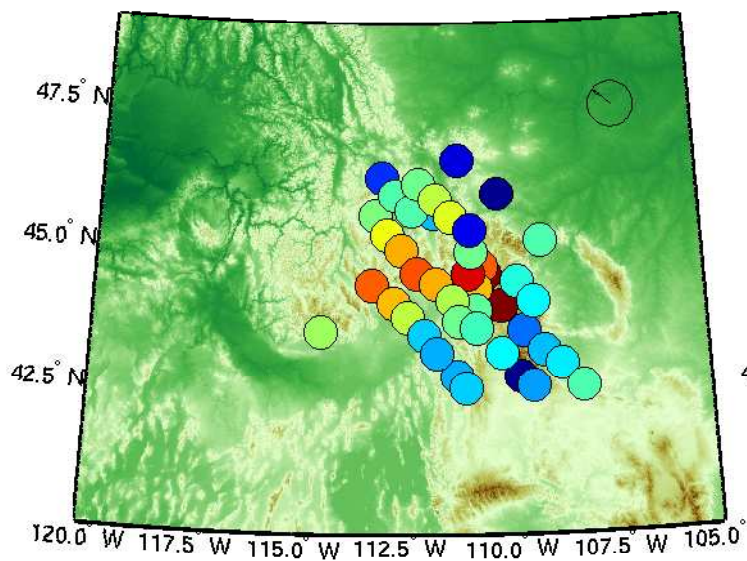
Stack  
Event\_2000\_313\_06\_59\_58



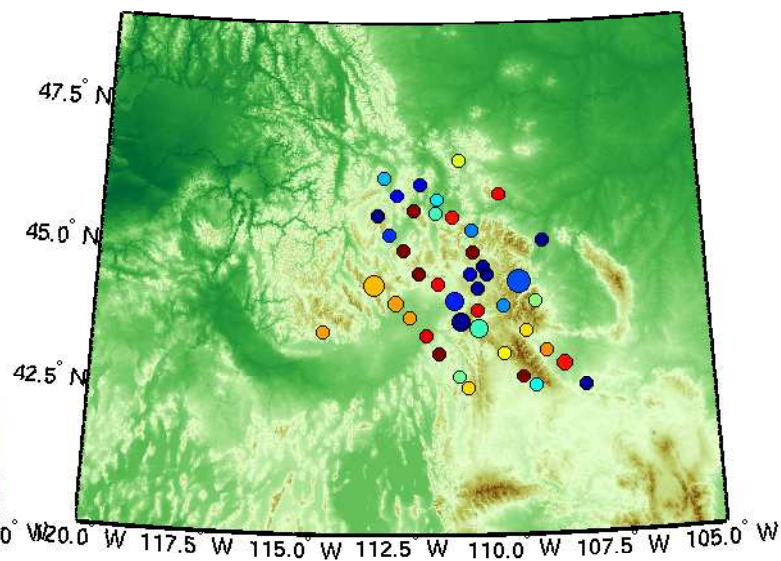
Baz = 132.2061  
Mean xcor value = 0.82651  
Range of  $t^*$  values is 2.4591  
Median  $t^*$  err is 0.41431  
Slope =  $-0.17194 \pm 0.1039$



travel time residuals

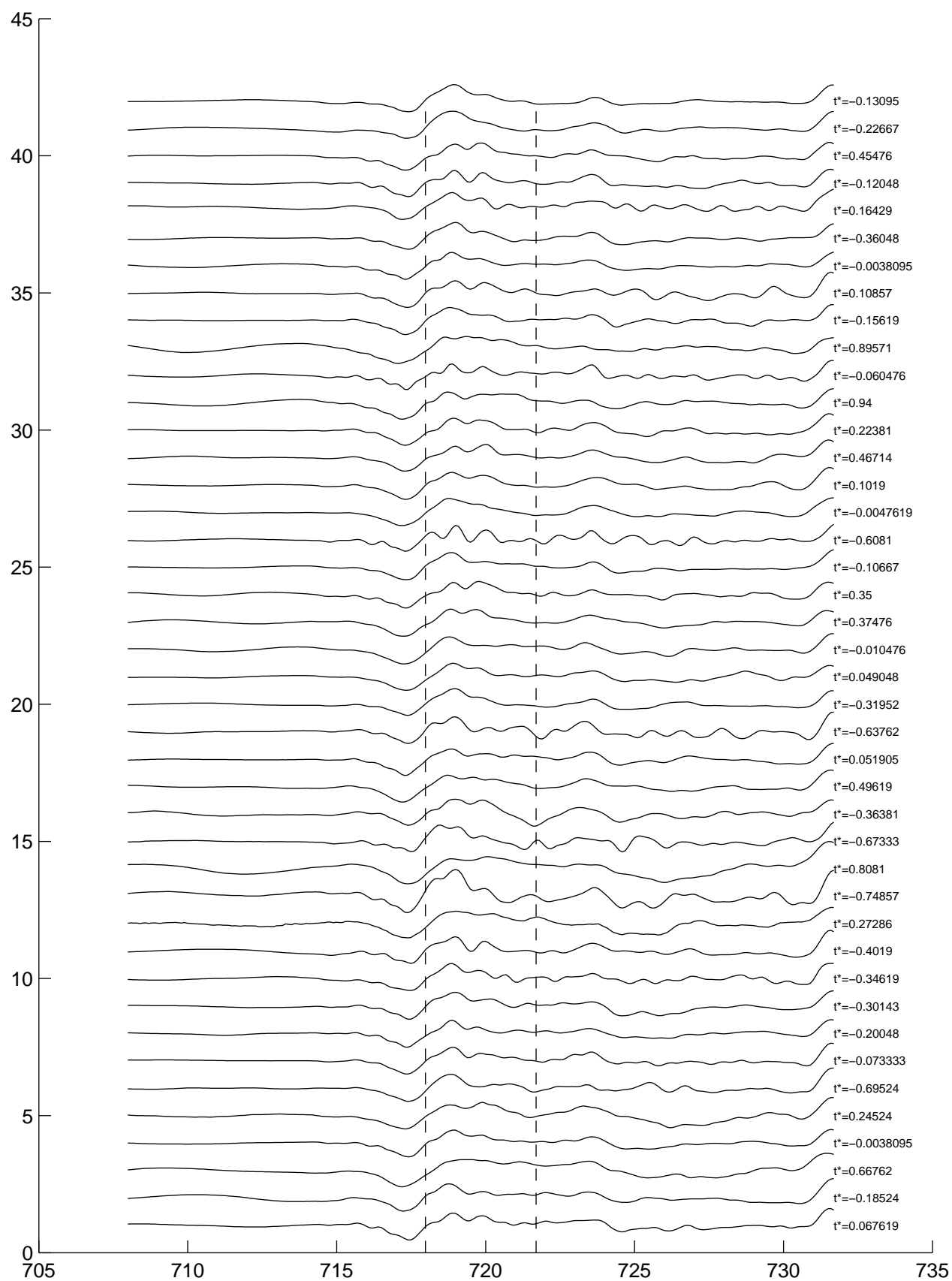


$t^*$  values

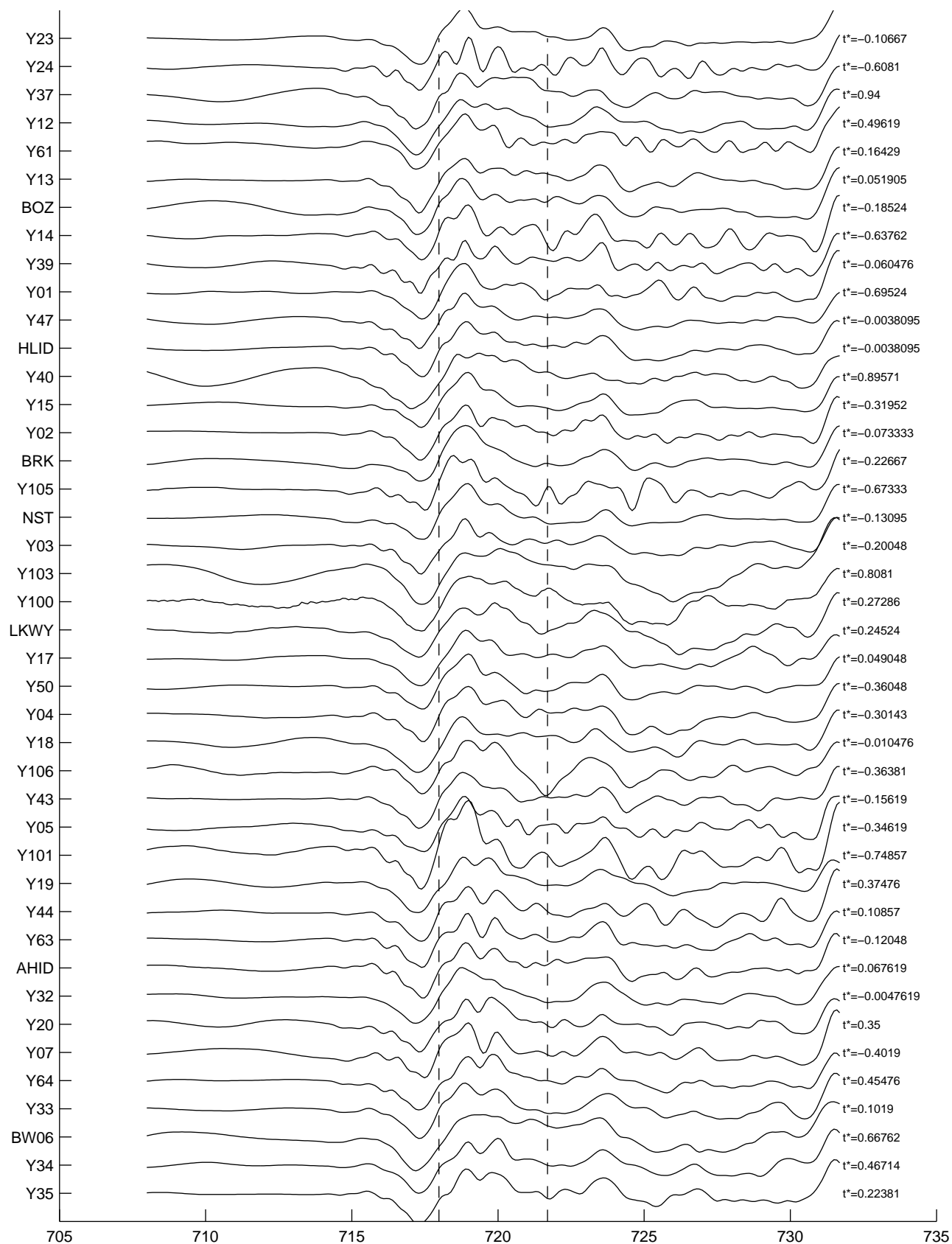




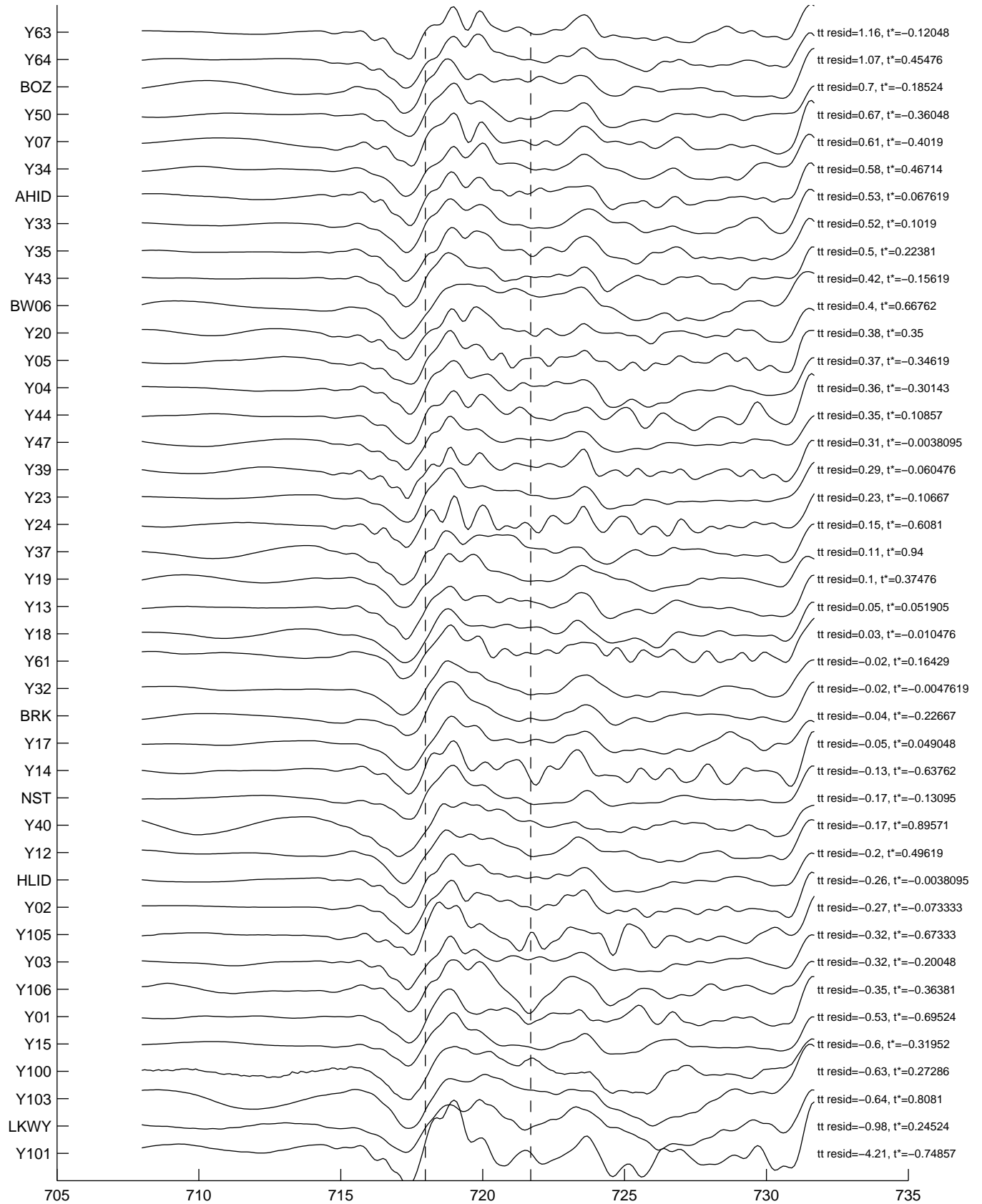
# Event\_2000\_334\_10\_25\_13



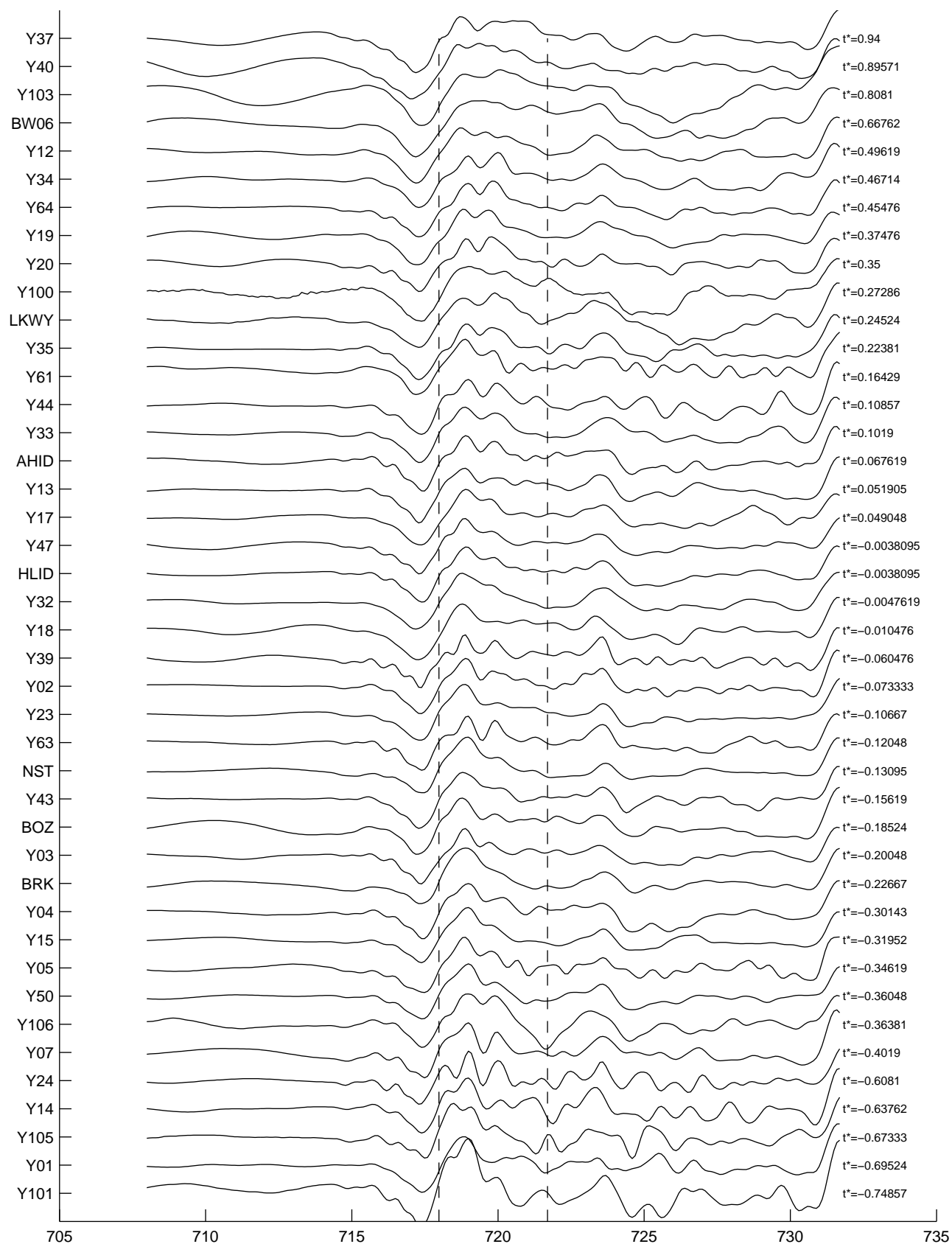
# Sorted by Delta:Event\_2000\_334\_10\_25\_13



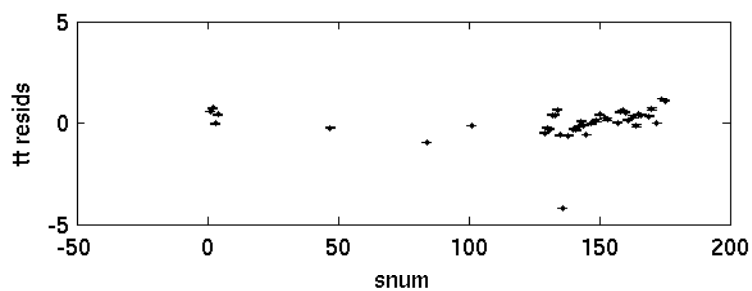
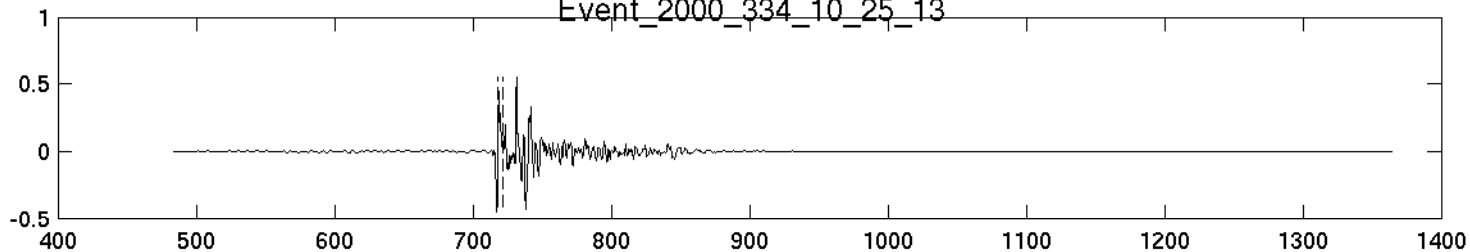
# Sorted by travel time:Event\_2000\_334\_10\_25\_13



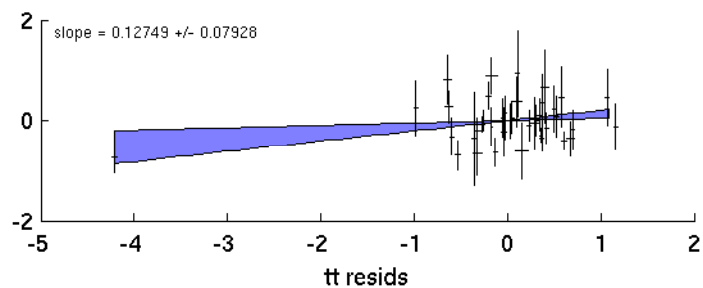
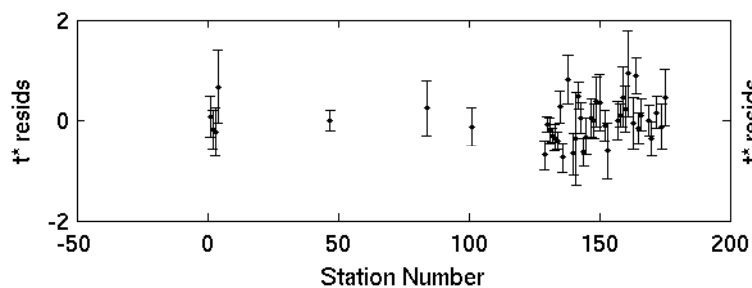
# Sorted by $t^*$ :Event\_2000\_334\_10\_25\_13



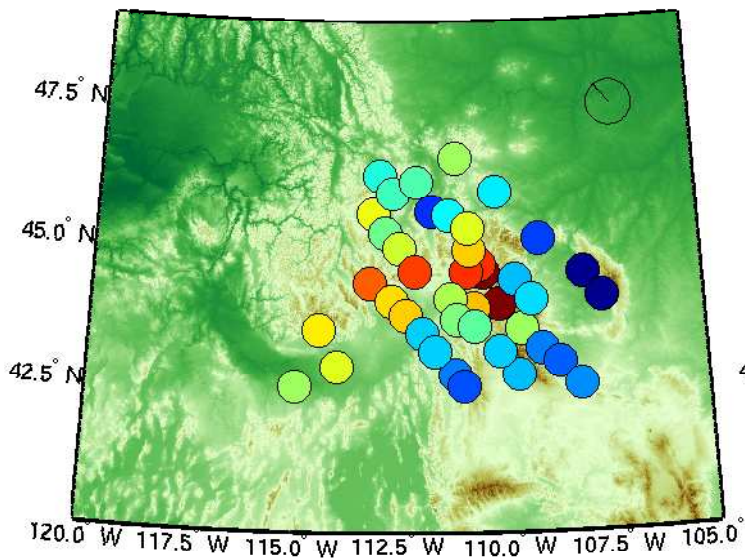
# Stack Event\_2000\_334\_10\_25\_13



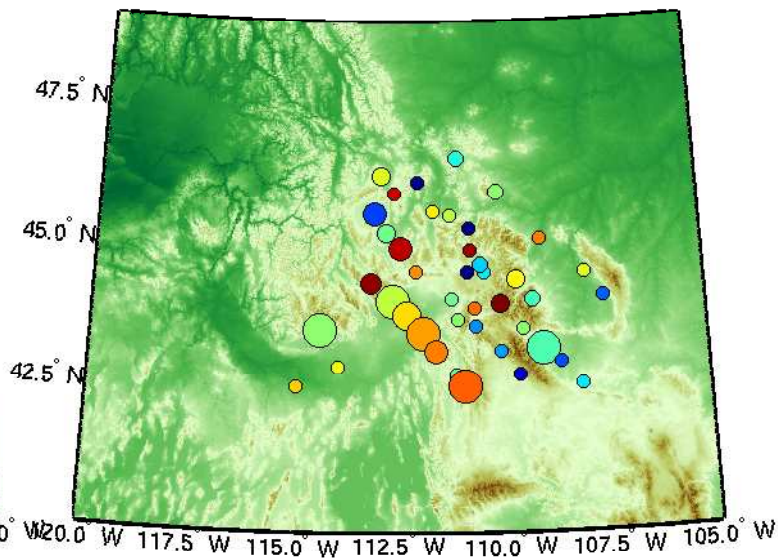
Baz = 143.2559  
Mean xcor value = 0.77548  
Range of  $t^*$  values is 1.6886  
Median  $t^*$  err is 0.36098  
Slope = 0.12749 +/- 0.07928



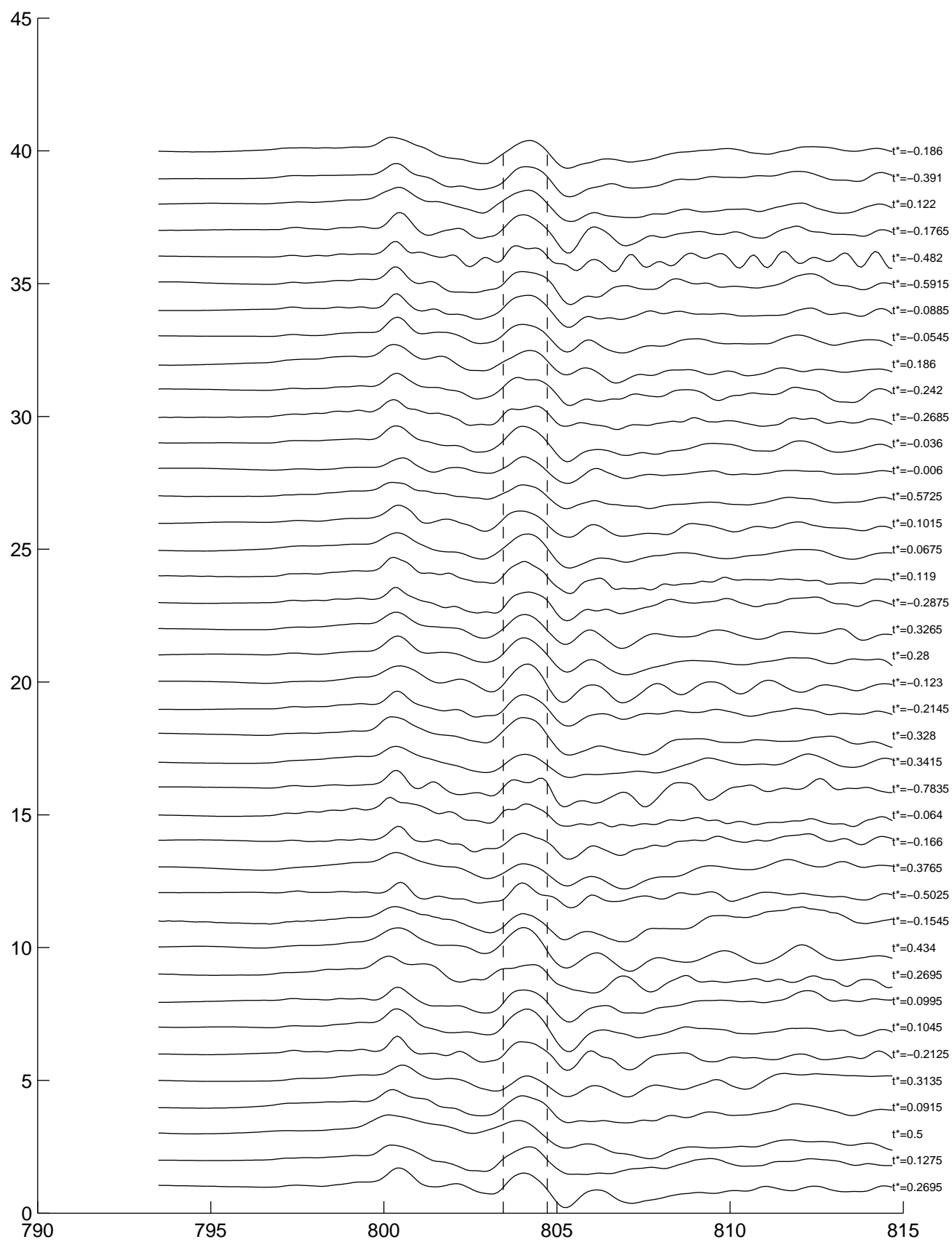
travel time residuals



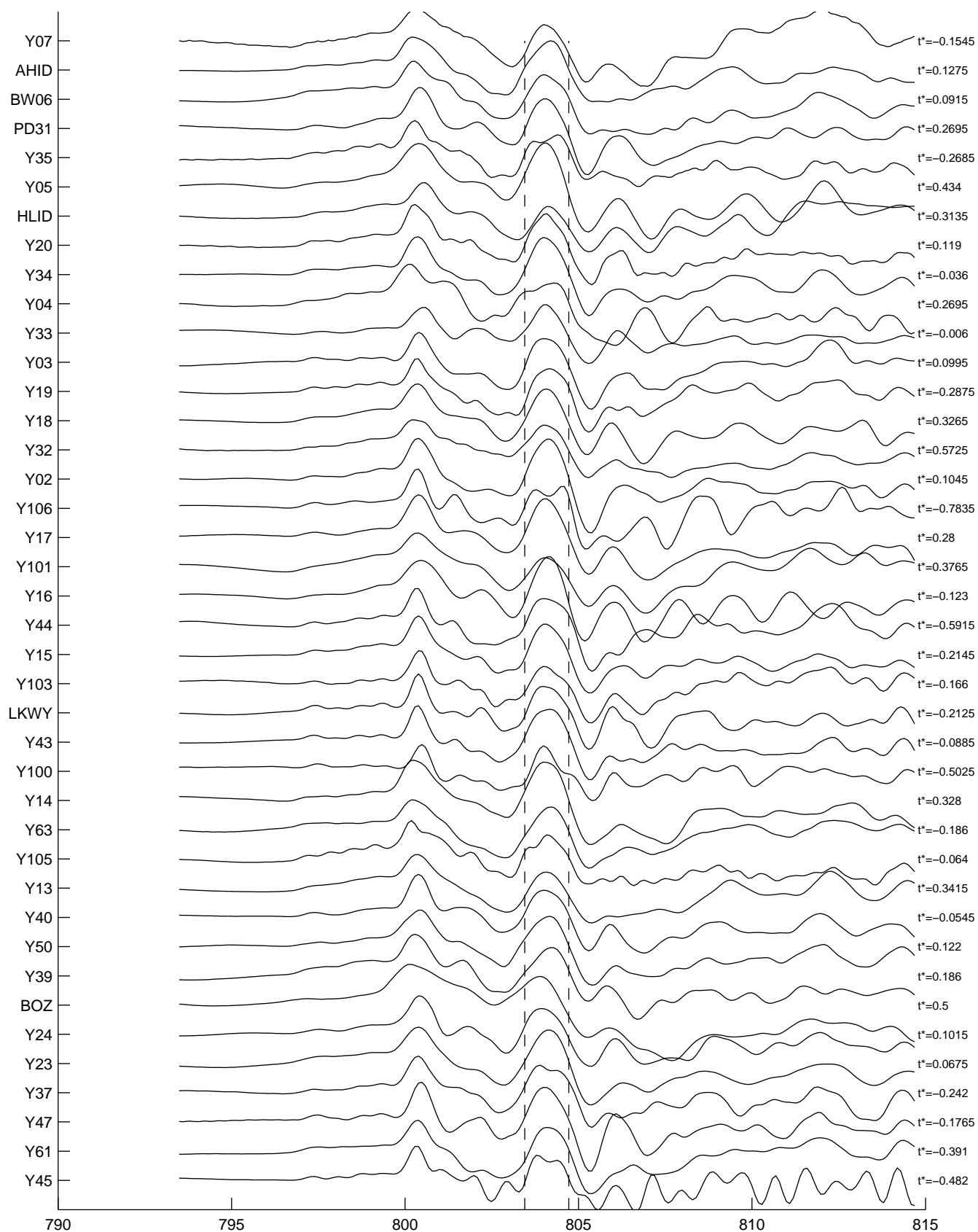
$t^*$  values



# Event\_2000\_341\_17\_11\_06

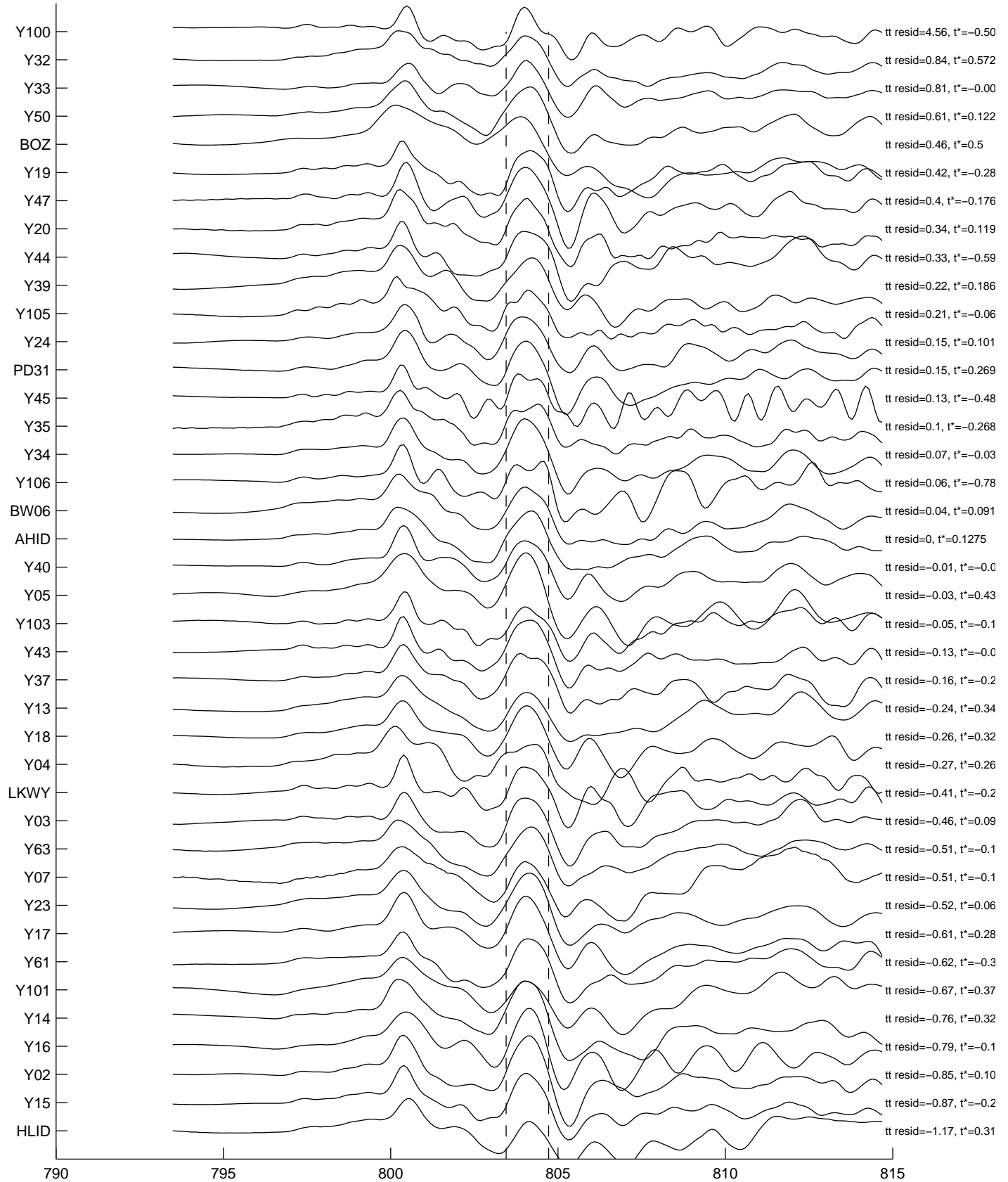


# Sorted by Delta:Event\_2000\_341\_17\_11\_06

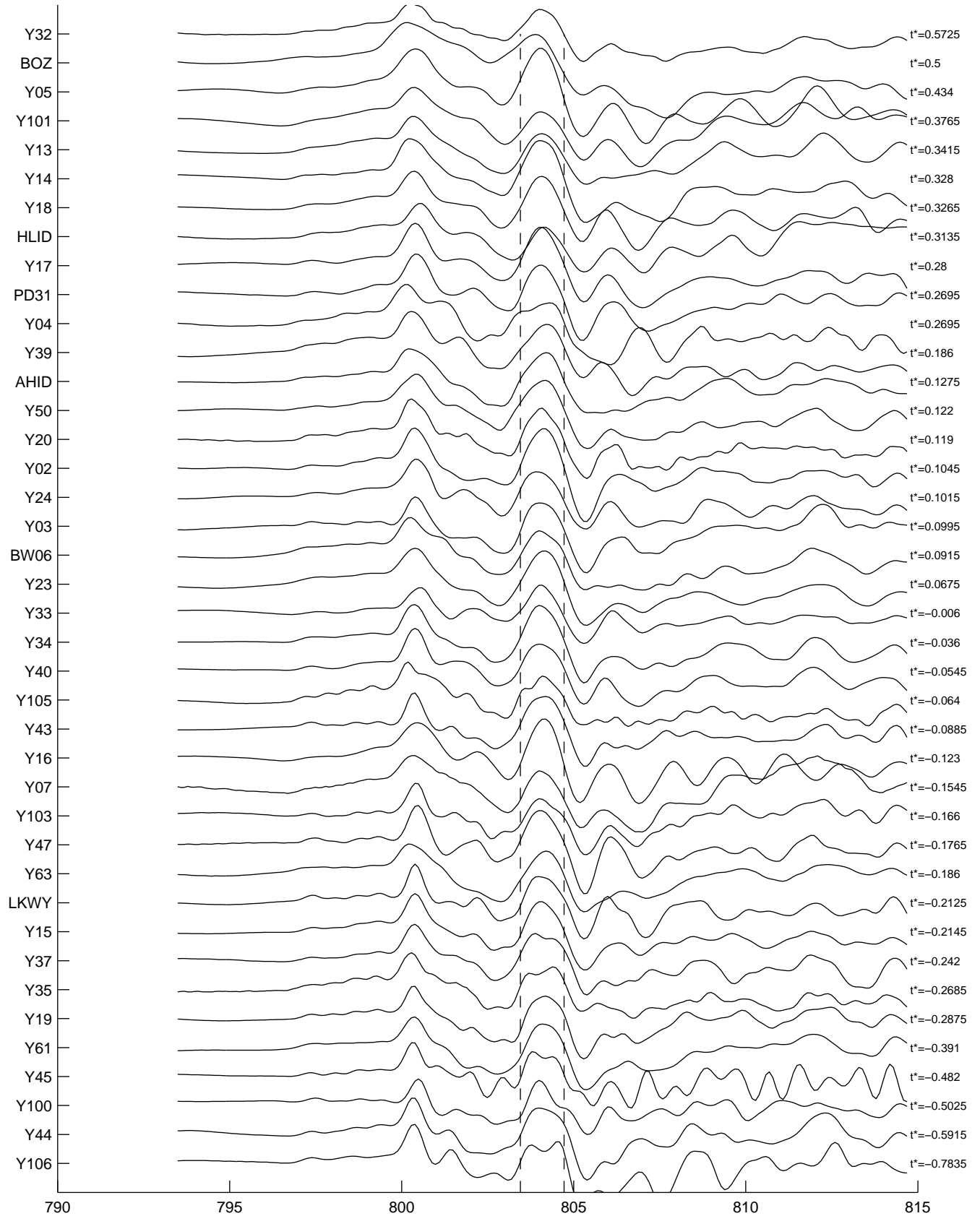




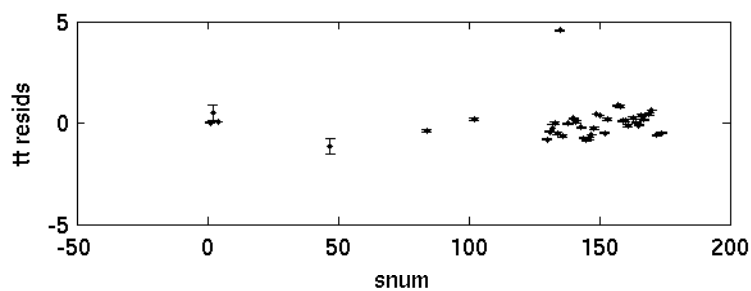
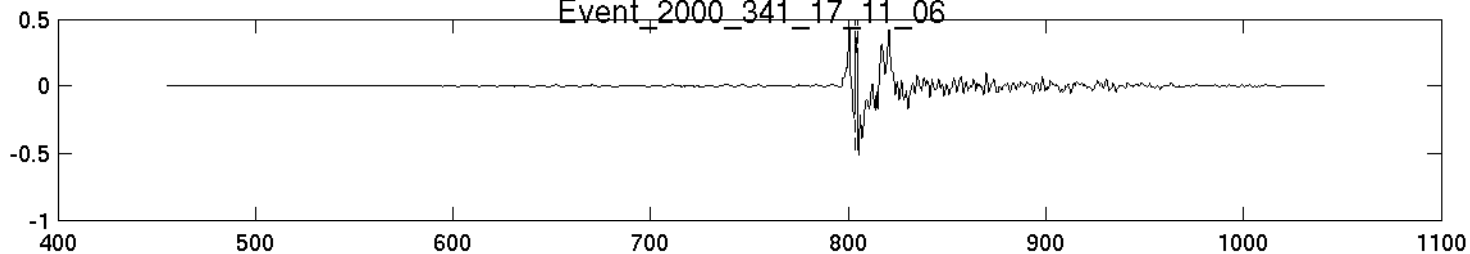
# Sorted by travel time:Event\_2000\_341\_17\_11\_06



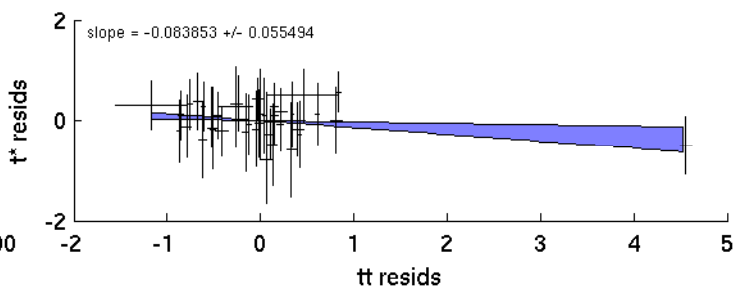
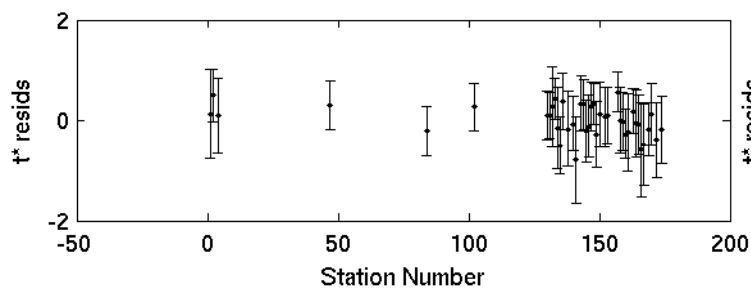
Sorted by  $t^*$ :Event\_2000\_341\_17\_11\_06



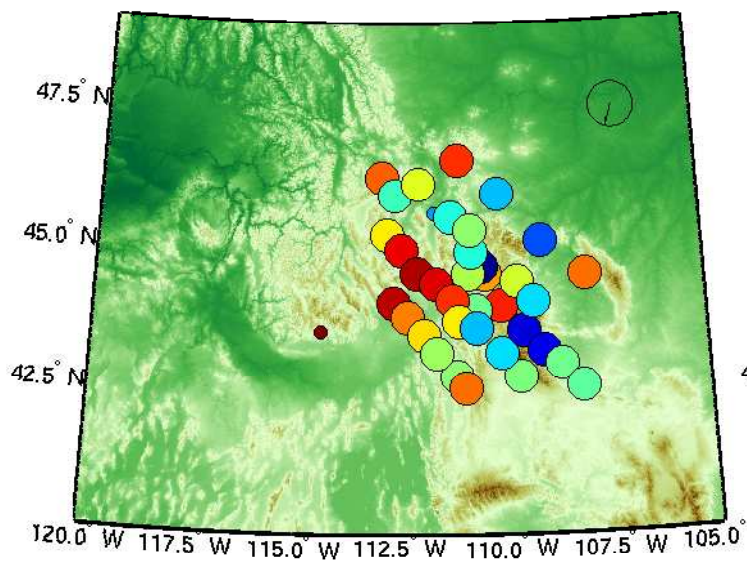
Stack  
Event\_2000\_341\_17\_11\_06



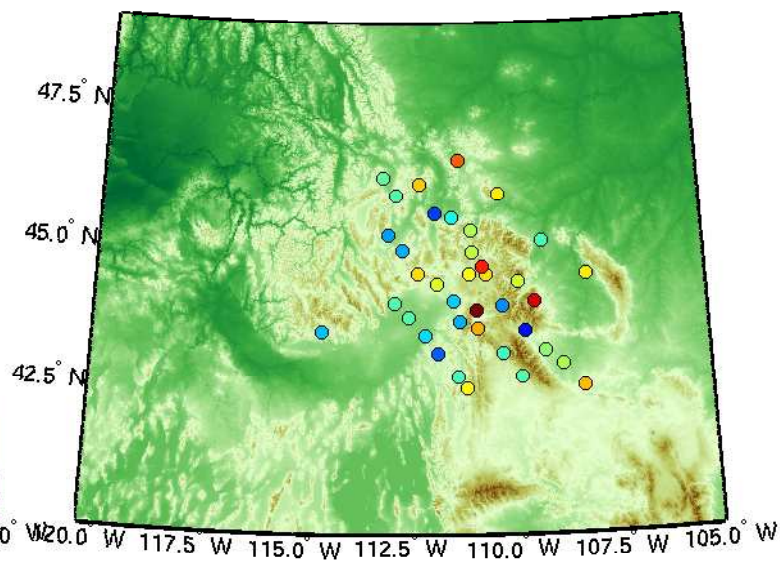
Baz = 17.1423  
Mean xcor value = 0.775  
Range of  $t^*$  values is 1.356  
Median  $t^*$  err is 0.5898  
Slope = -0.083853 +/- 0.055494



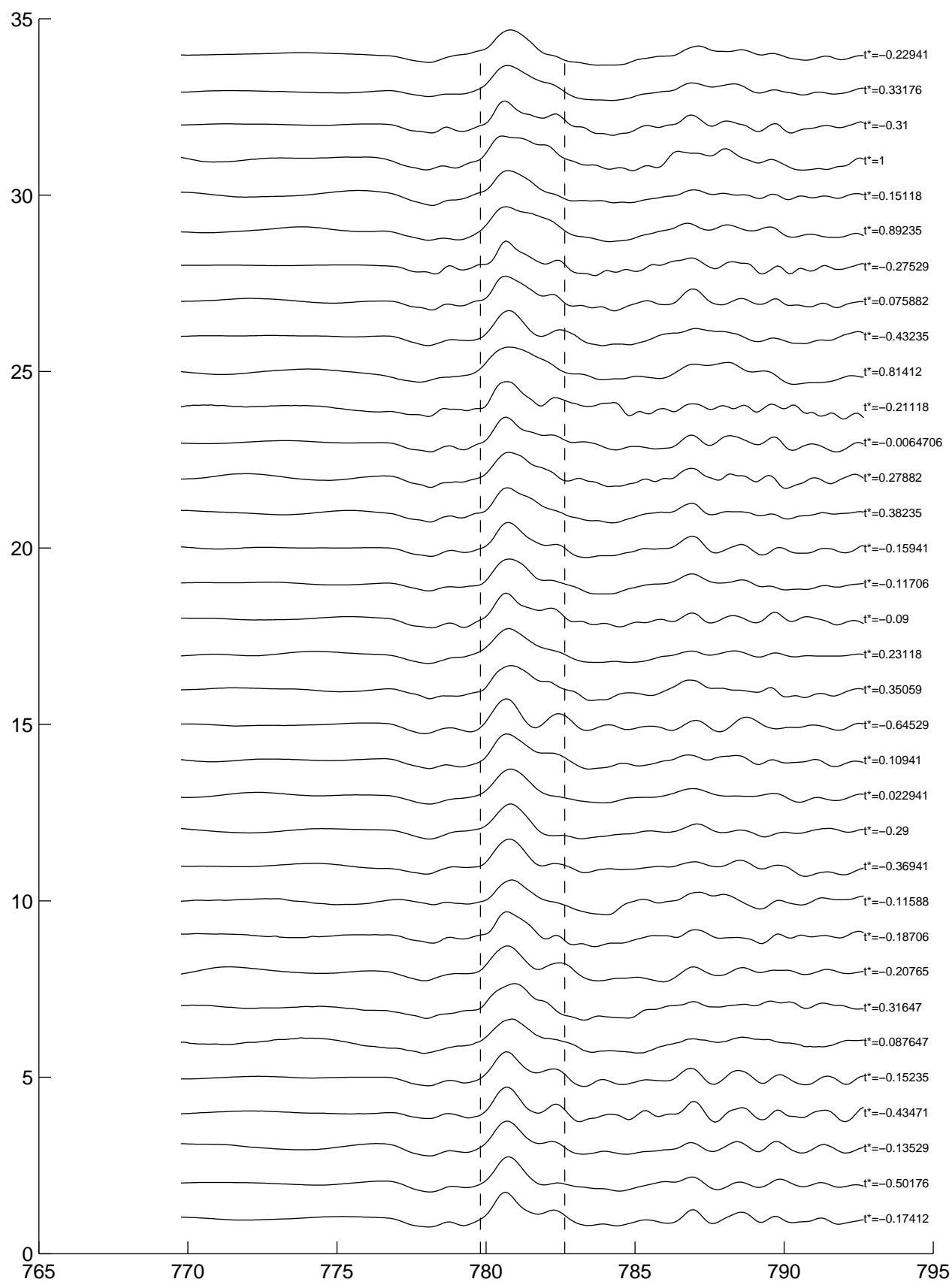
travel time residuals



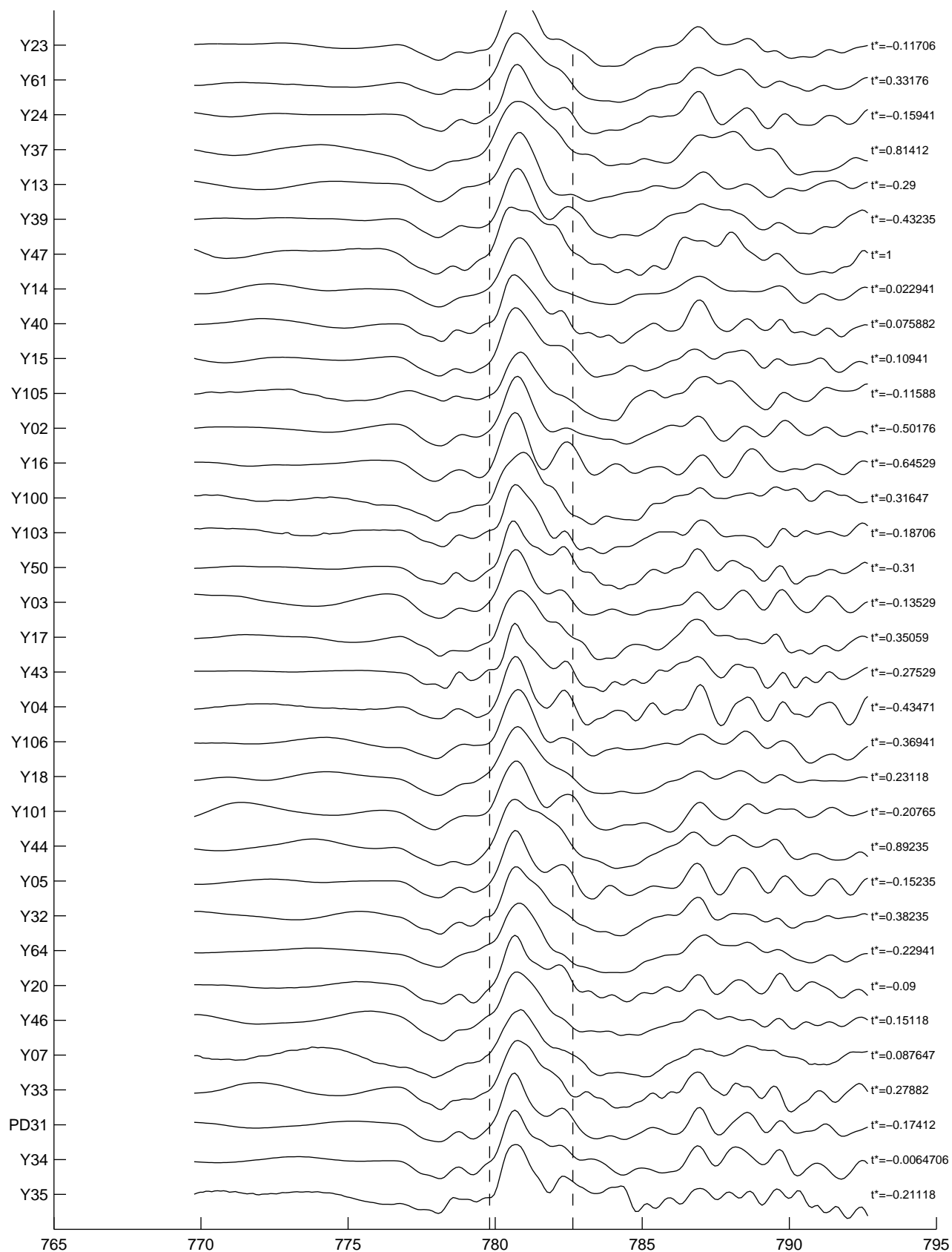
$t^*$  values



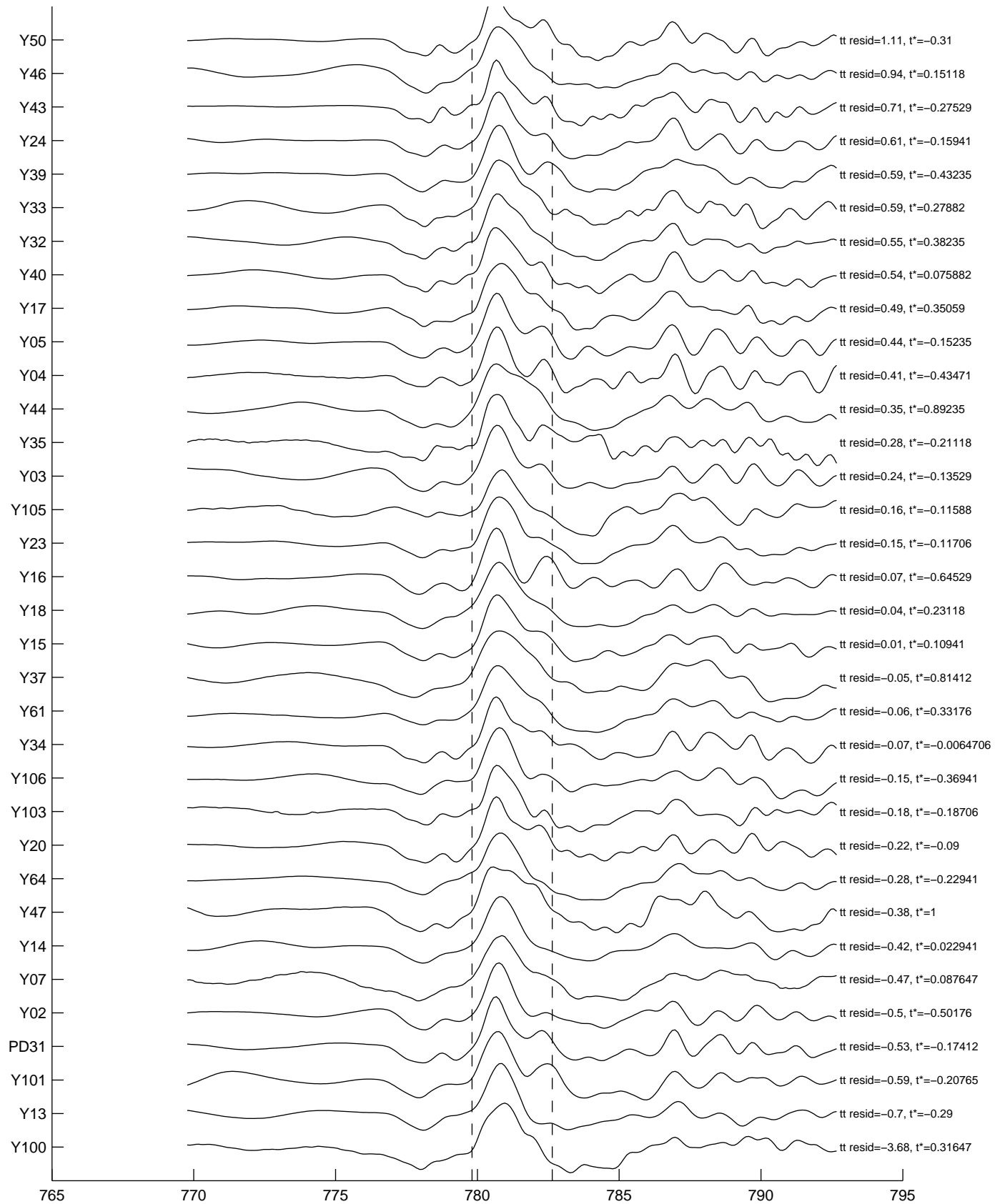
# Event\_2000\_355\_11\_23\_54



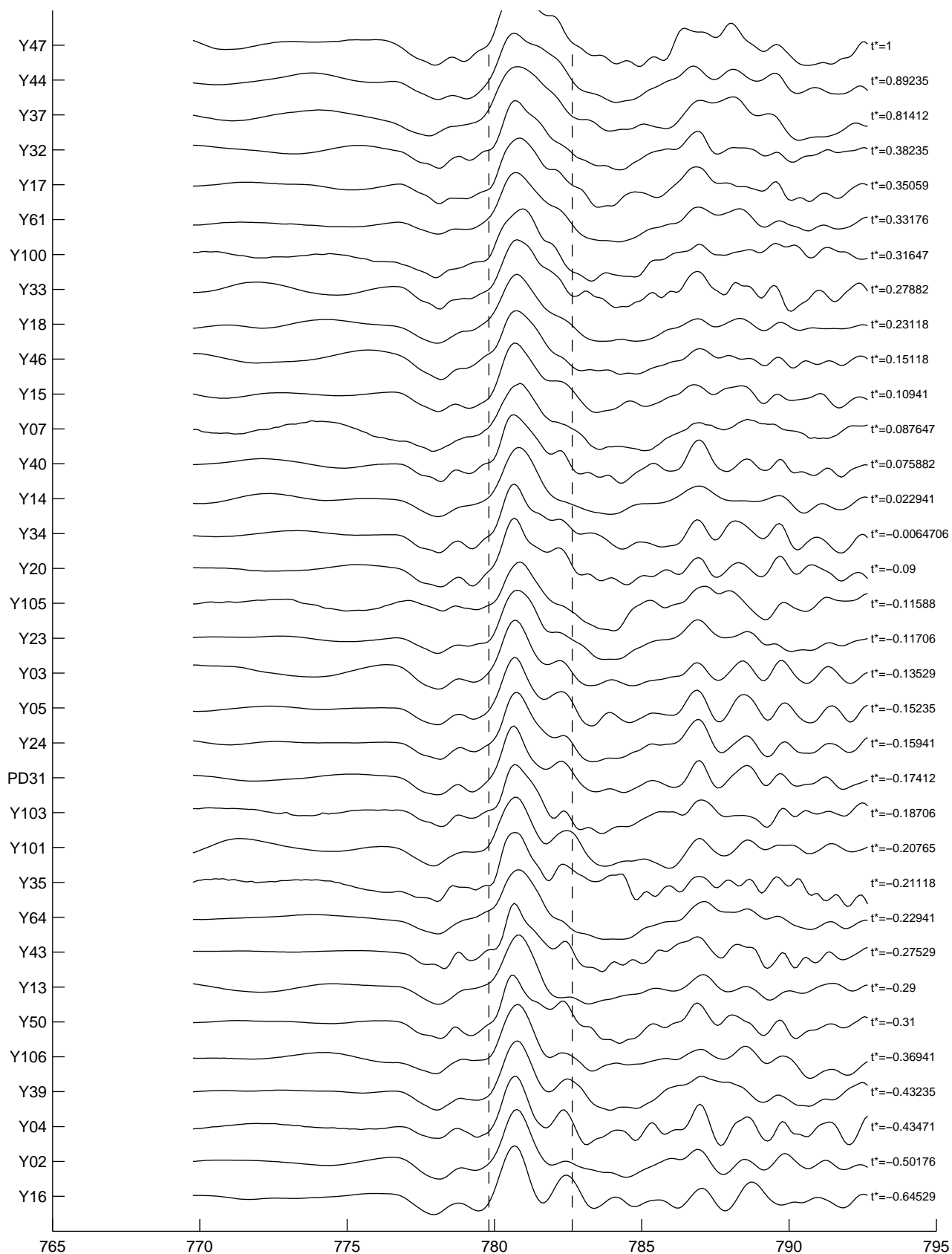
# Sorted by Delta:Event\_2000\_355\_11\_23\_54



# Sorted by travel time: Event\_2000\_355\_11\_23\_54



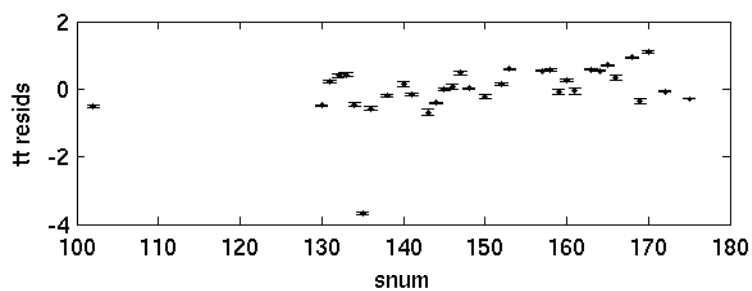
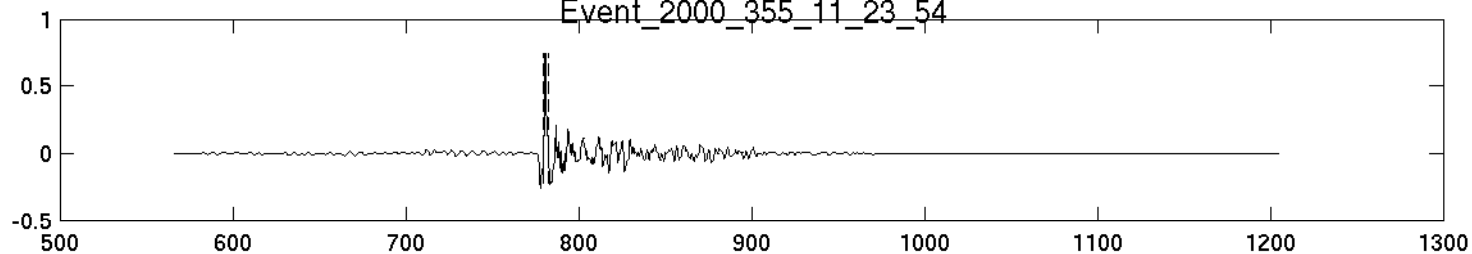
Sorted by  $t^*$ :Event\_2000\_355\_11\_23\_54



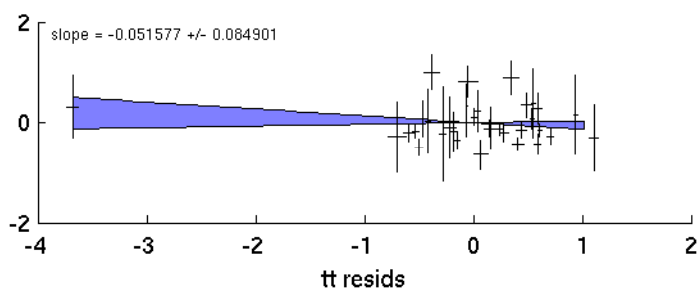
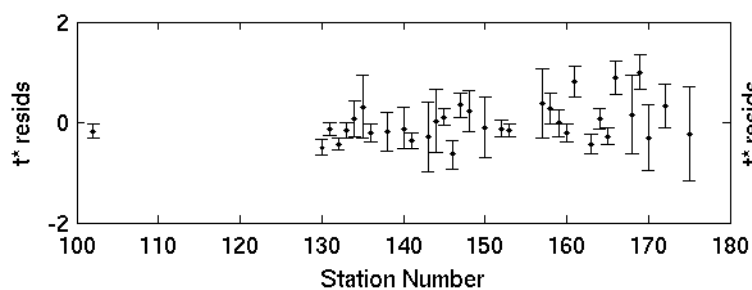


# Event\_2000\_355\_11\_23\_54

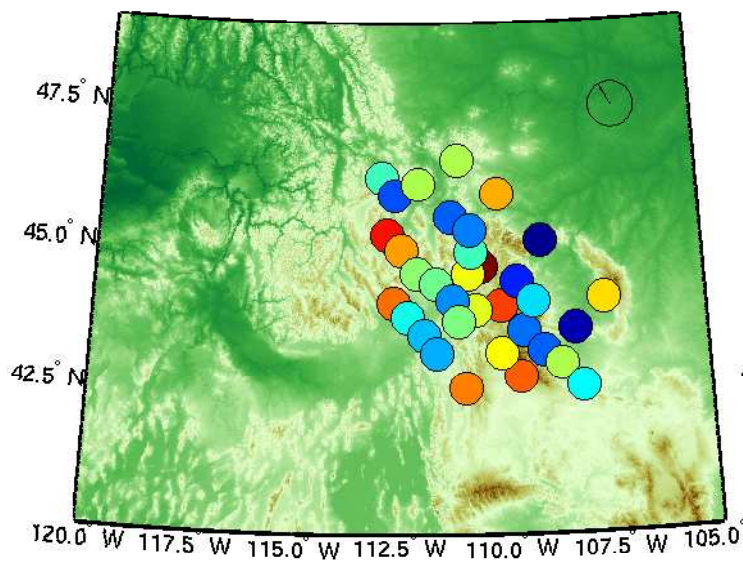
Stack



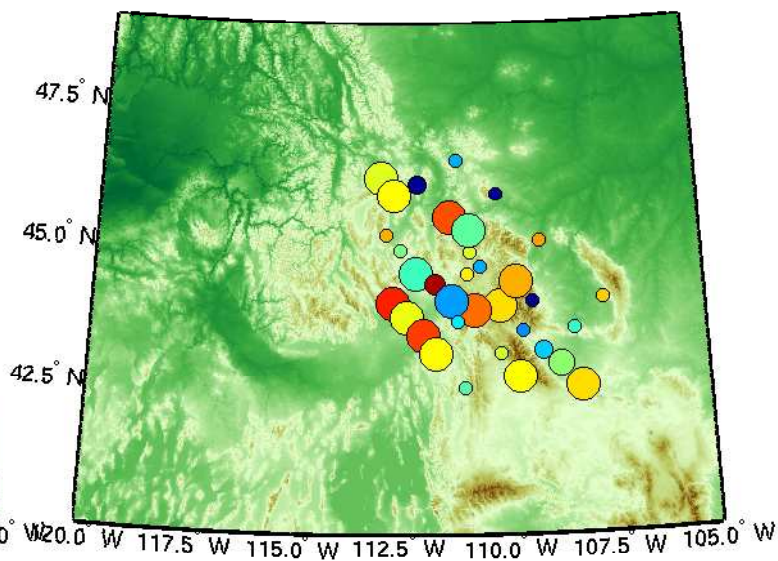
Baz = 152.6194  
Mean xcor value = 0.81588  
Range of  $t^*$  values is 1.6453  
Median  $t^*$  err is 0.29252  
Slope =  $-0.051577 \pm 0.084901$



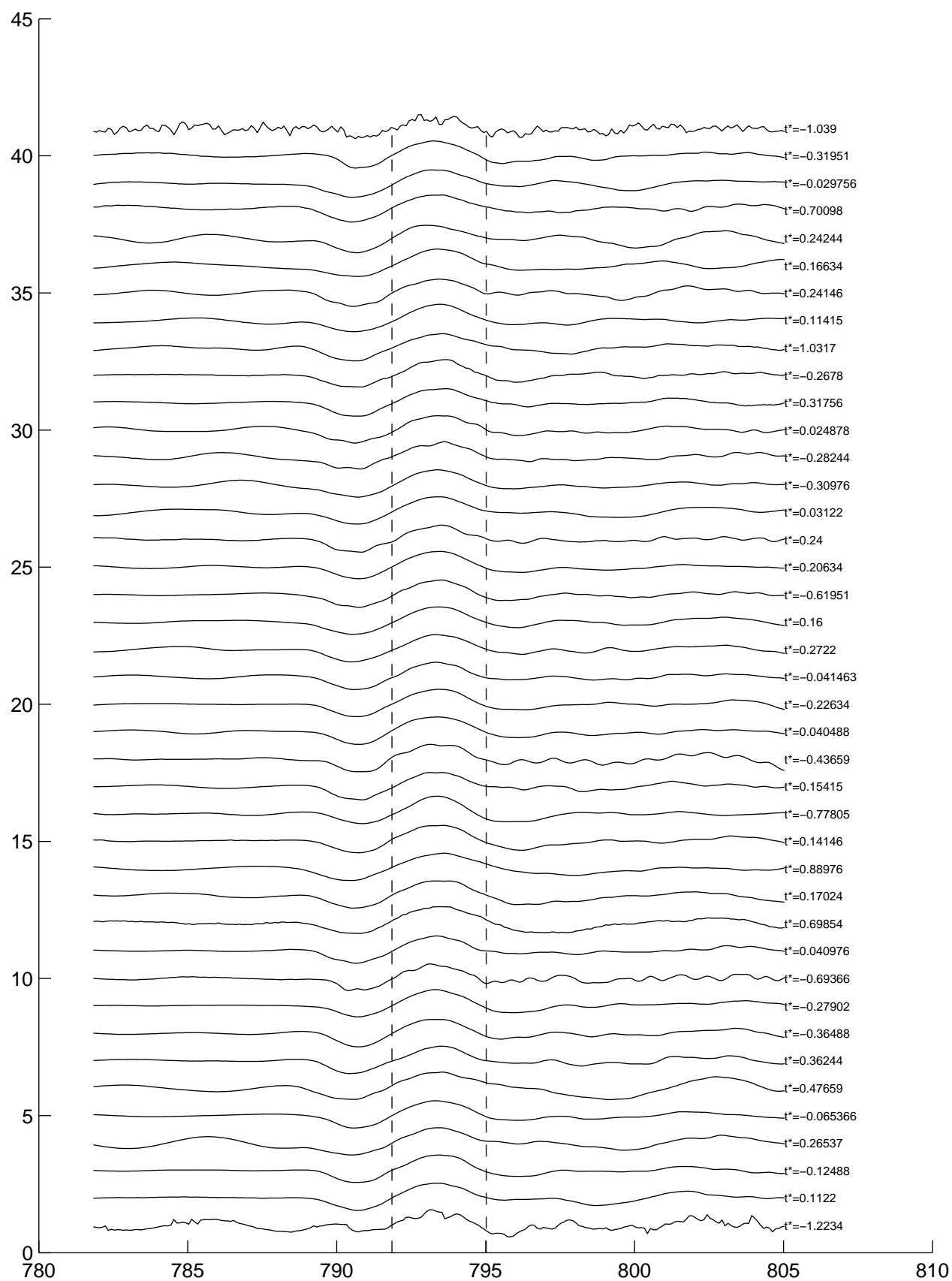
travel time residuals



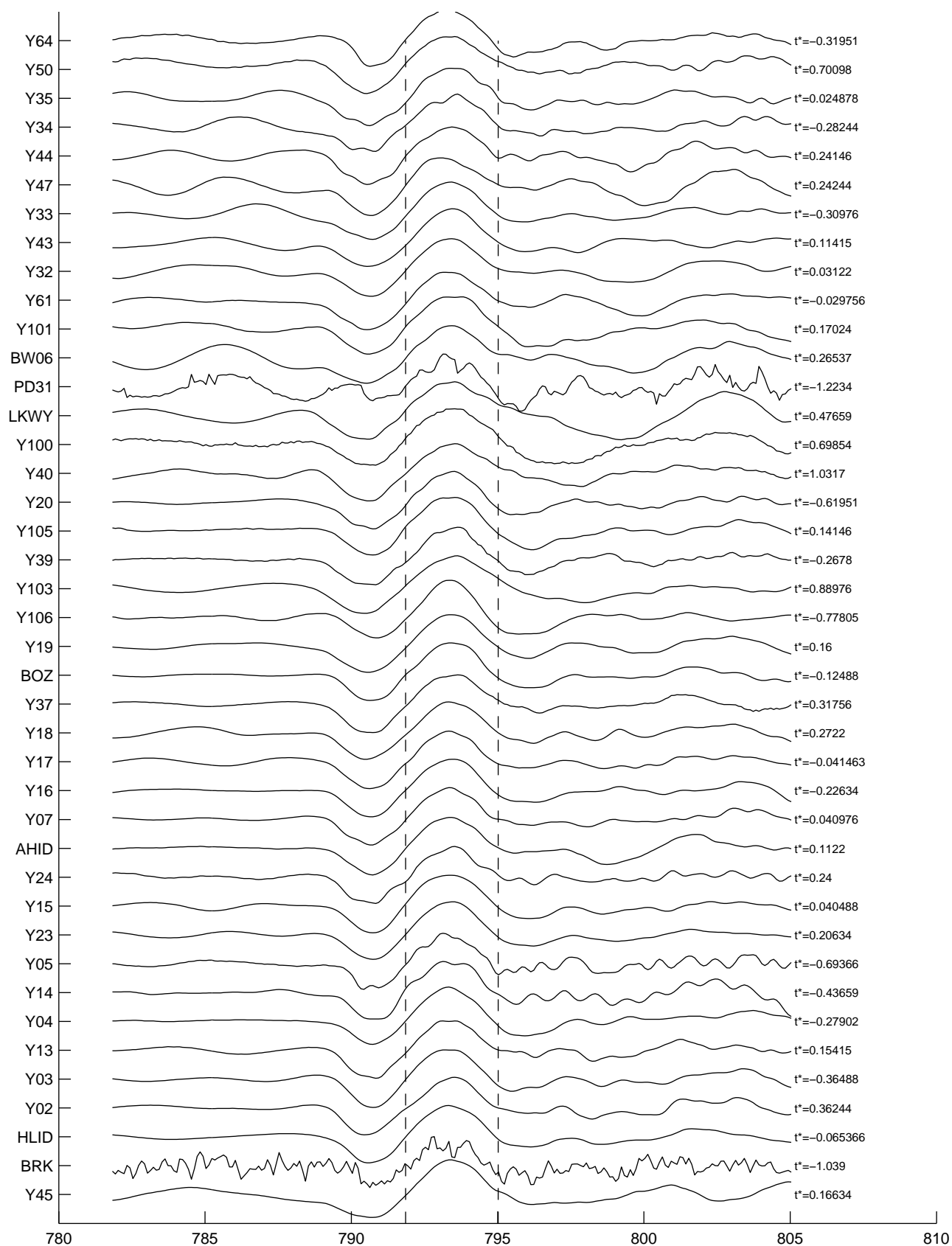
$t^*$  values



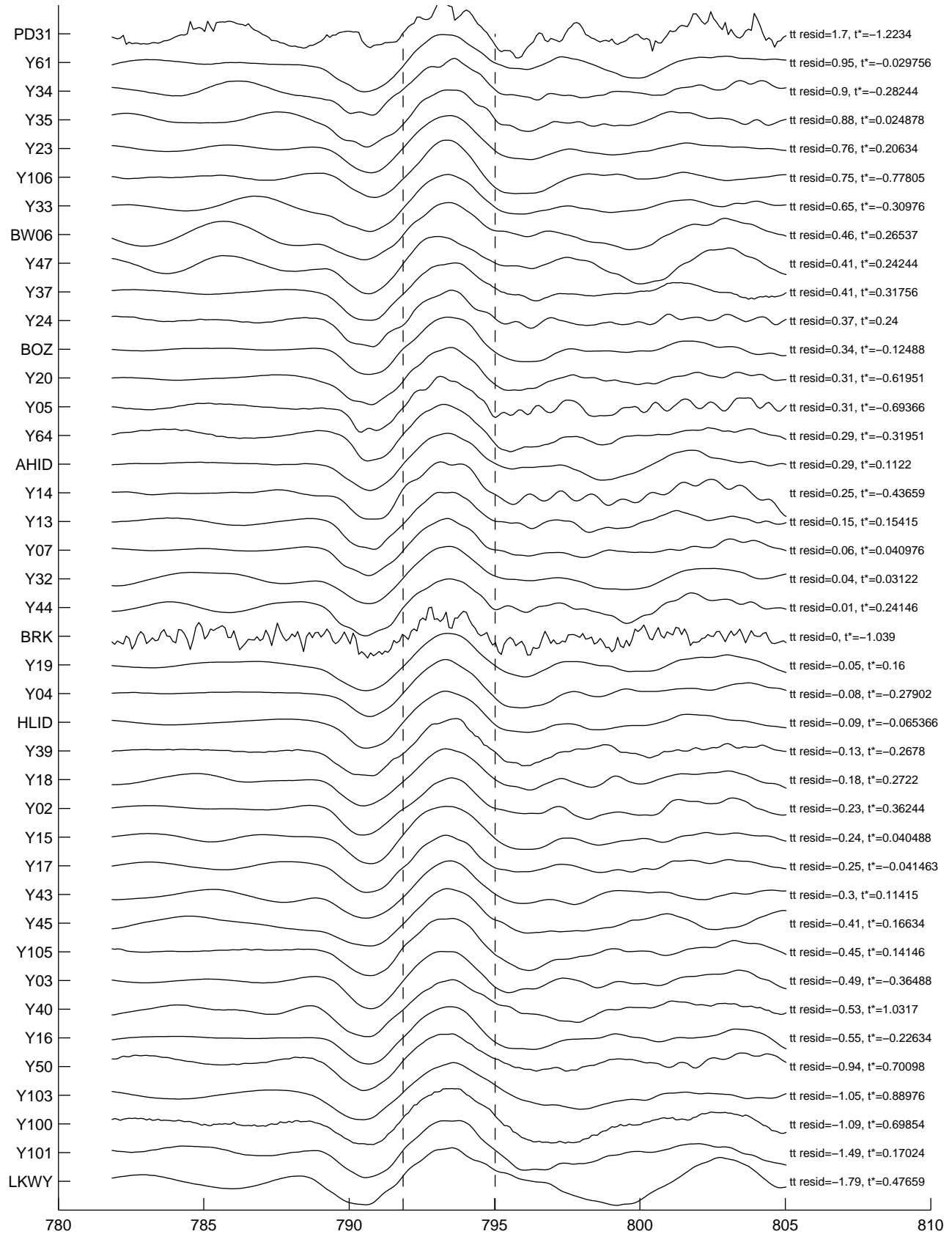
# Event\_2001\_009\_16\_49\_28



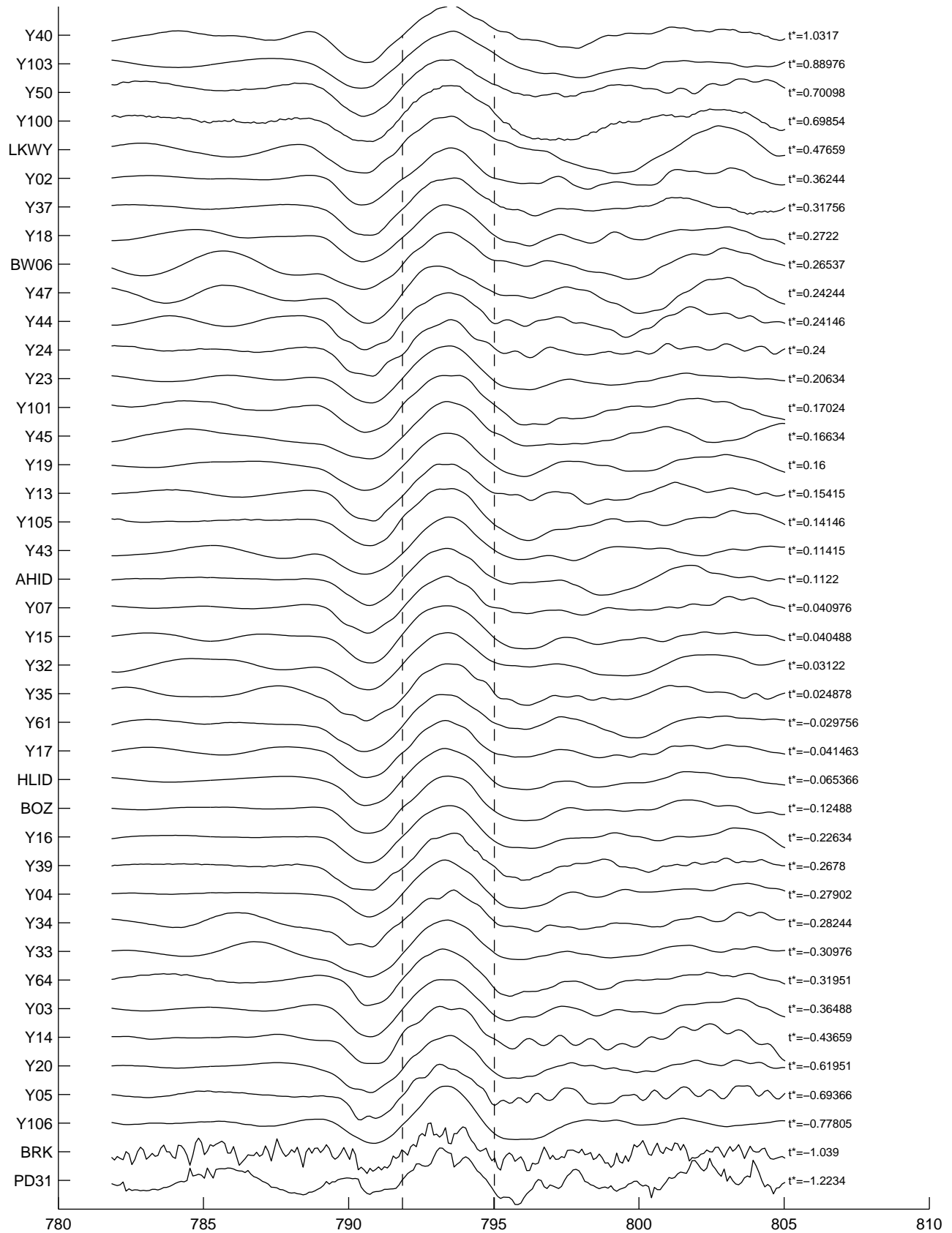
# Sorted by Delta:Event\_2001\_009\_16\_49\_28



# Sorted by travel time:Event\_2001\_009\_16\_49\_28

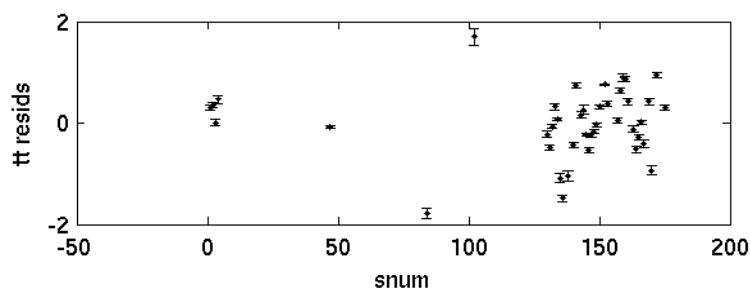
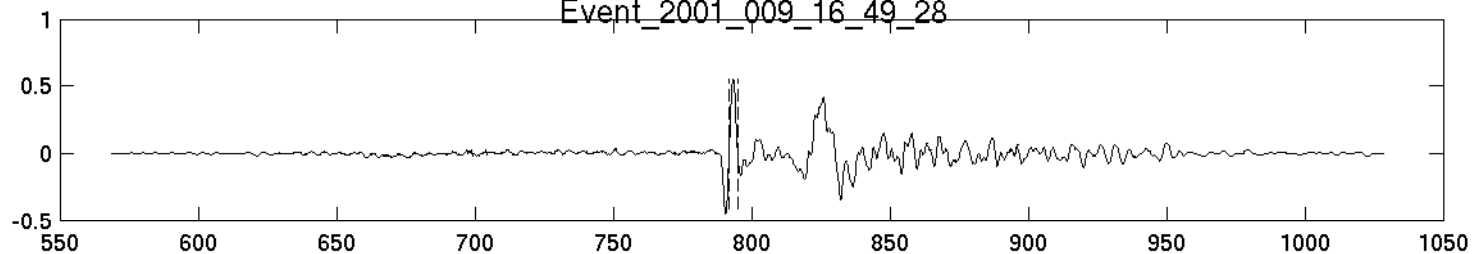


# Sorted by $t^*$ :Event\_2001\_009\_16\_49\_28

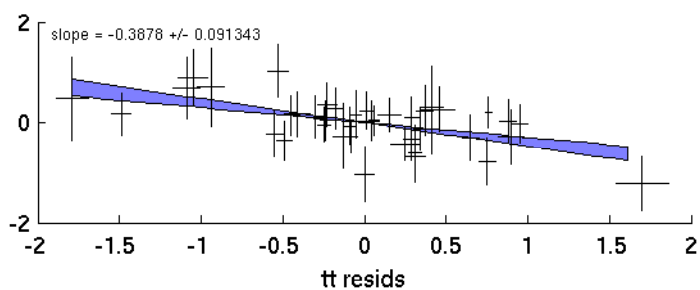
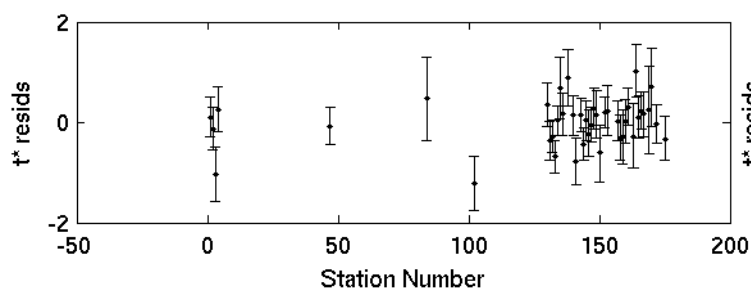


# Event\_2001\_009\_16\_49\_28

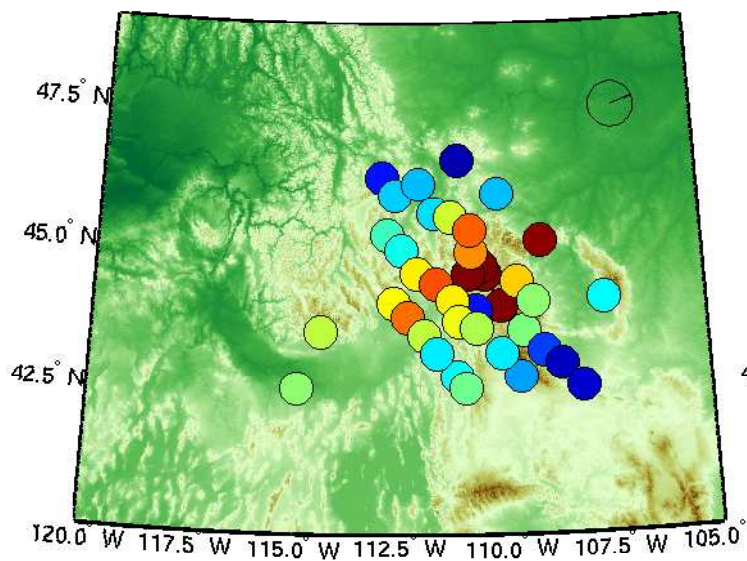
Stack



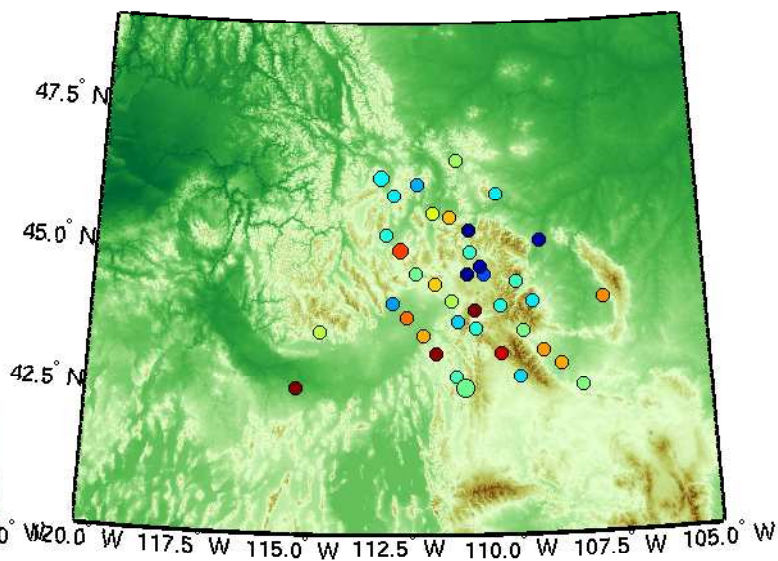
Baz = 250.5612  
Mean xcor value = 0.82878  
Range of  $t^*$  values is 2.2551  
Median  $t^*$  err is 0.43438  
Slope = -0.3878 +/- 0.091343



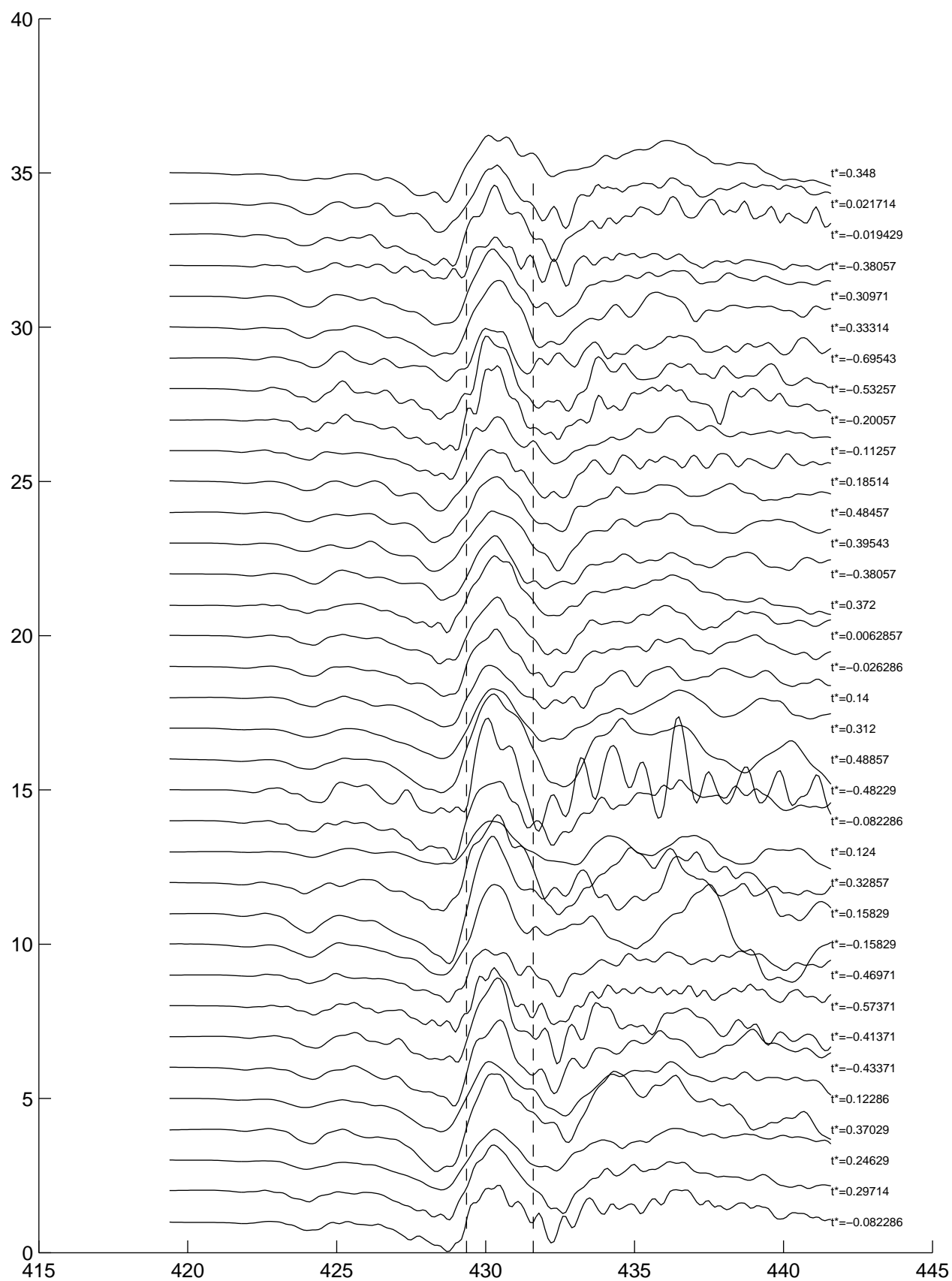
travel time residuals



$t^*$  values

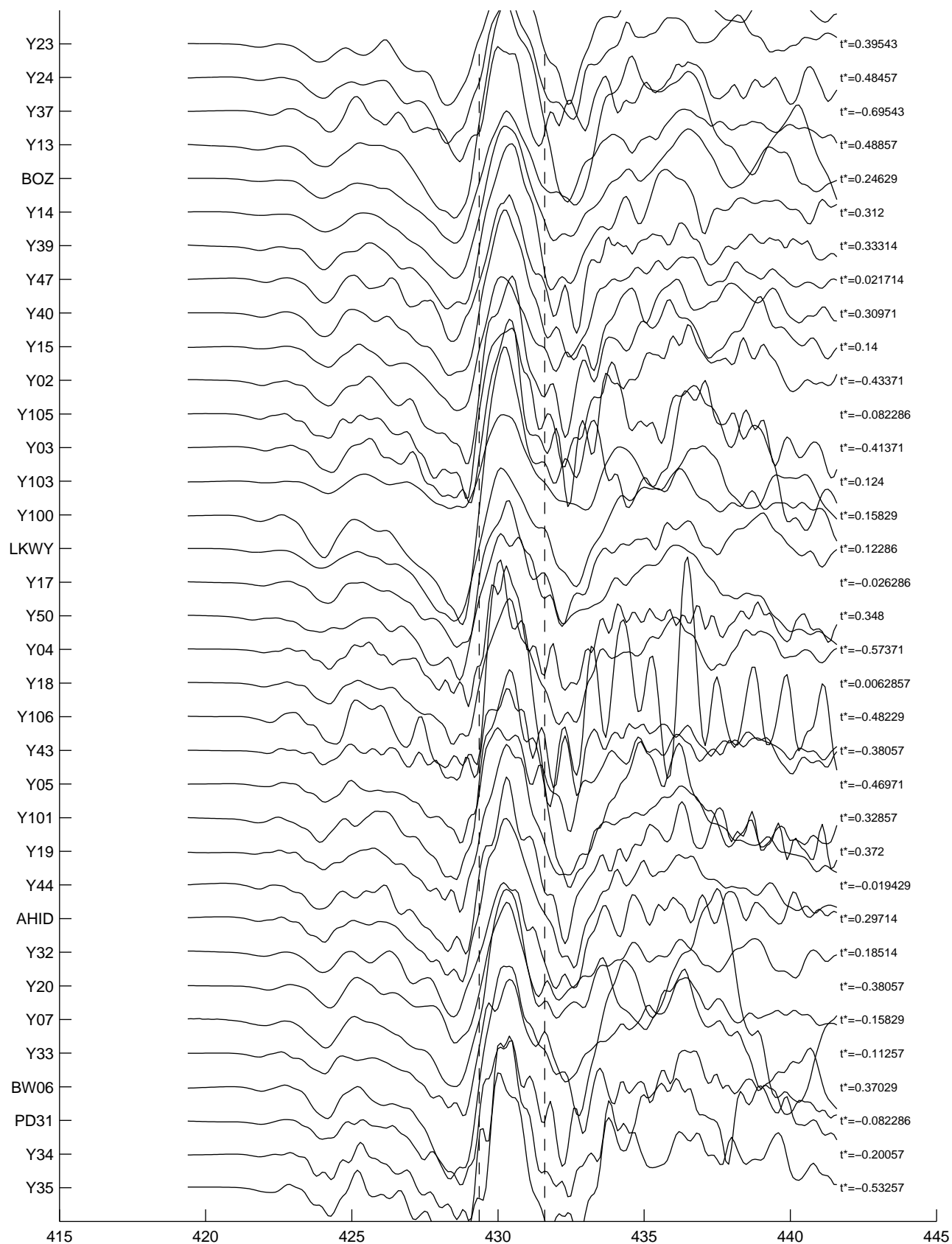


# Event\_2001\_013\_17\_33\_32

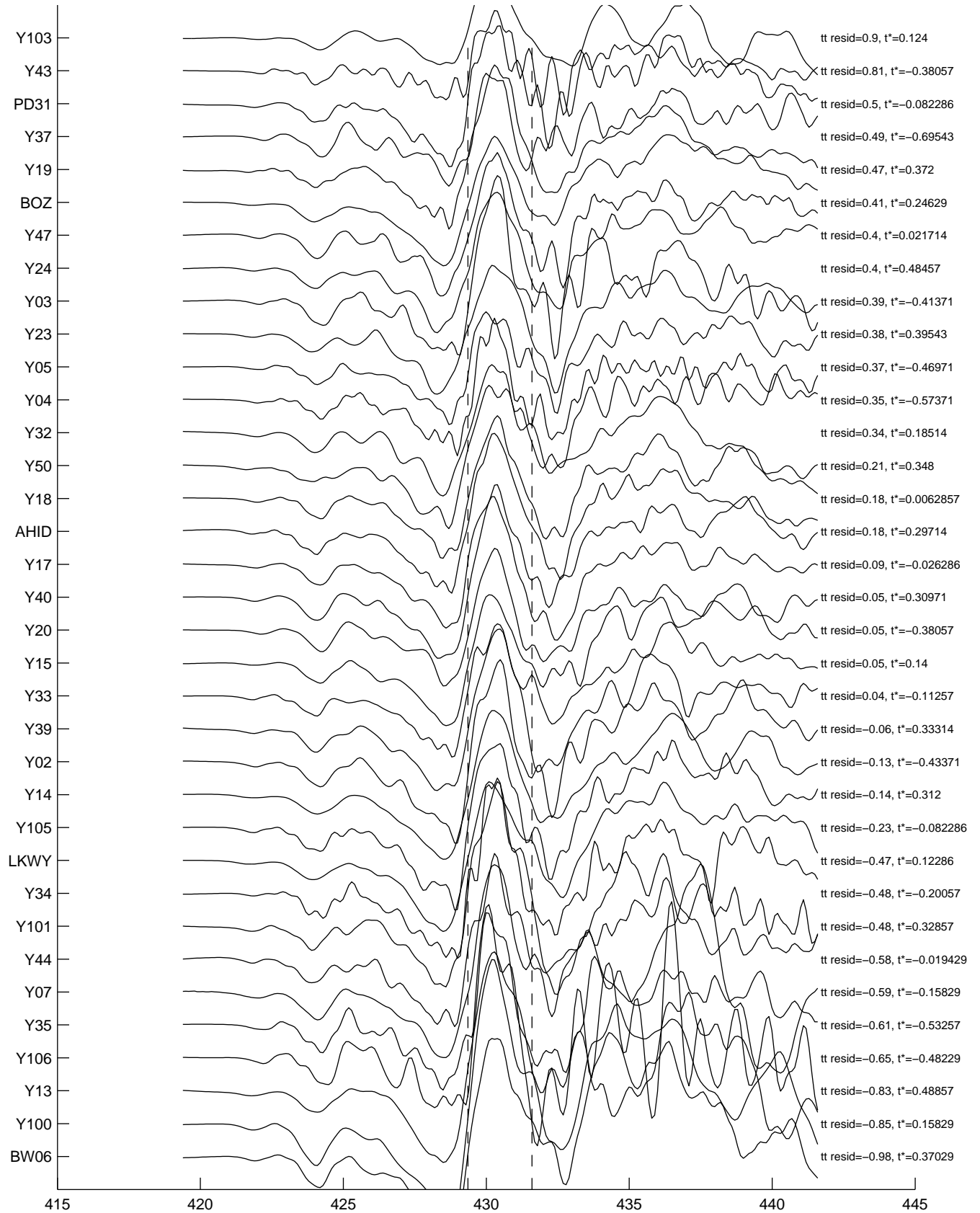




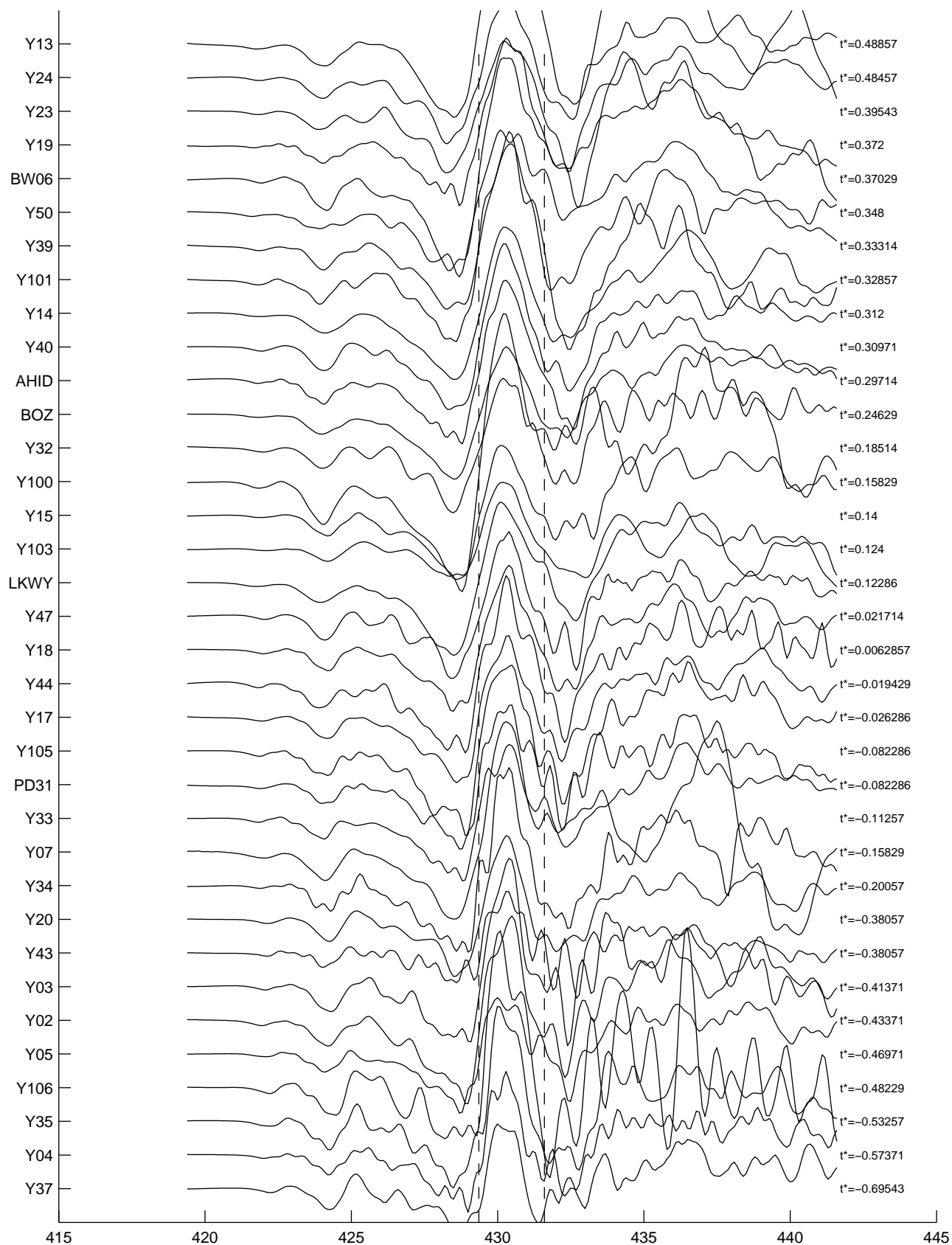
# Sorted by Delta:Event\_2001\_013\_17\_33\_32



# Sorted by travel time:Event\_2001\_013\_17\_33\_32

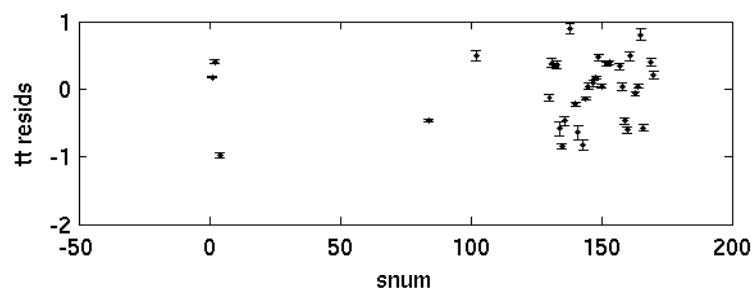
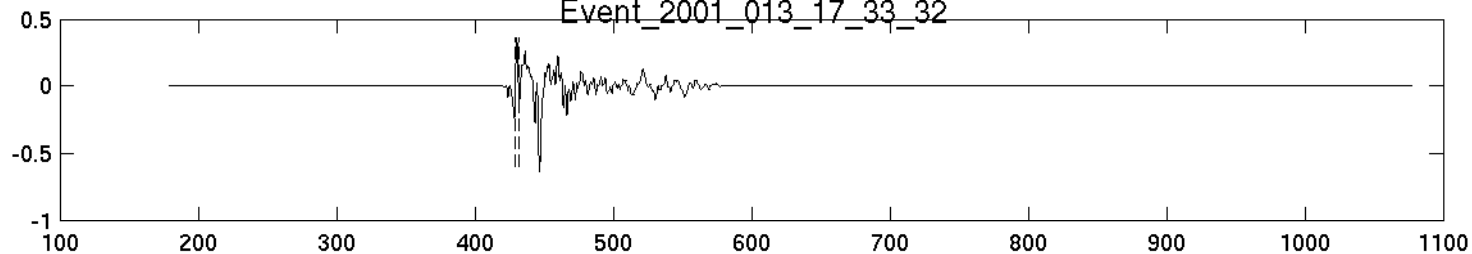


# Sorted by $t^*$ :Event\_2001\_013\_17\_33\_32

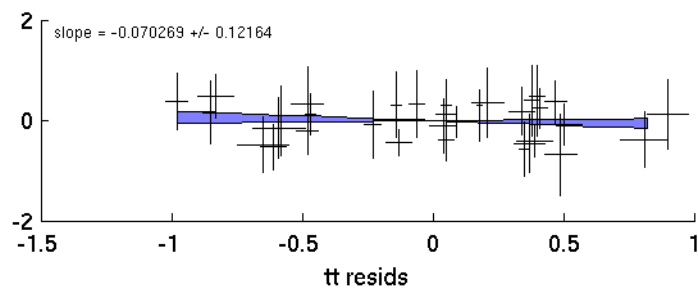
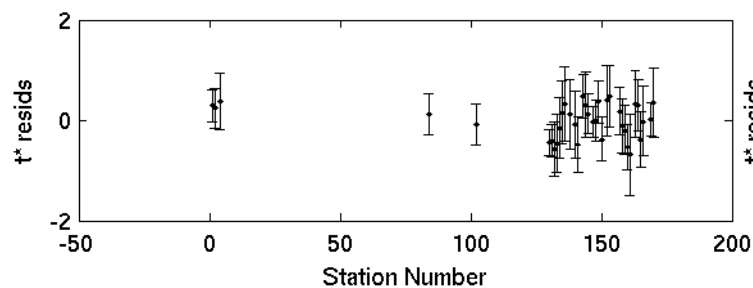


Event\_2001\_013\_17\_33\_32

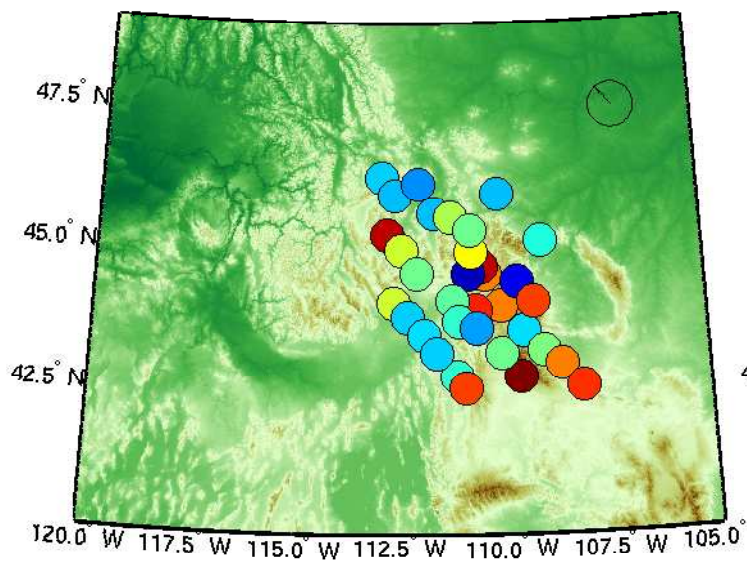
Stack



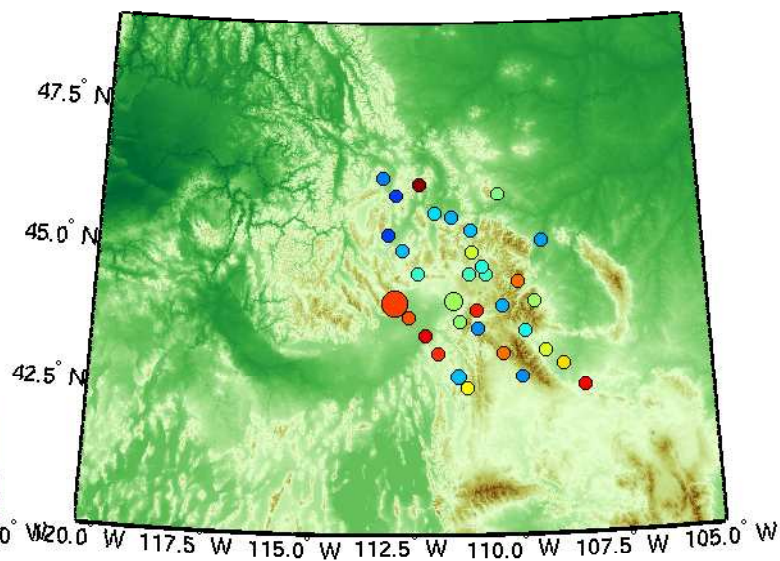
Baz = 141.9137  
Mean xcor value = 0.81343  
Range of  $t^*$  values is 1.184  
Median  $t^*$  err is 0.54807  
Slope = -0.070269 +/- 0.12164



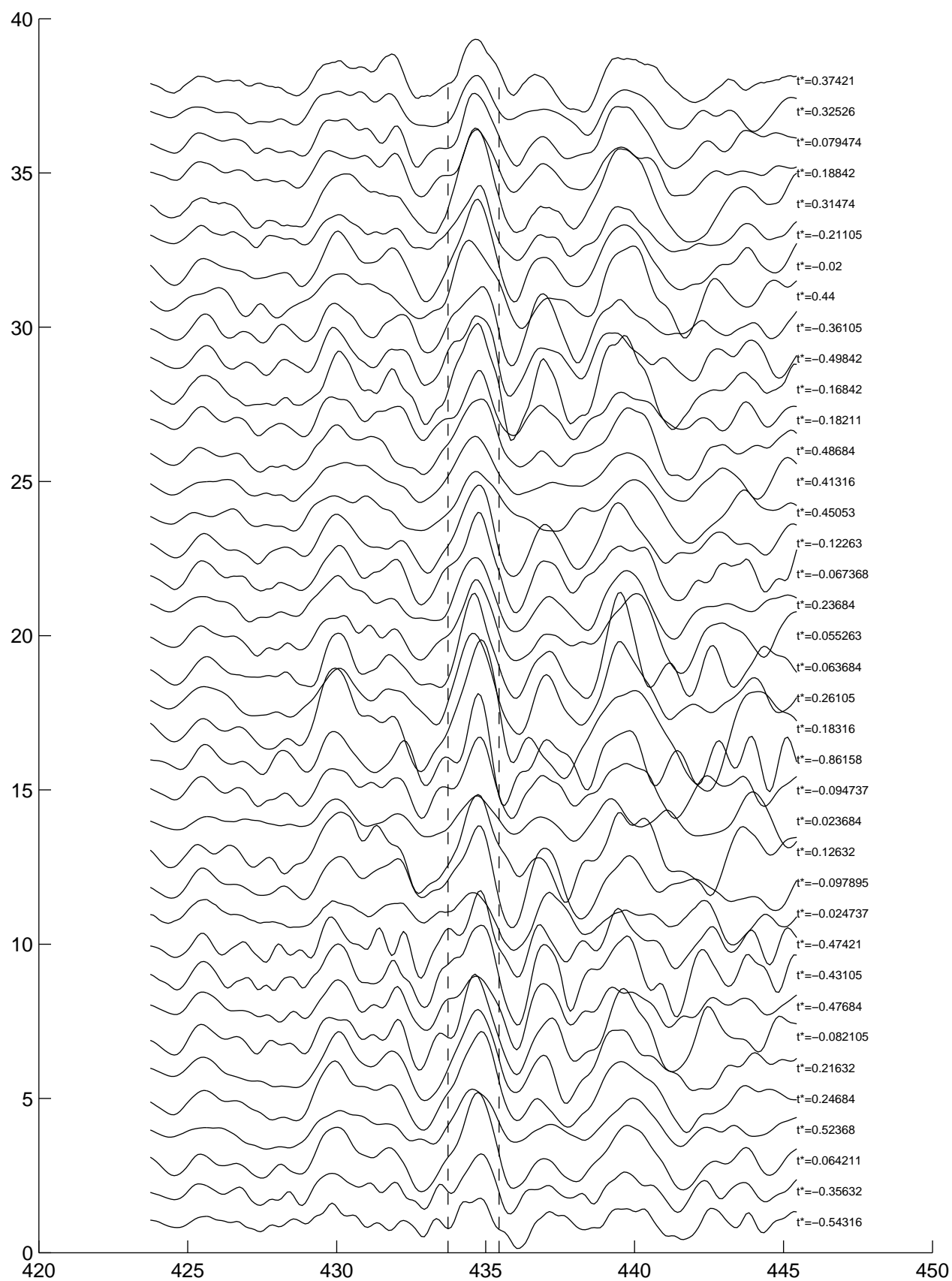
travel time residuals



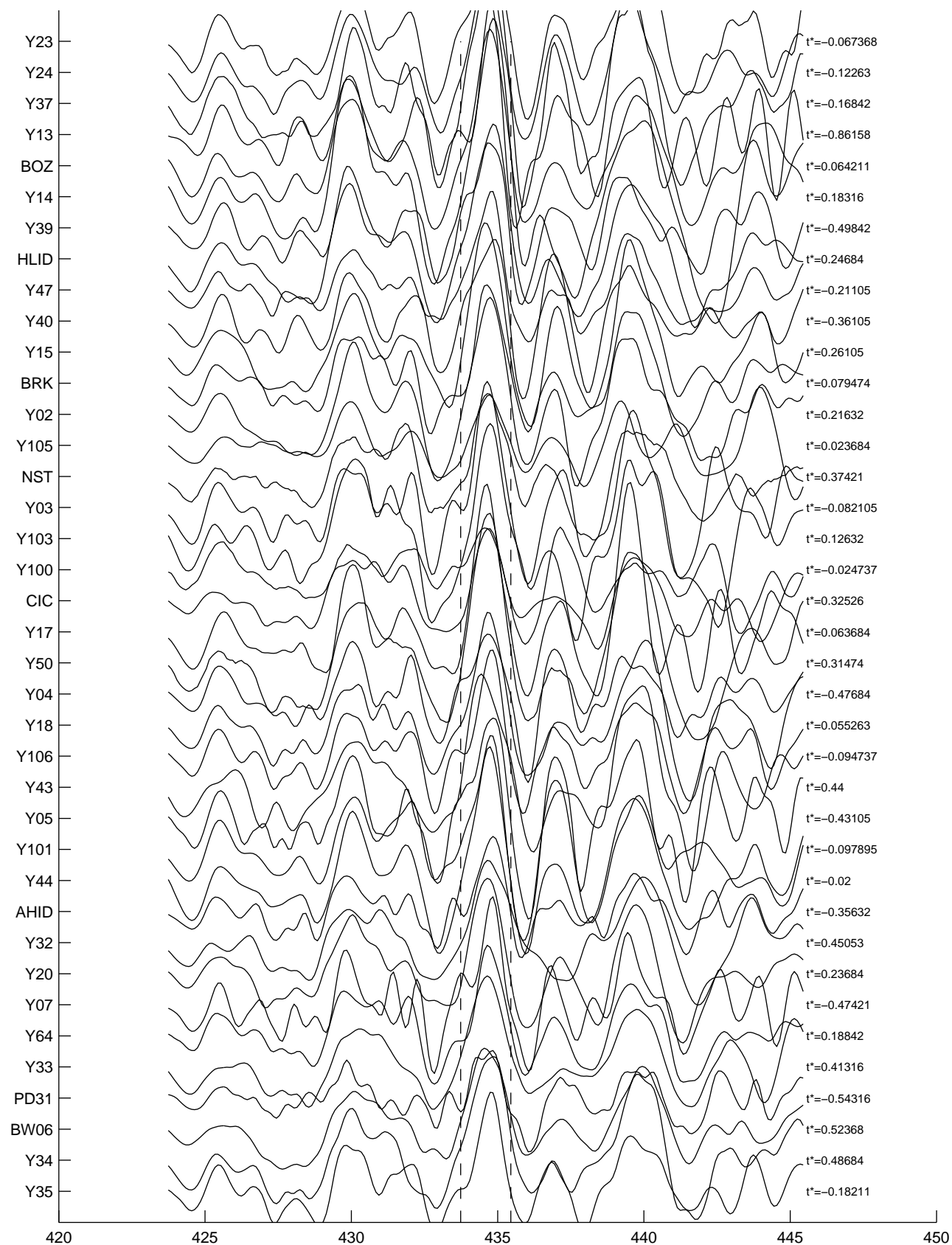
$t^*$  values



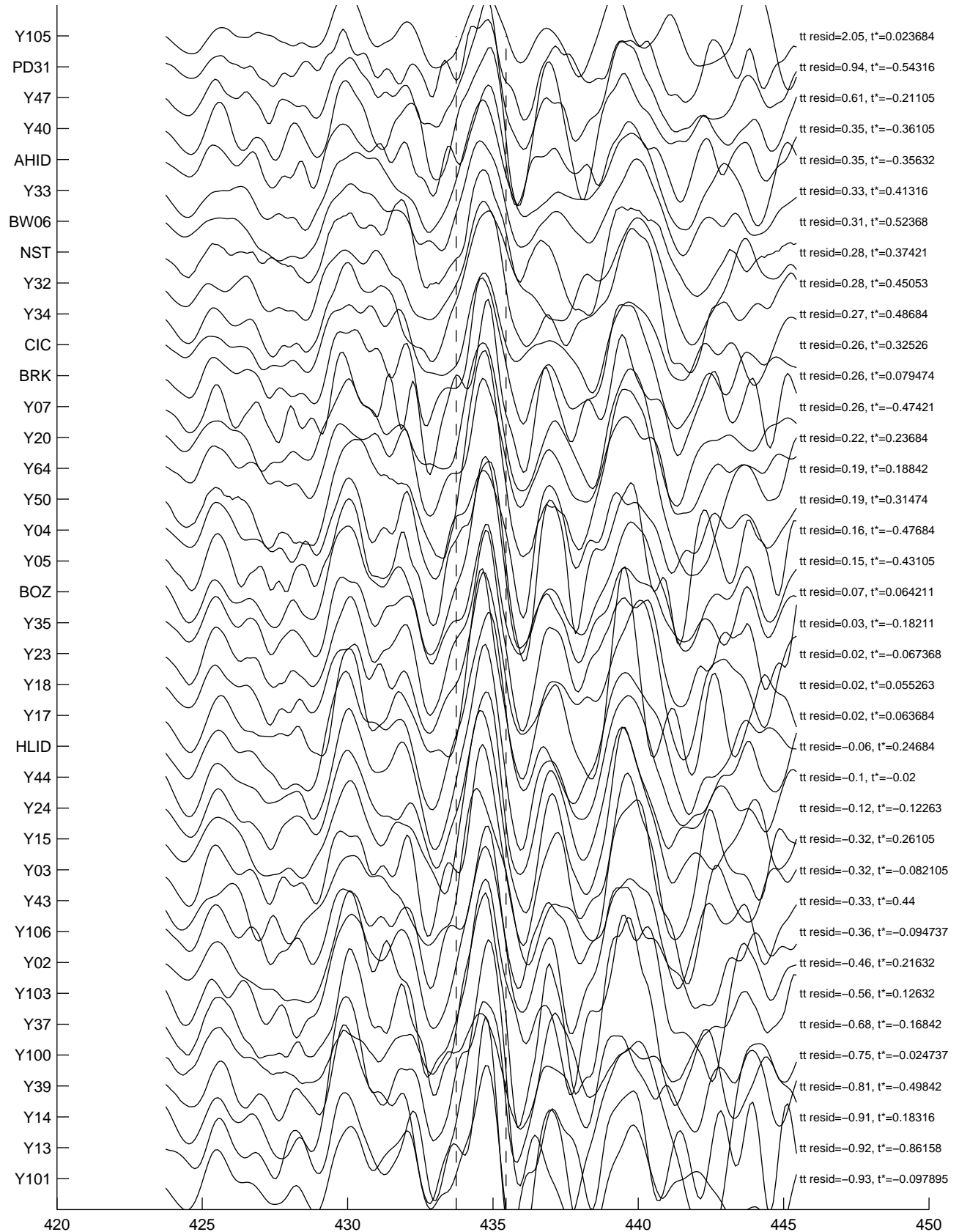
# Event\_2001\_044\_14\_22\_05



# Sorted by Delta:Event\_2001\_044\_14\_22\_05

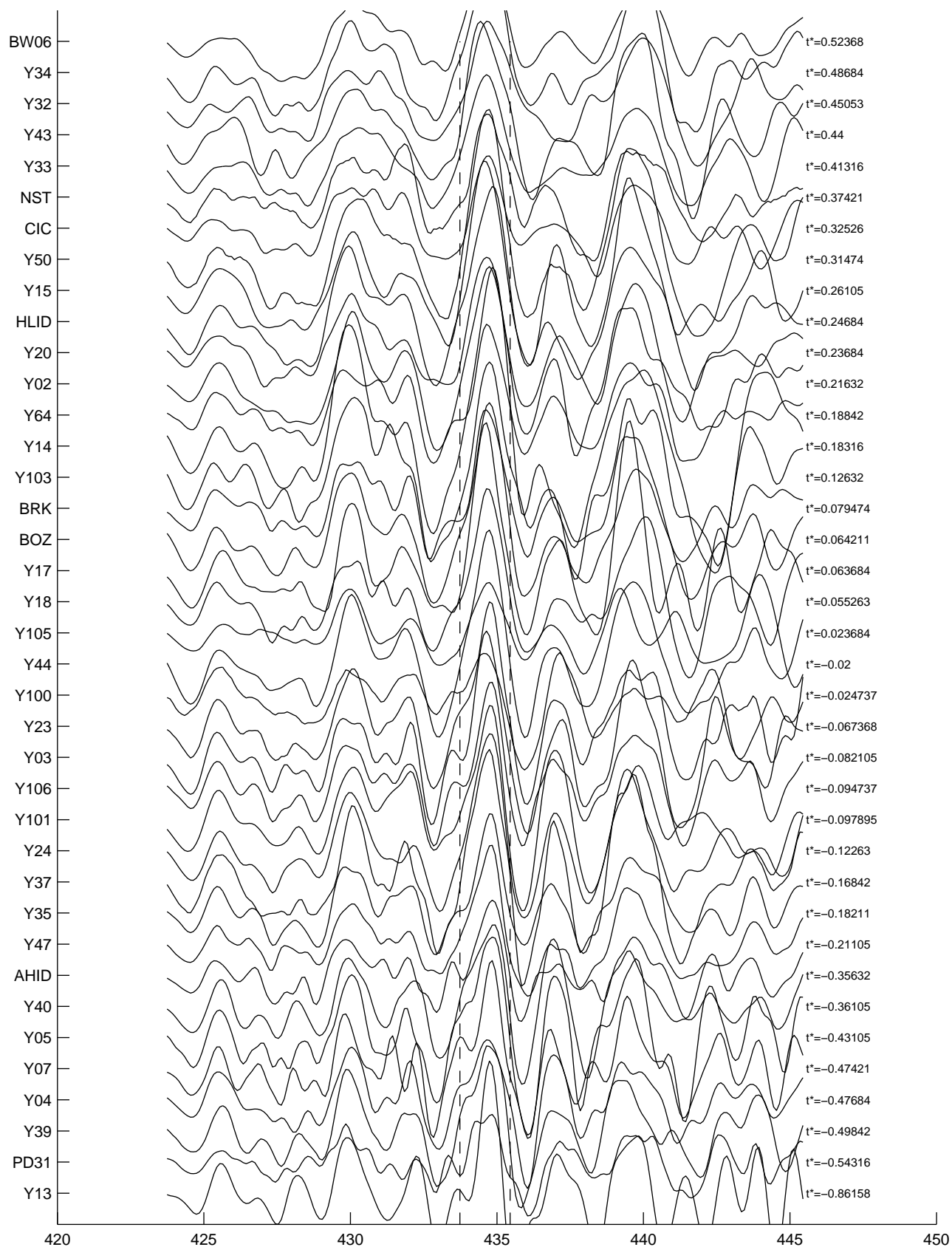


# Sorted by travel time:Event\_2001\_044\_14\_22\_05



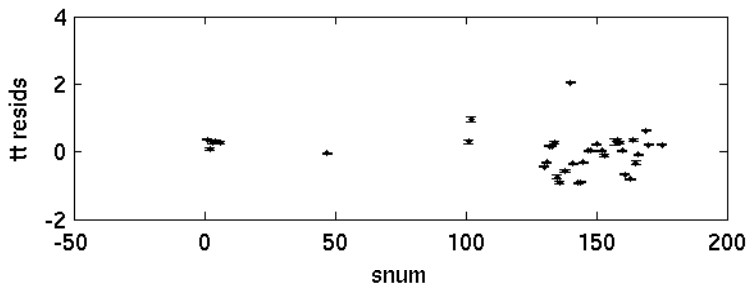
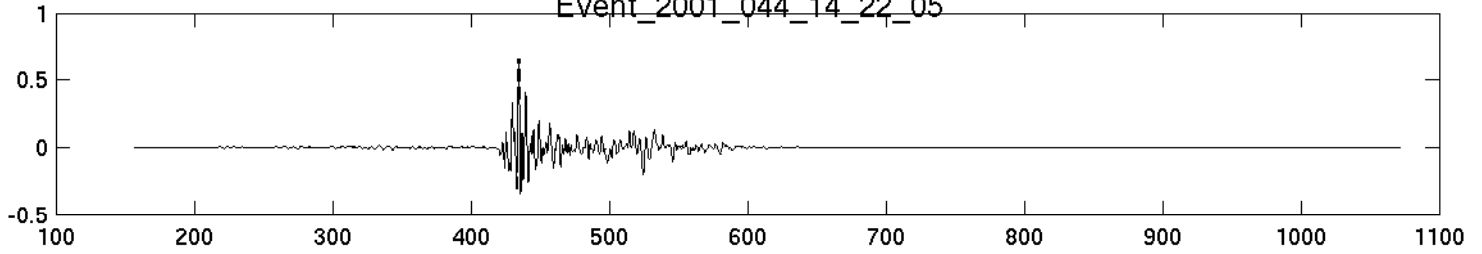


Sorted by  $t^*$ :Event\_2001\_044\_14\_22\_05

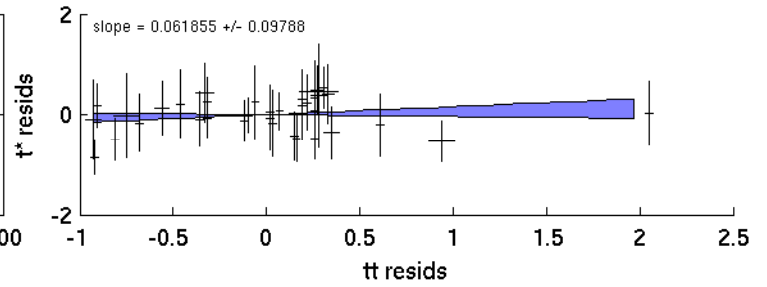
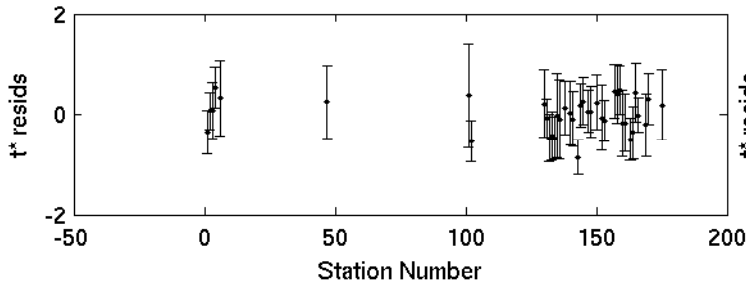


# Event\_2001\_044\_14\_22\_05

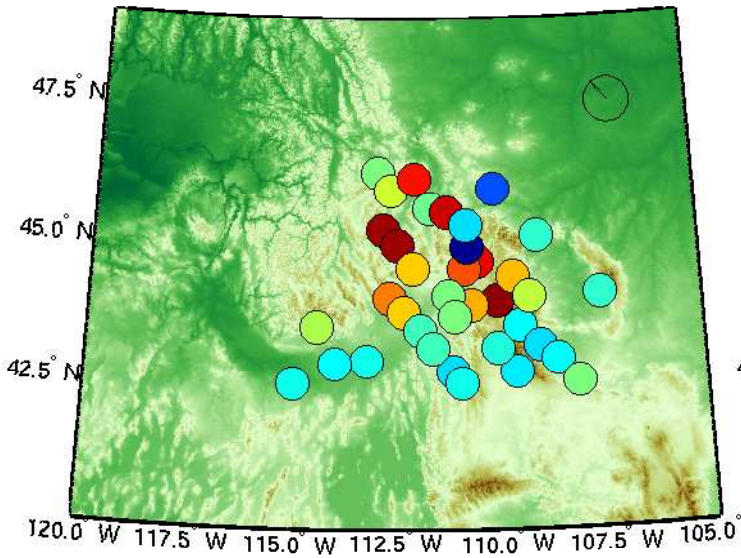
Stack



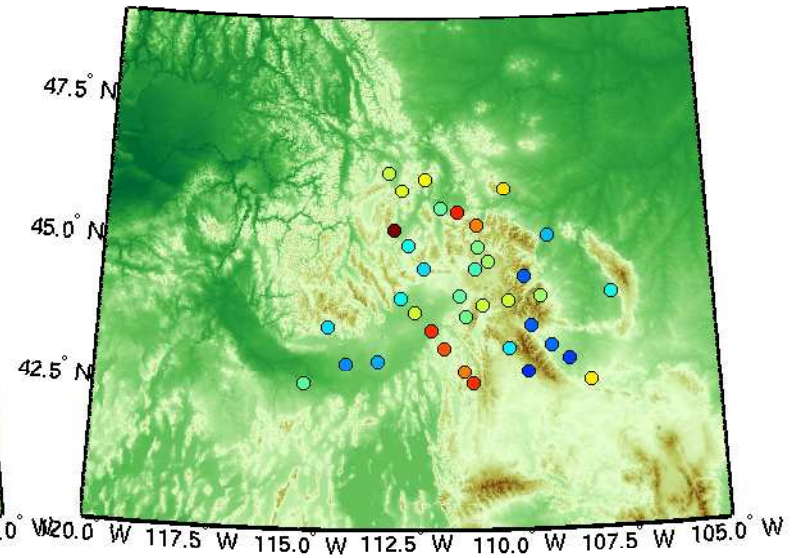
Baz = 141.2045  
Mean xcor value = 0.79263  
Range of t\* values is 1.3853  
Median t\* err is 0.52559  
Slope = 0.061855 +/- 0.09788



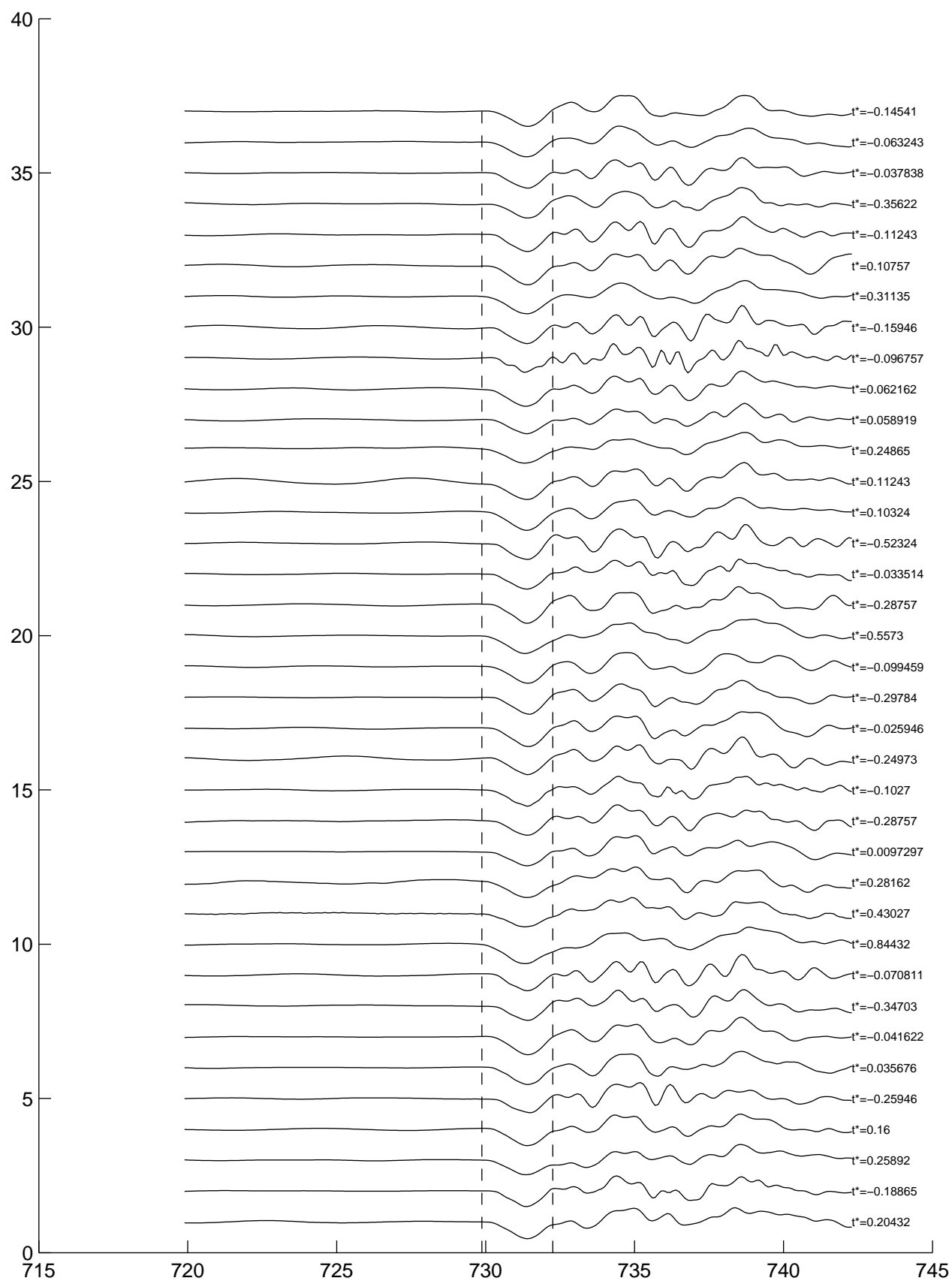
travel time residuals



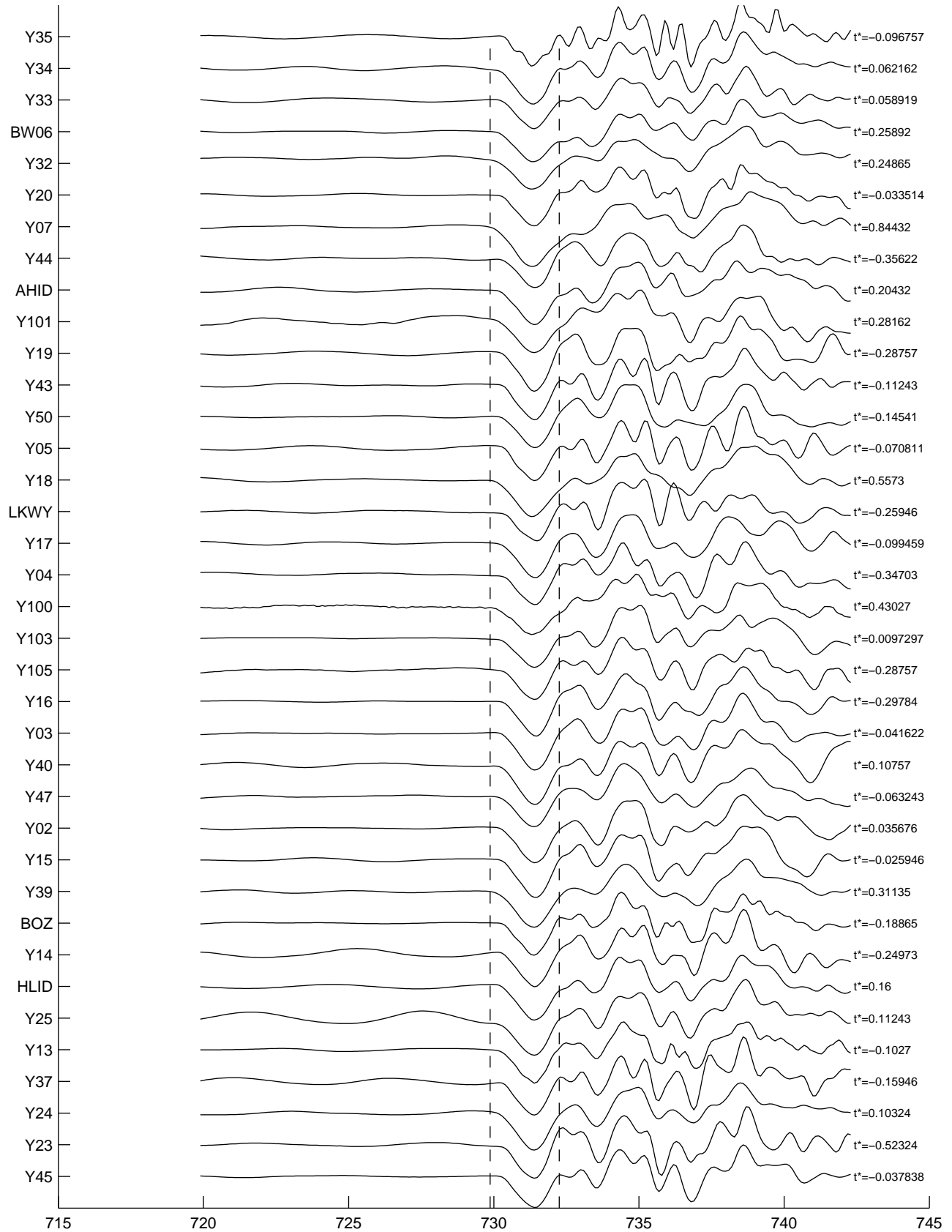
t\* values



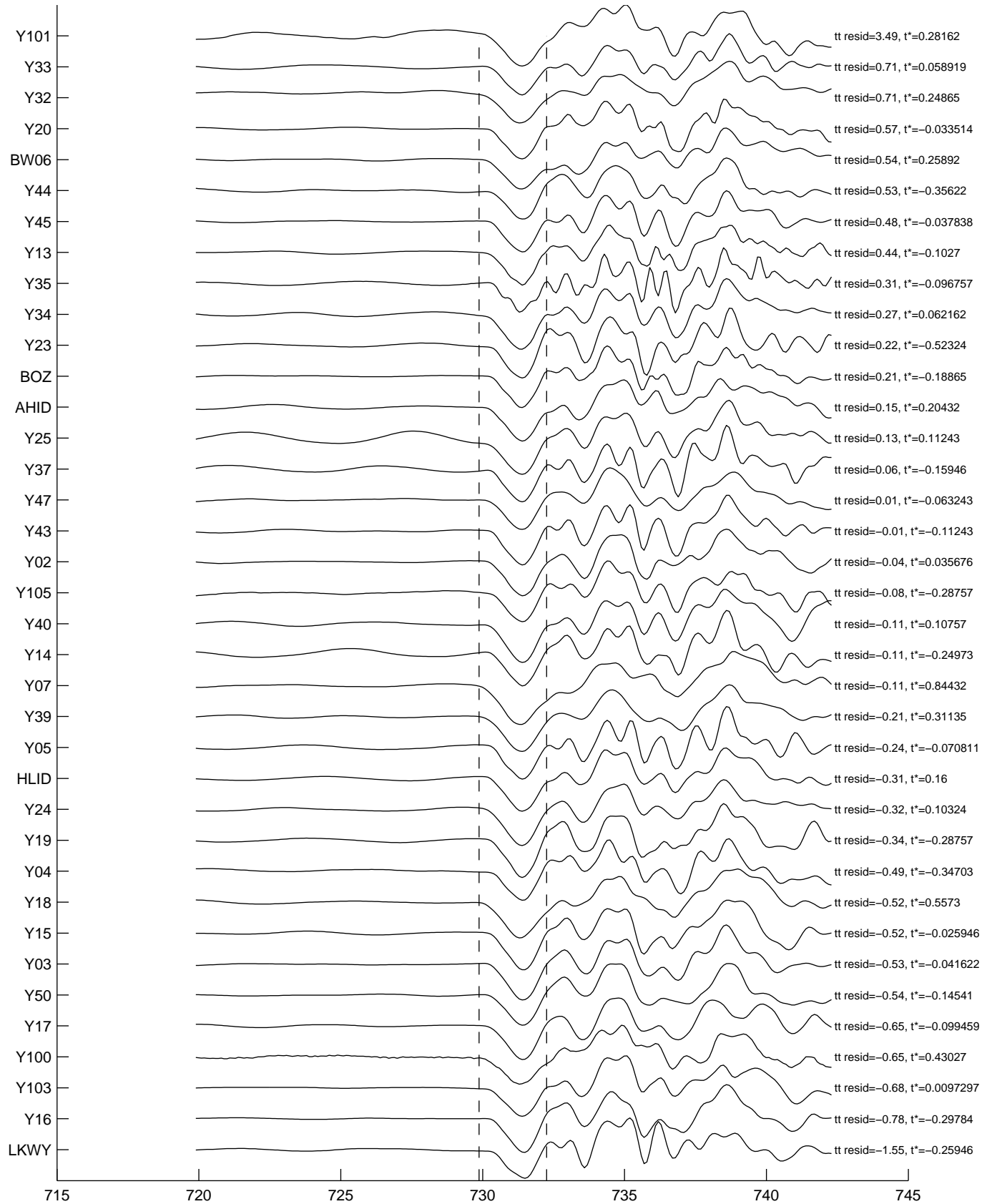
# Event\_2001\_083\_06\_27\_53



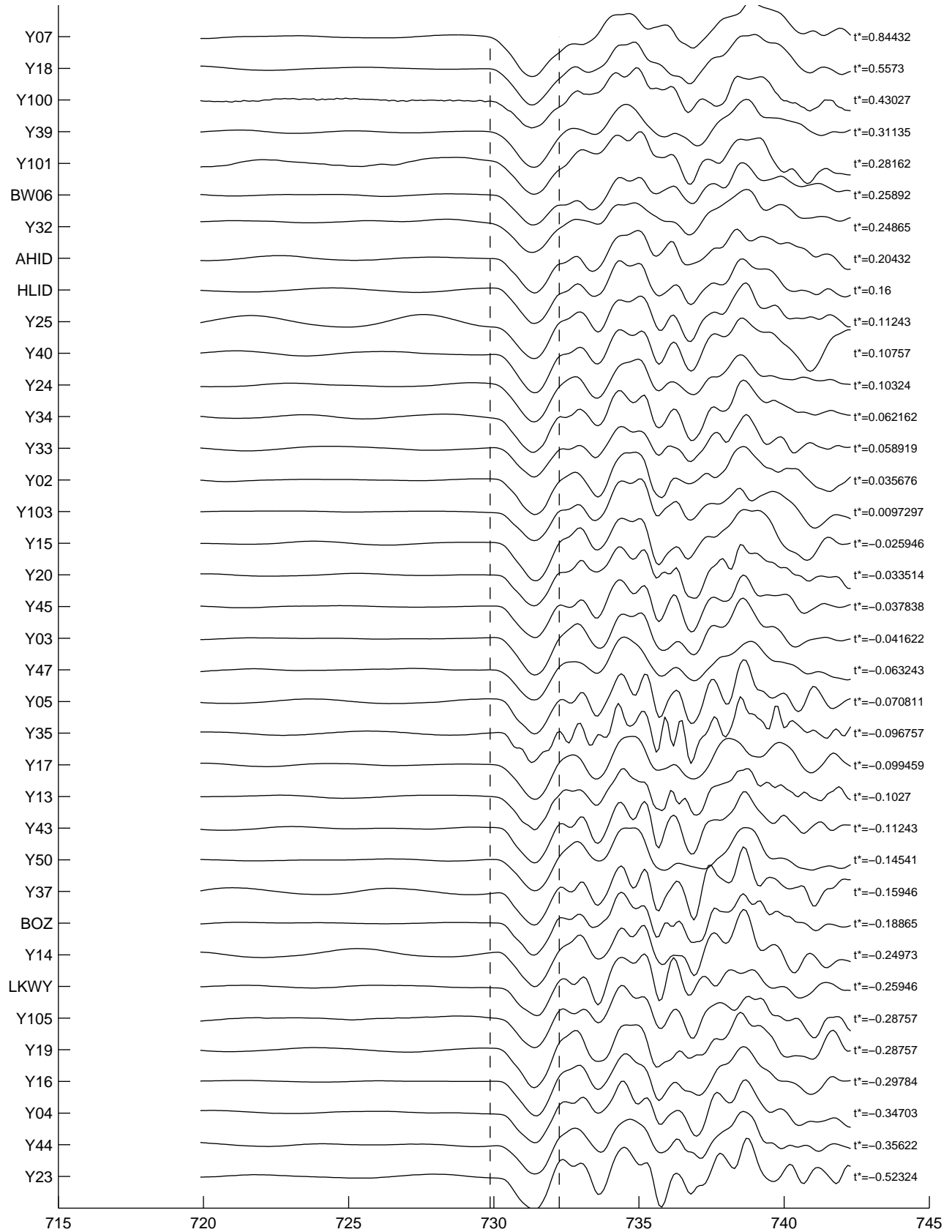
# Sorted by Delta:Event\_2001\_083\_06\_27\_53



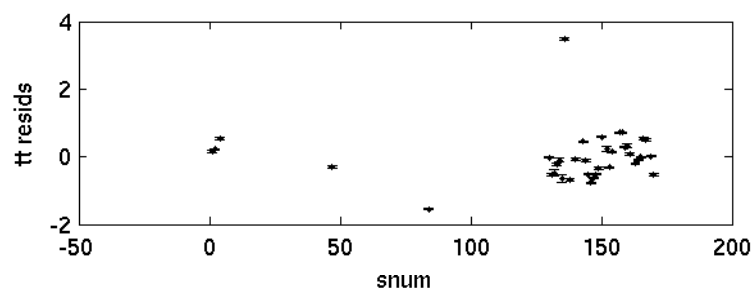
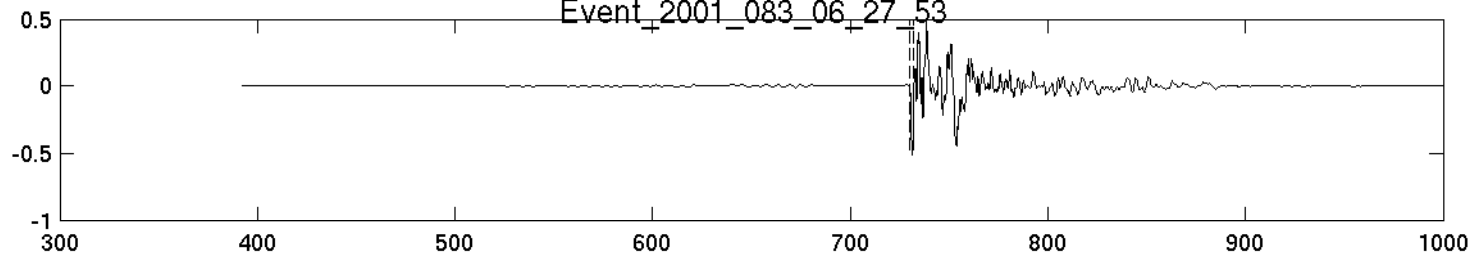
# Sorted by travel time:Event\_2001\_083\_06\_27\_53



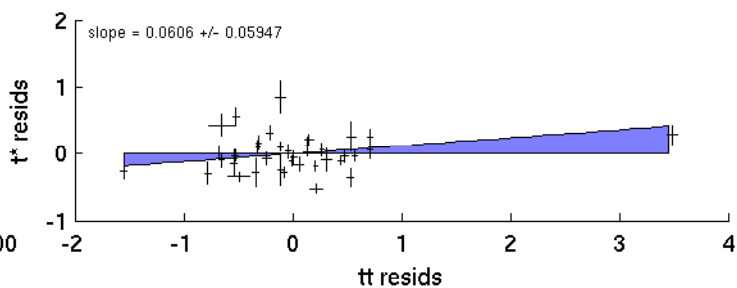
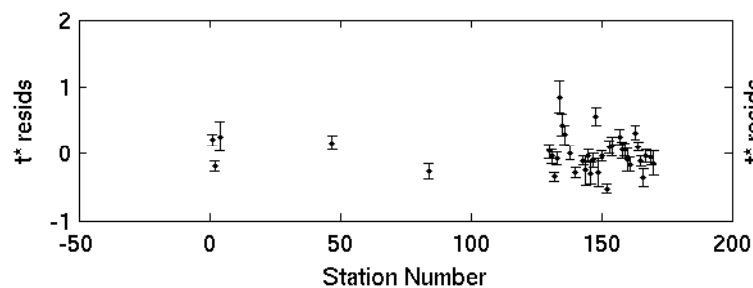
# Sorted by $t^*$ :Event\_2001\_083\_06\_27\_53



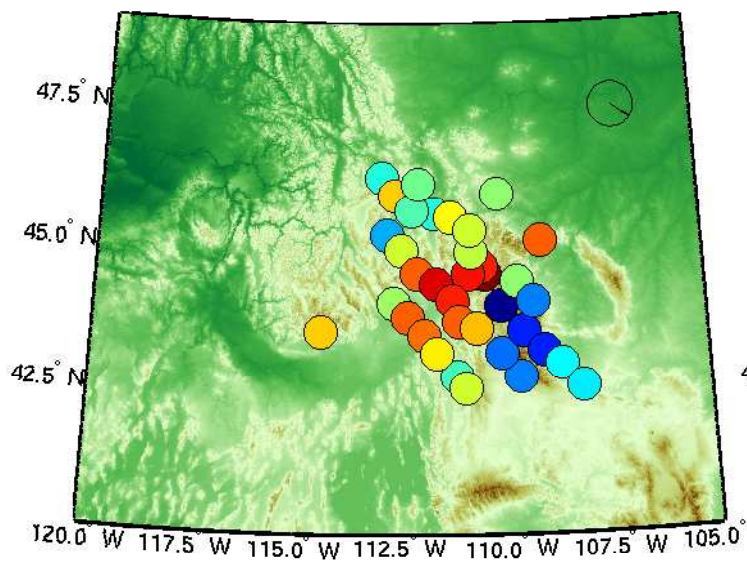
Stack  
Event\_2001\_083\_06\_27\_53



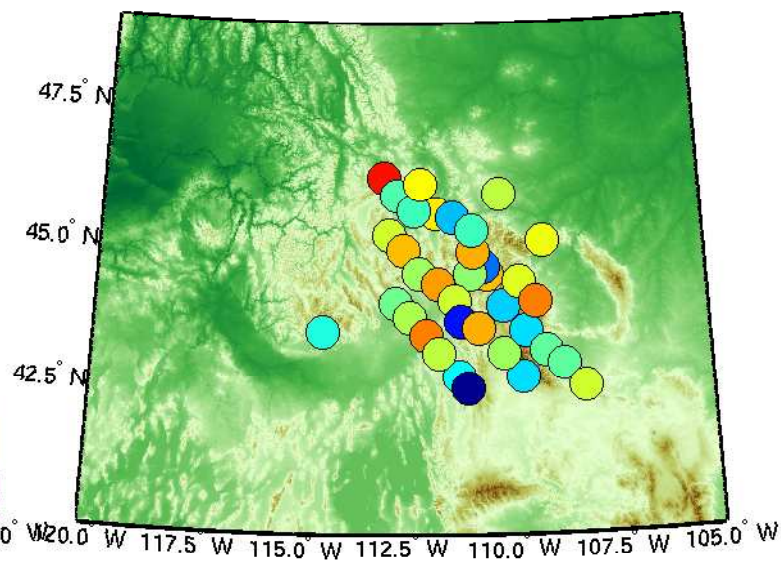
Baz = 306.5493  
Mean xcor value = 0.76324  
Range of  $t^*$  values is 1.3676  
Median  $t^*$  err is 0.10331  
Slope = 0.0606 +/- 0.05947



travel time residuals

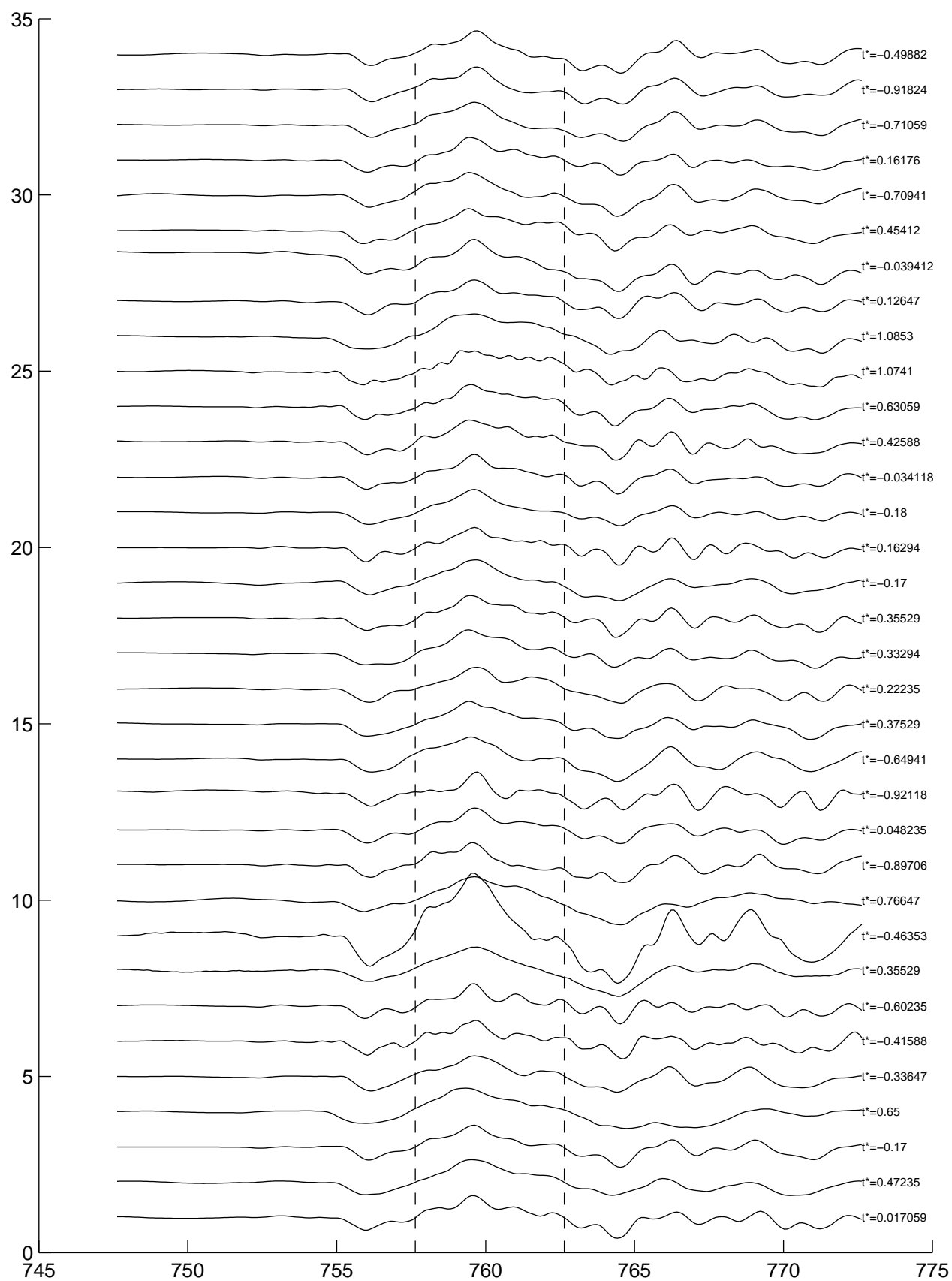


$t^*$  values

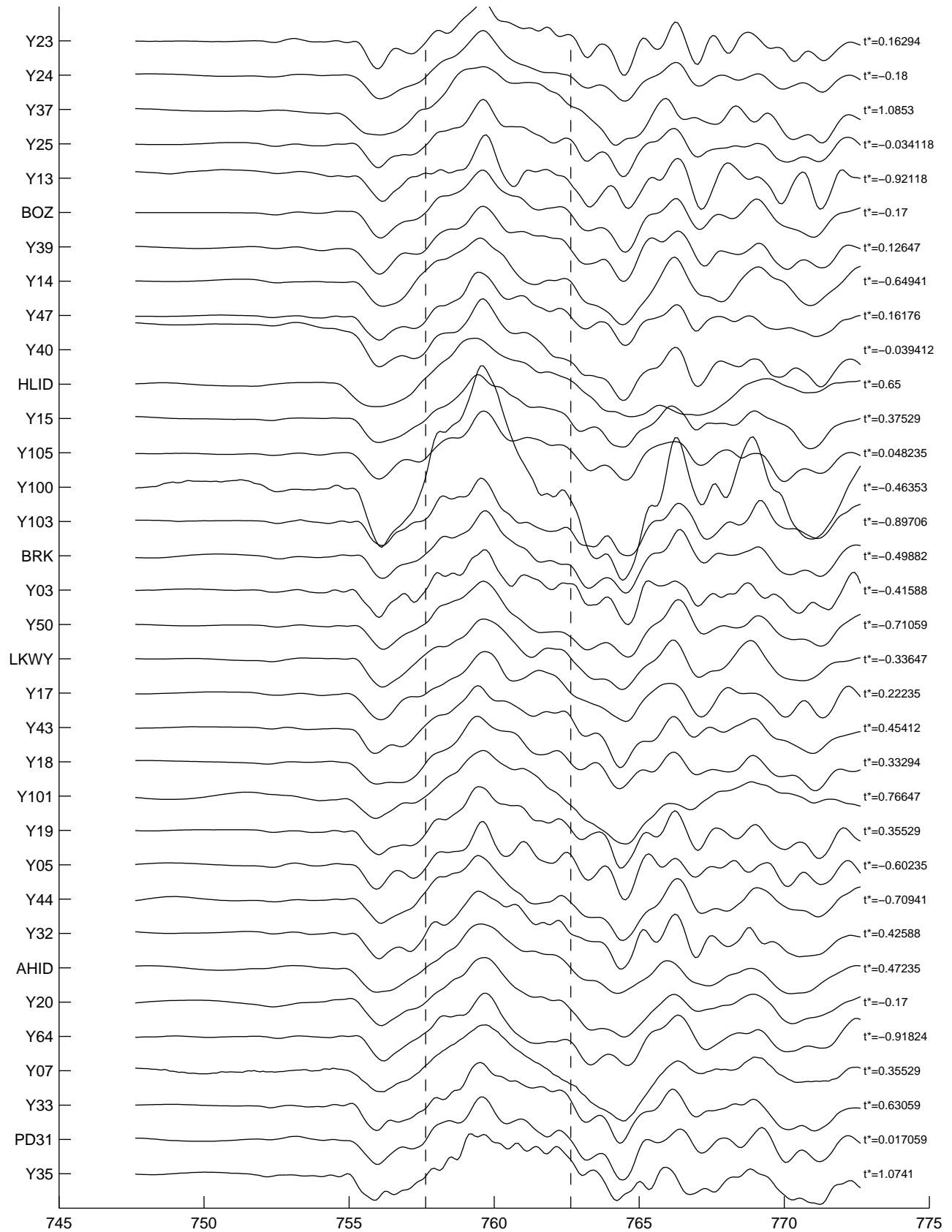




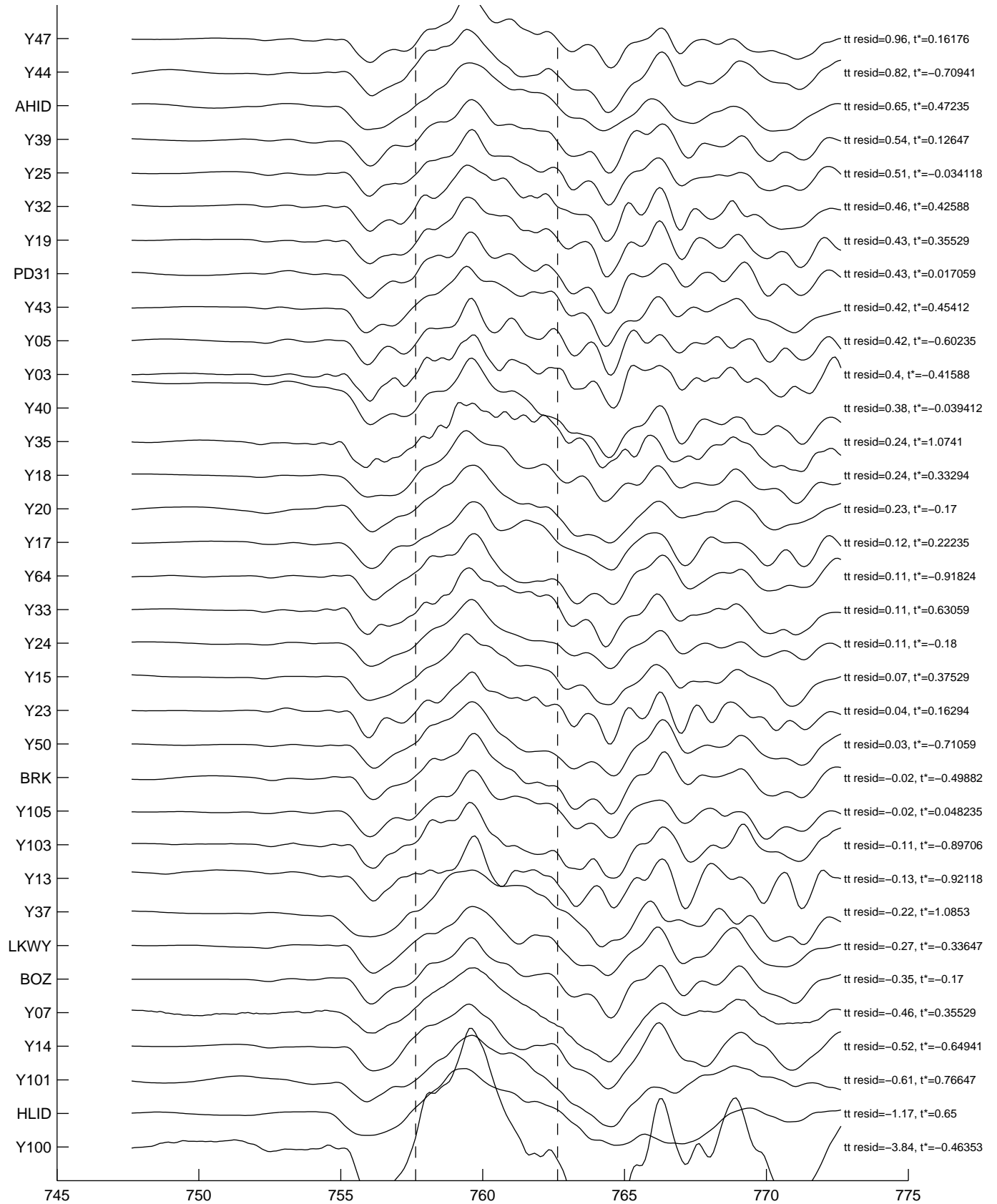
# Event\_2001\_099\_09\_00\_57



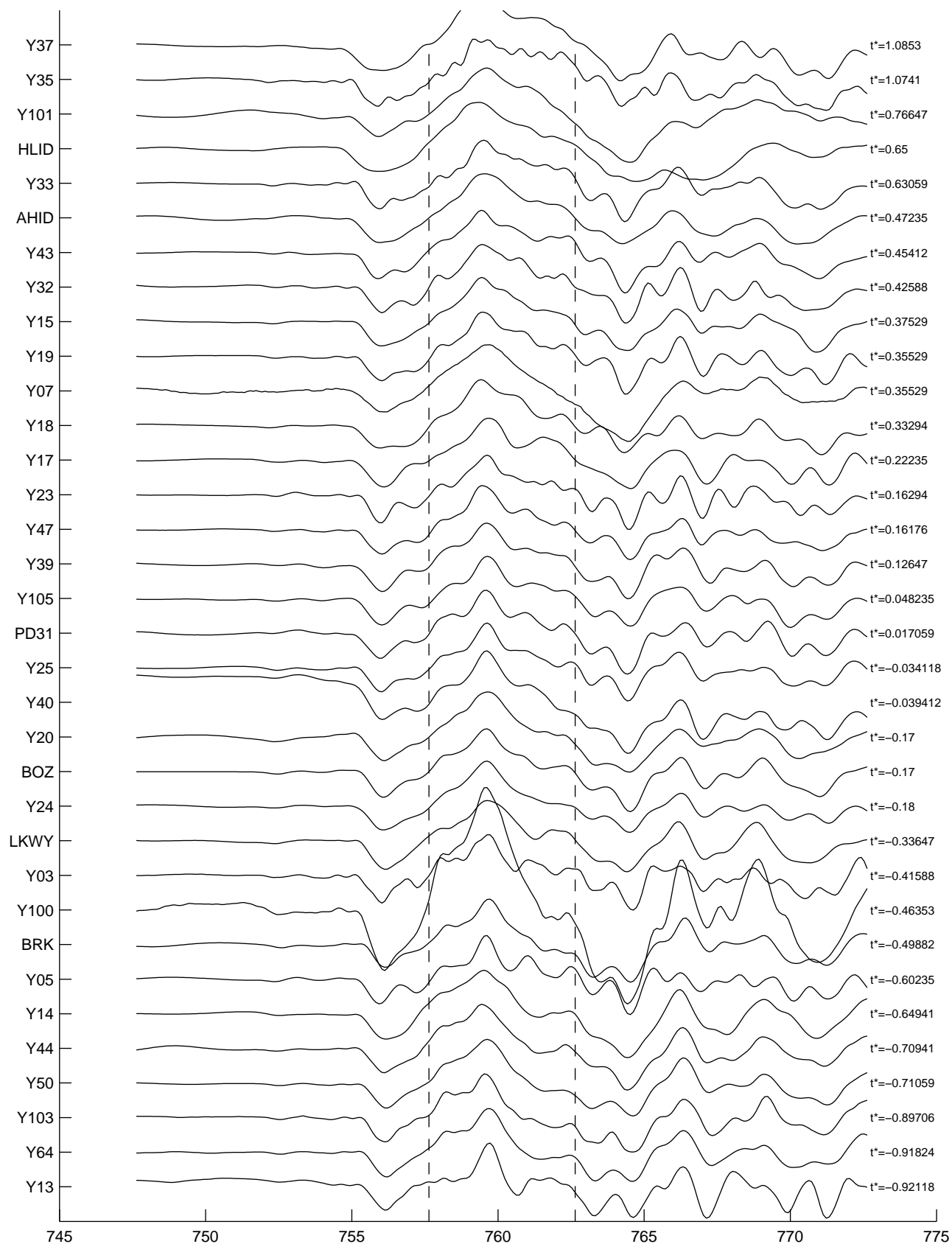
# Sorted by Delta:Event\_2001\_099\_09\_00\_57



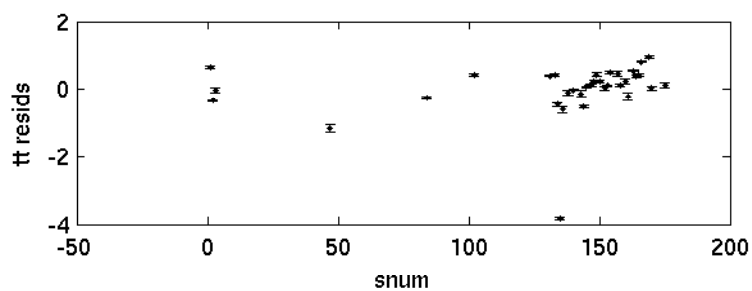
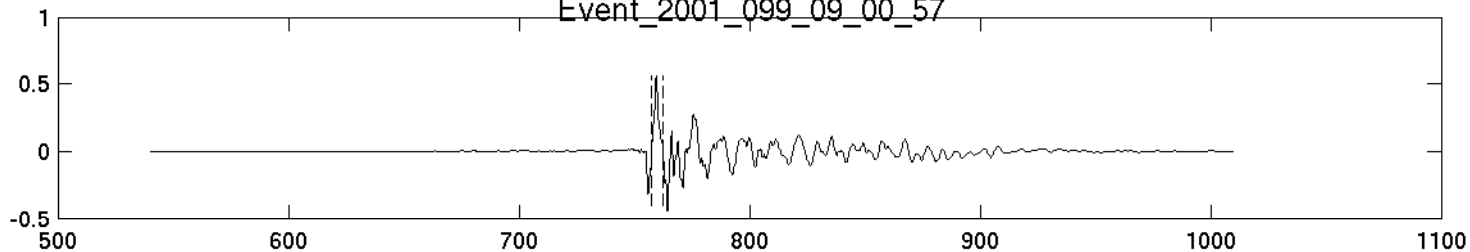
# Sorted by travel time:Event\_2001\_099\_09\_00\_57



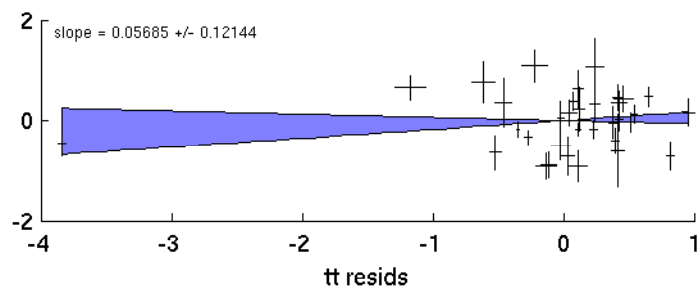
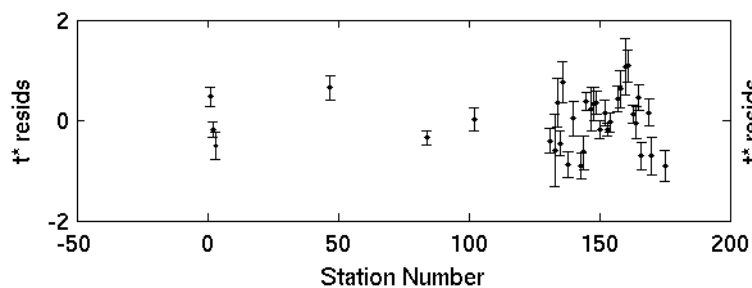
Sorted by  $t^*$ :Event\_2001\_099\_09\_00\_57



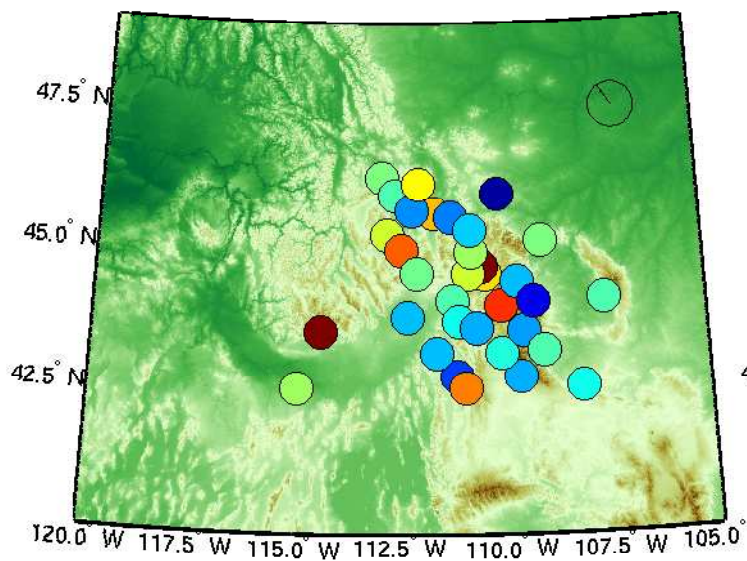
Stack  
Event\_2001\_099\_09\_00\_57



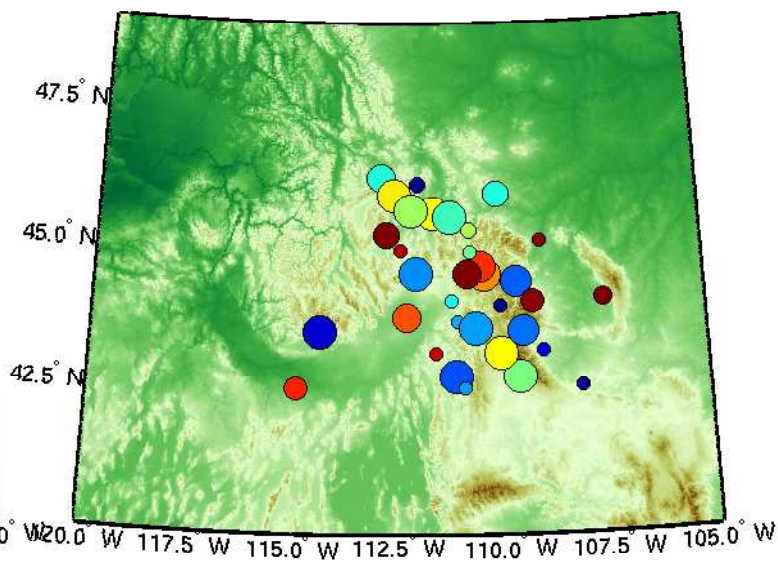
Baz = 148.6209  
Mean xcor value = 0.82735  
Range of  $t^*$  values is 2.0065  
Median  $t^*$  err is 0.2608  
Slope = 0.05685 +/- 0.12144



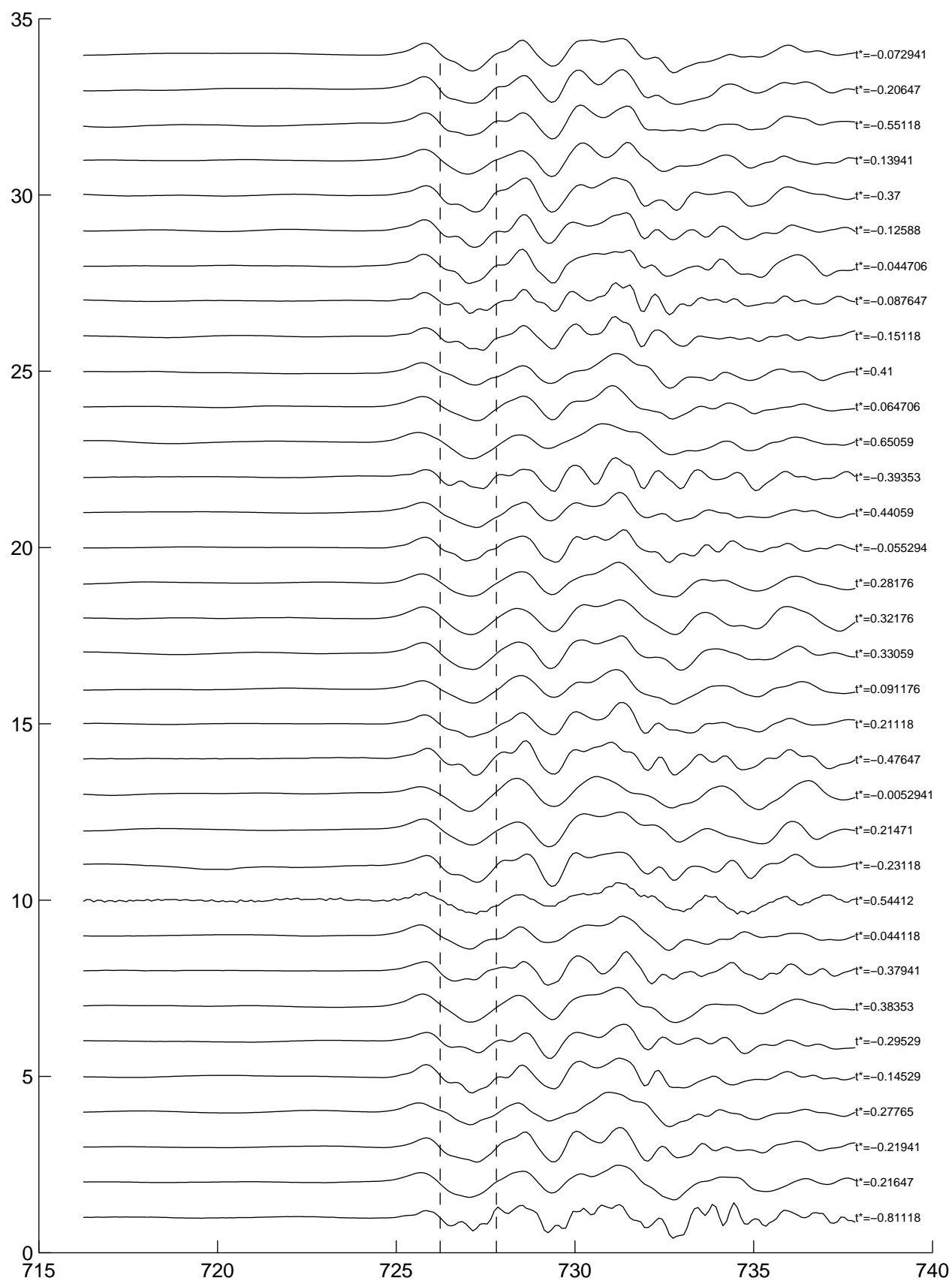
travel time residuals



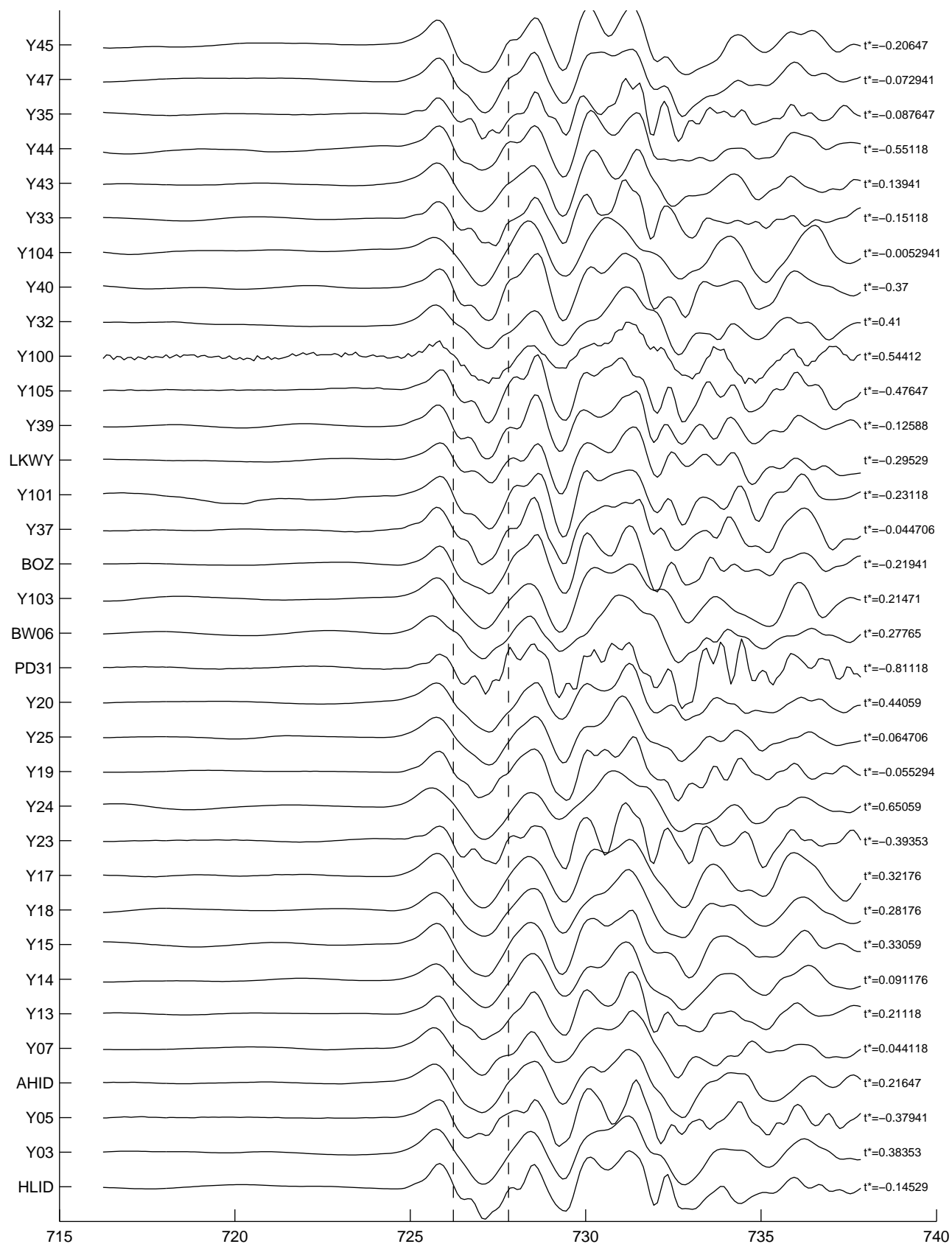
$t^*$  values



# Event\_2001\_118\_04\_49\_53

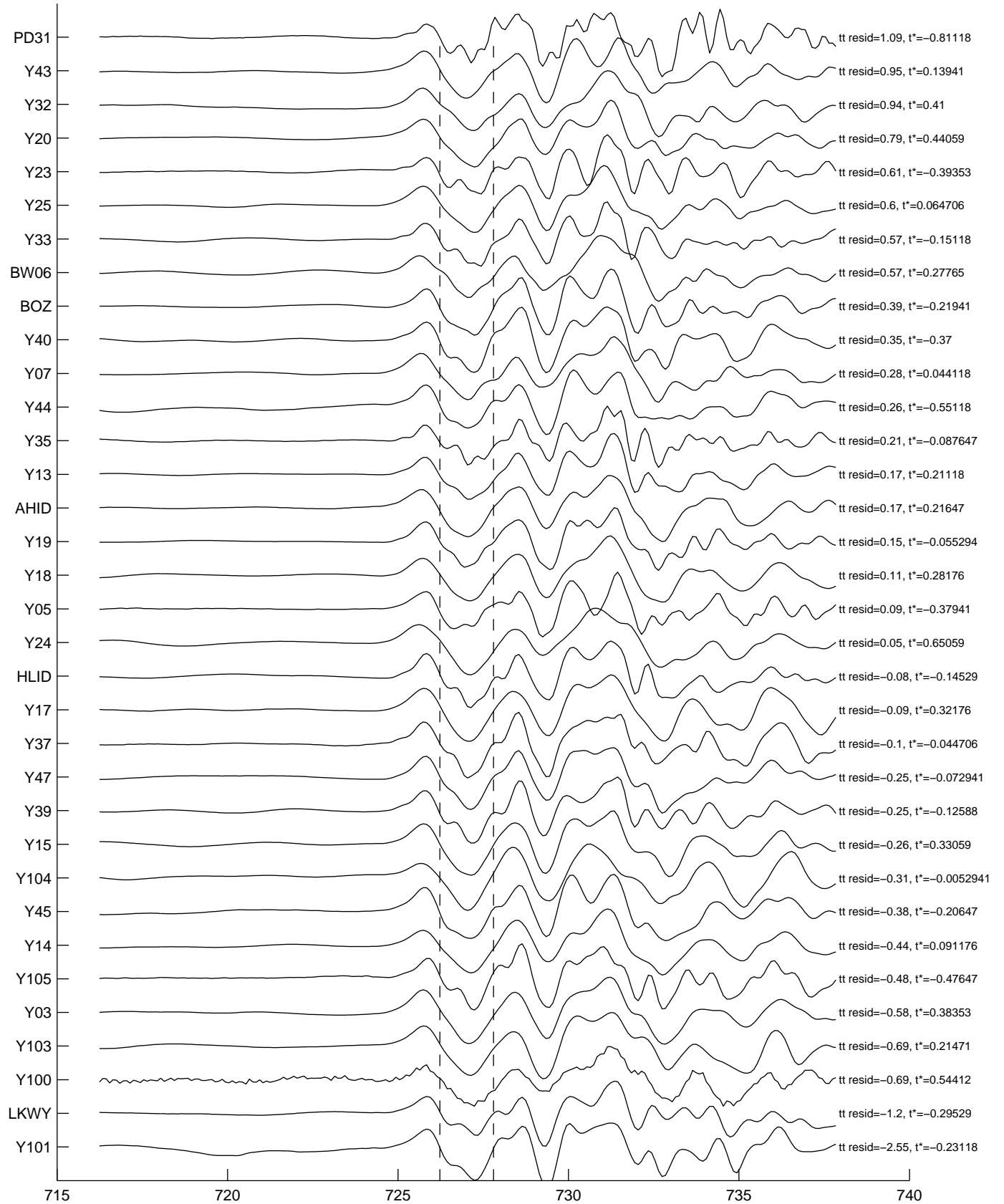


# Sorted by Delta:Event\_2001\_118\_04\_49\_53

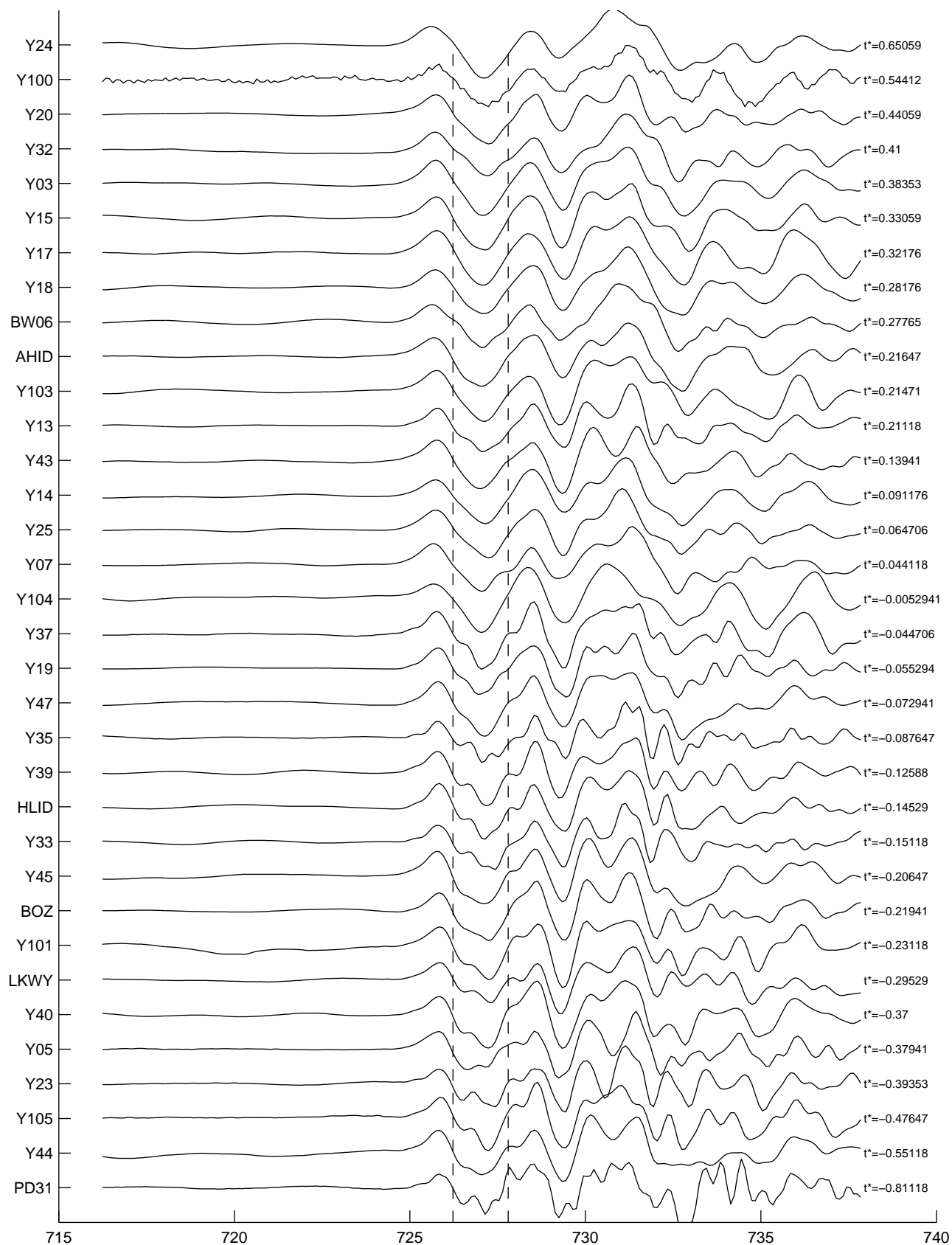




# Sorted by travel time:Event\_2001\_118\_04\_49\_53

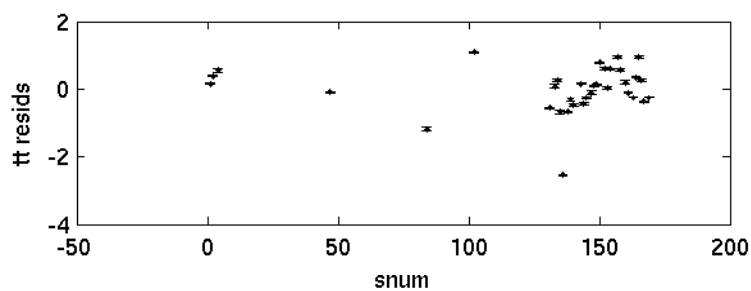
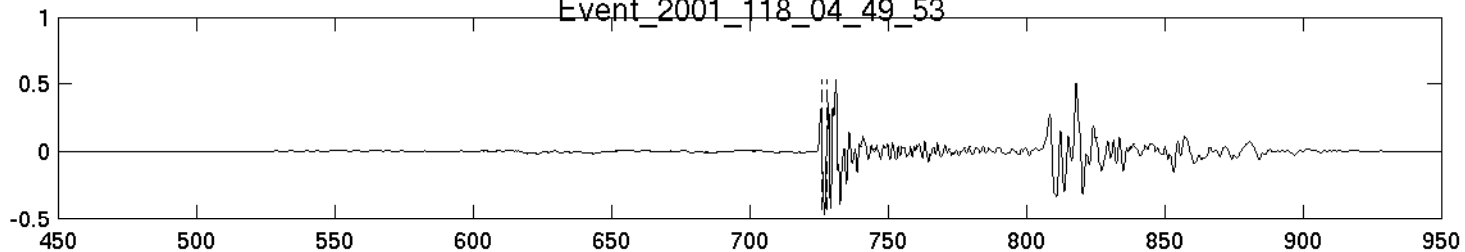


# Sorted by $t^*$ :Event\_2001\_118\_04\_49\_53

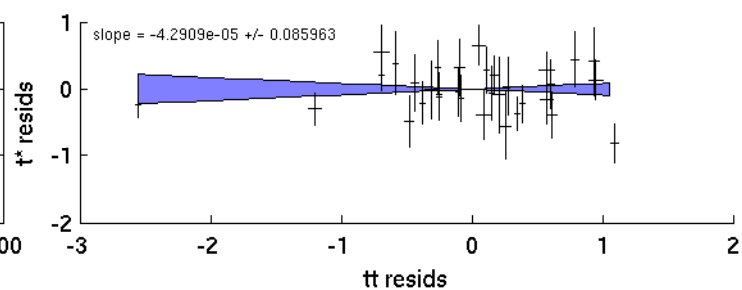
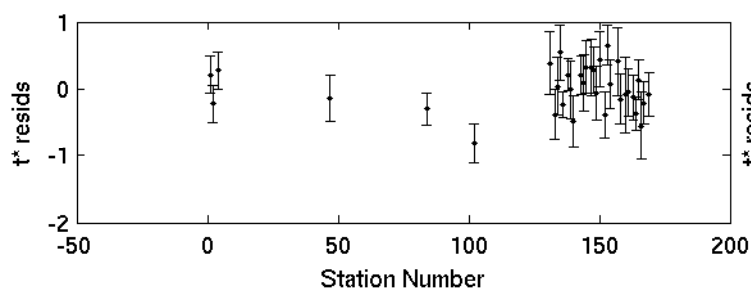


Event\_2001\_11\_18\_04\_49\_53

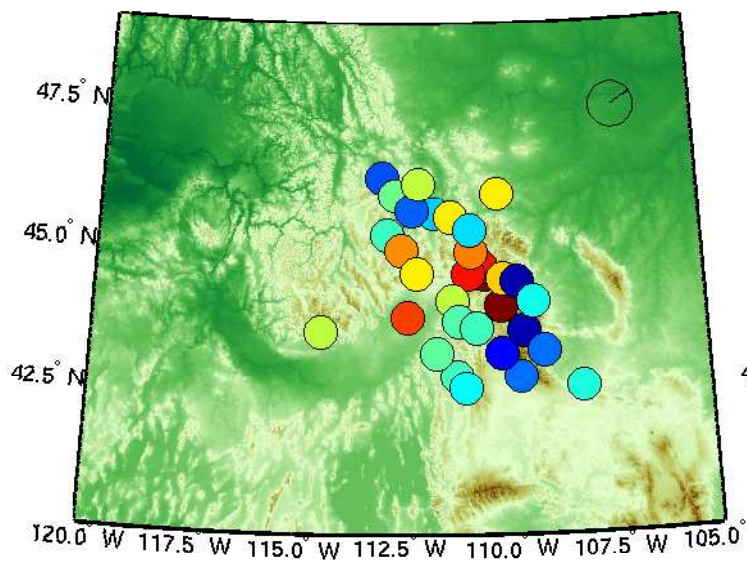
Stack



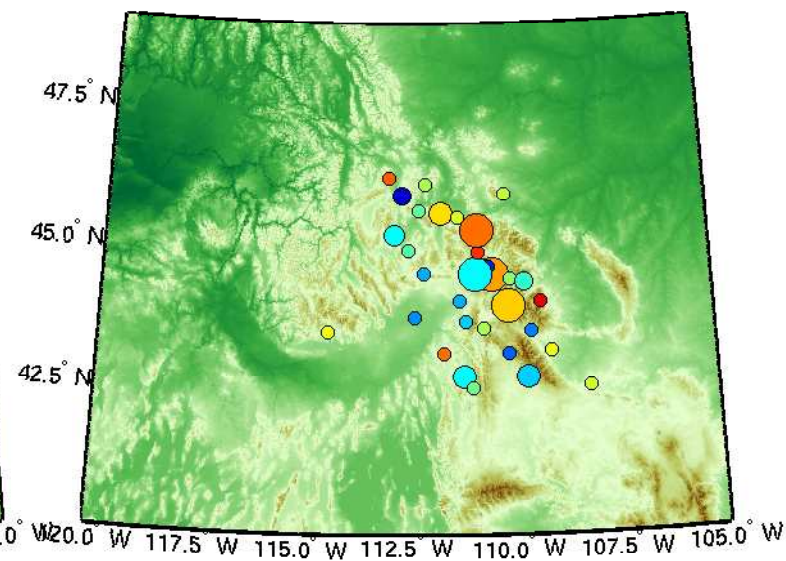
Baz = 237.1532  
Mean xcor value = 0.72029  
Range of  $t^*$  values is 1.4618  
Median  $t^*$  err is 0.34893  
Slope =  $-4.2909\text{e-}05 \pm 0.085963$



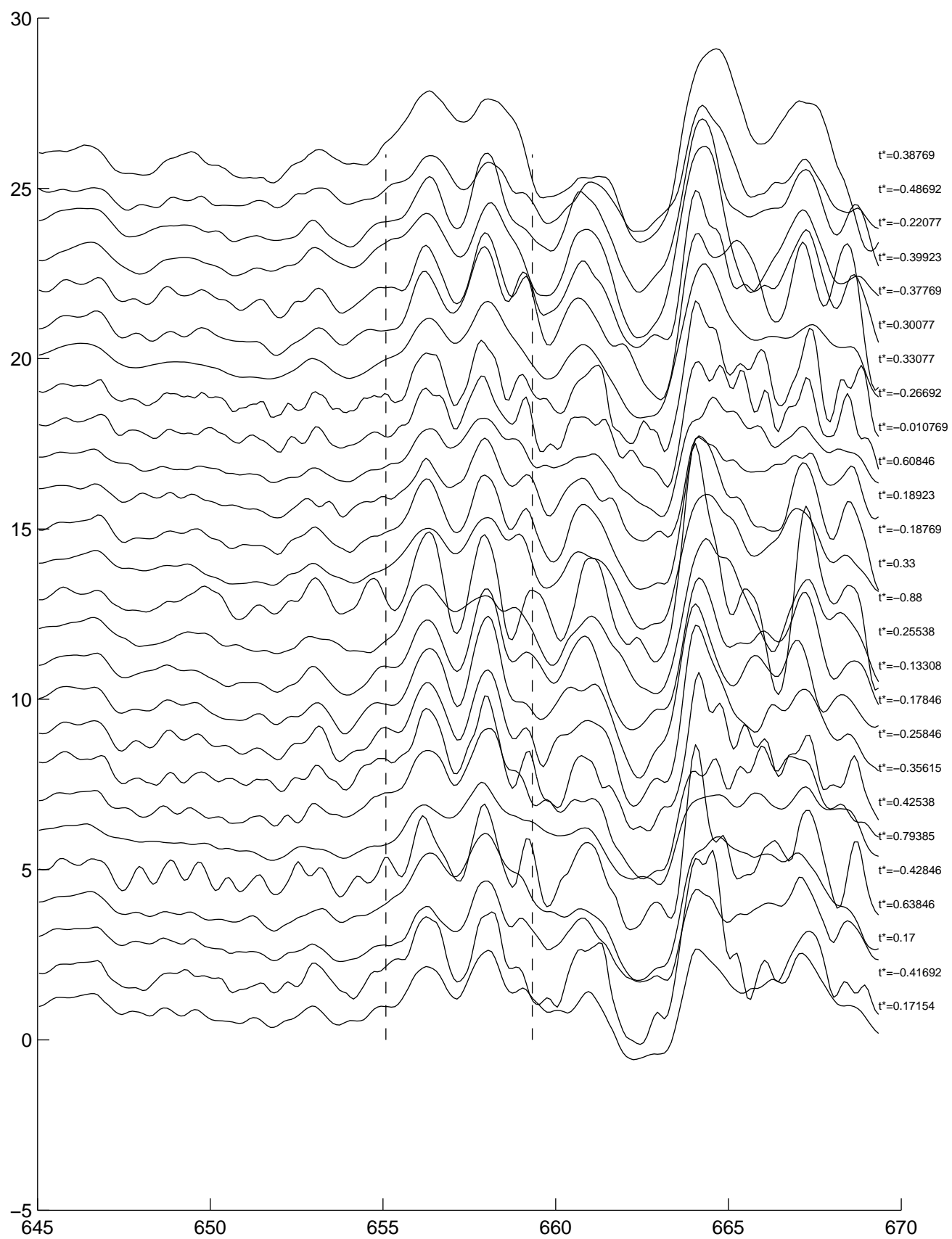
travel time residuals



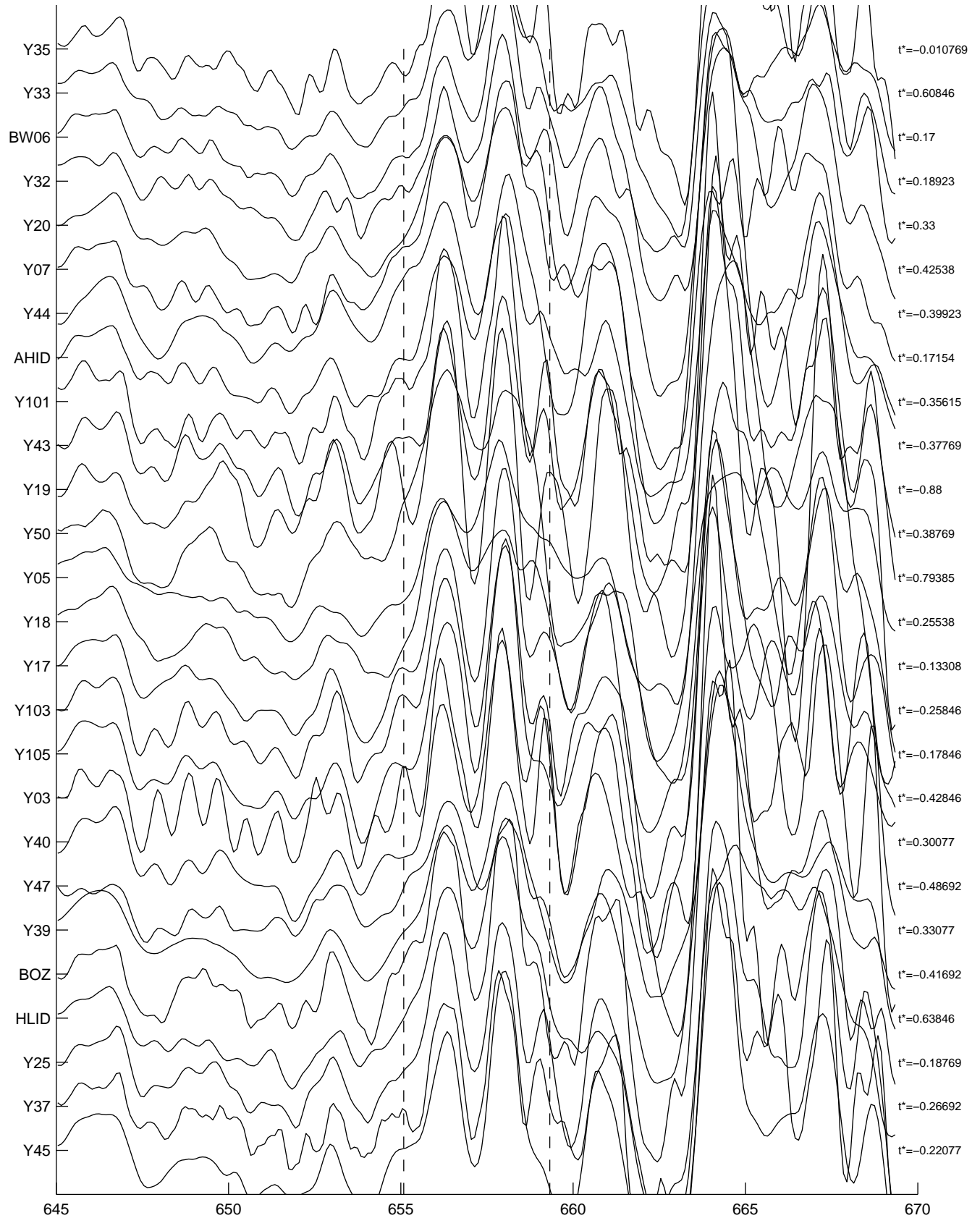
$t^*$  values



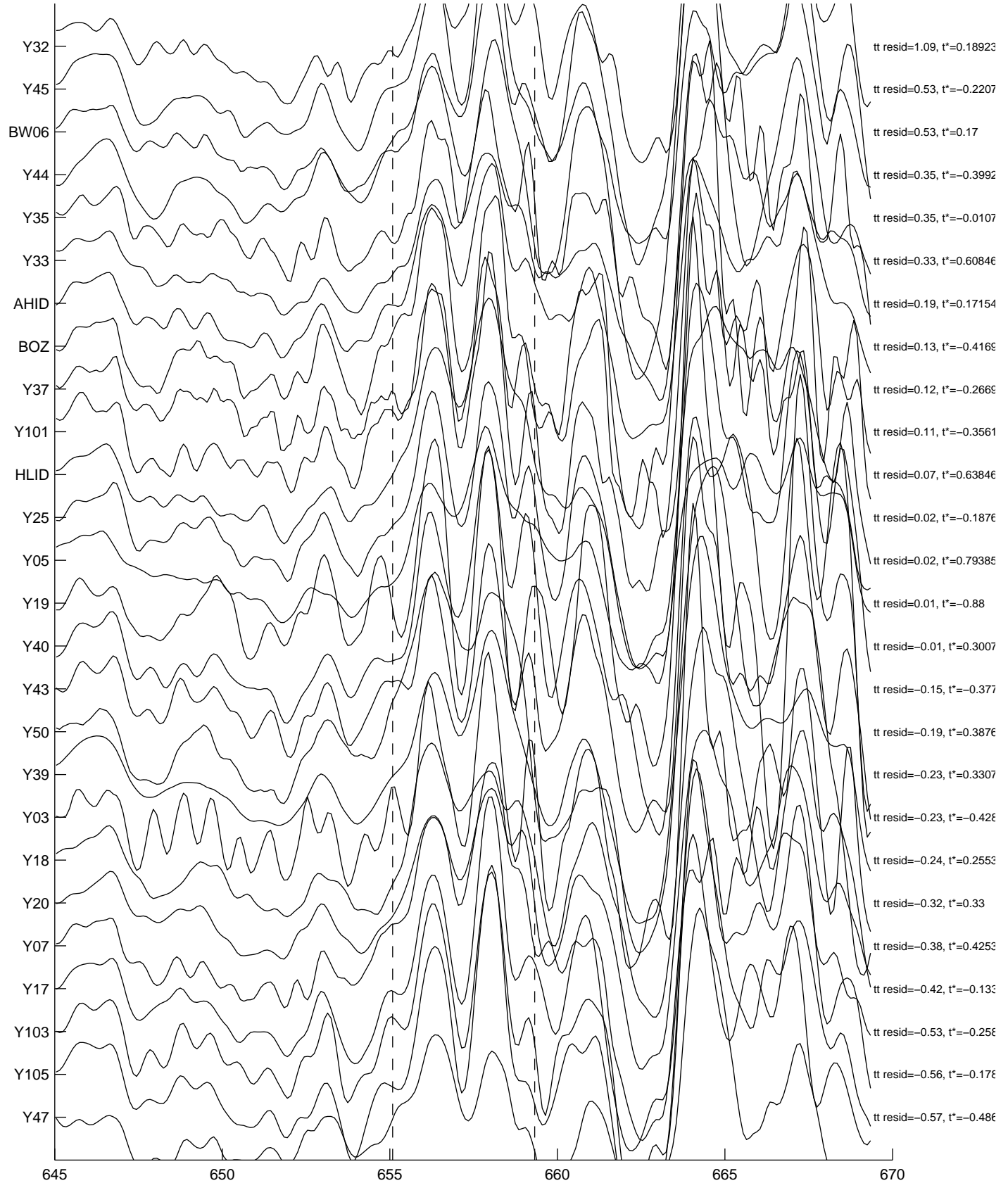
# Event\_2001\_145\_00\_40\_50



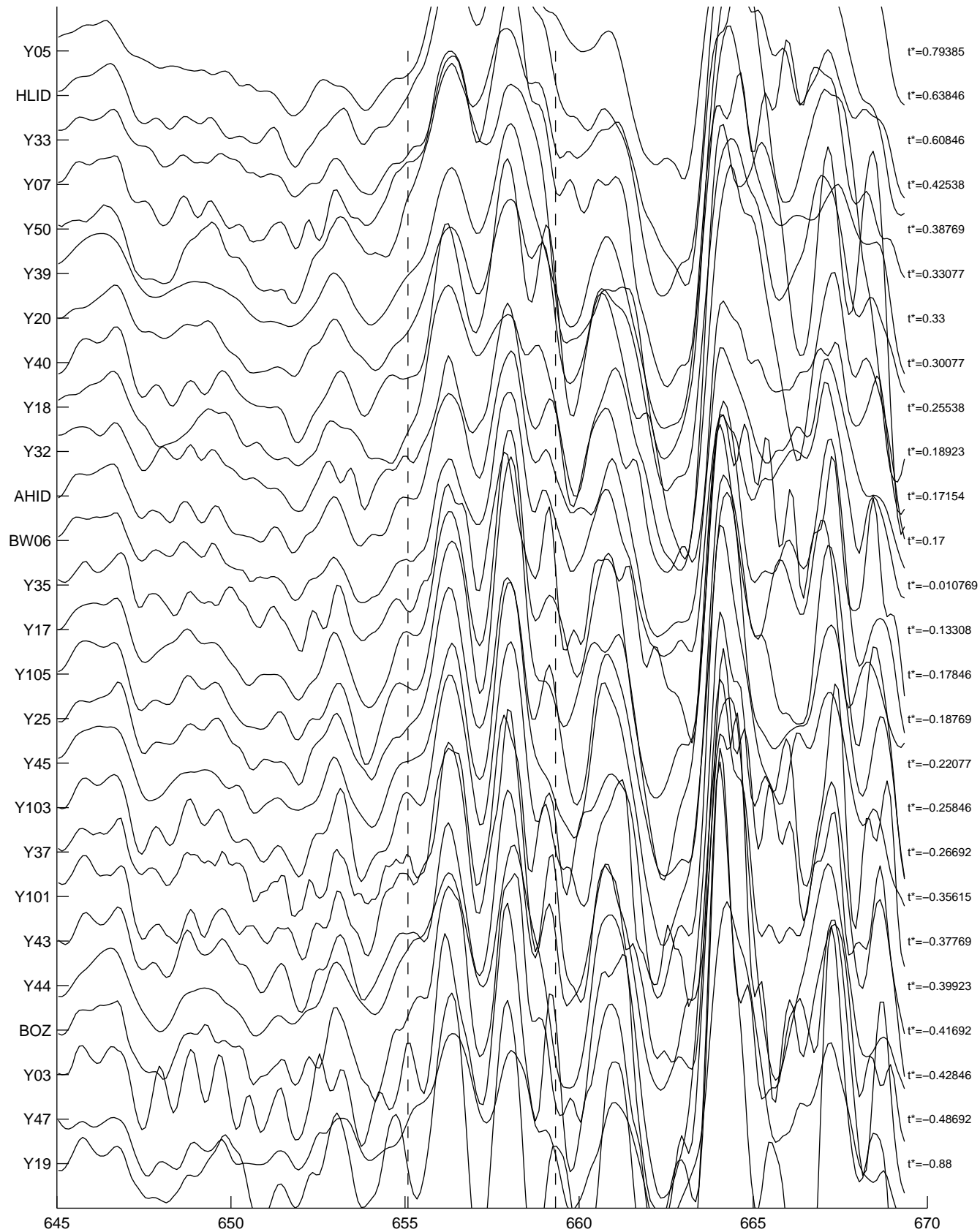
# Sorted by Delta:Event\_2001\_145\_00\_40\_50



# Sorted by travel time:Event\_2001\_145\_00\_40\_50

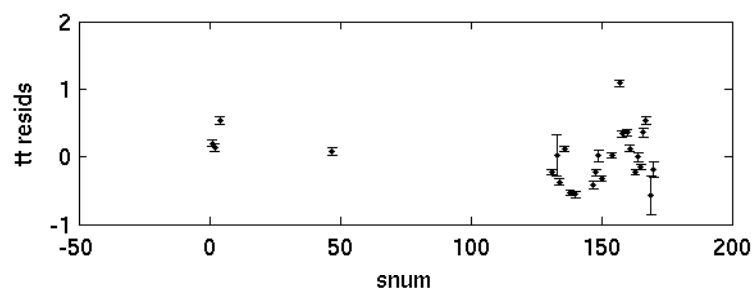
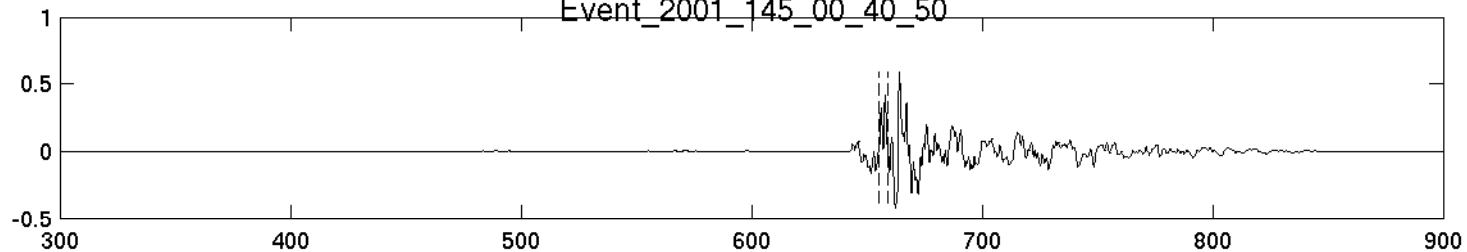


# Sorted by $t^*$ :Event\_2001\_145\_00\_40\_50

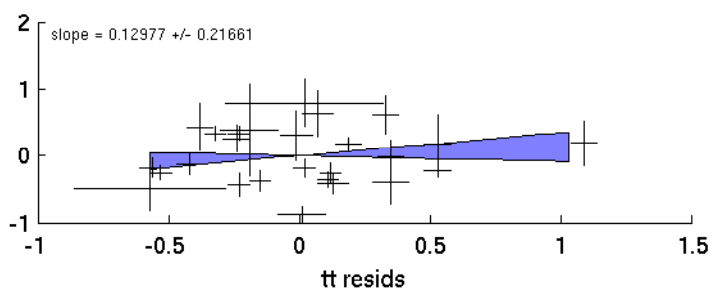
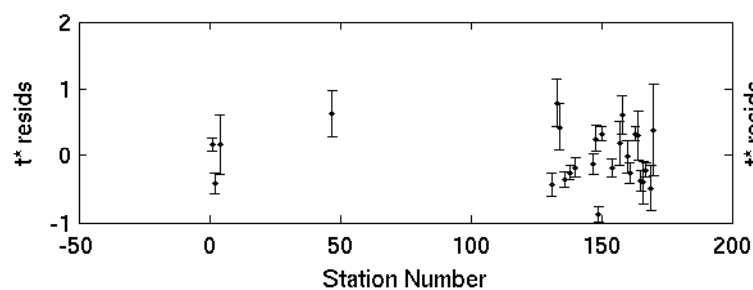




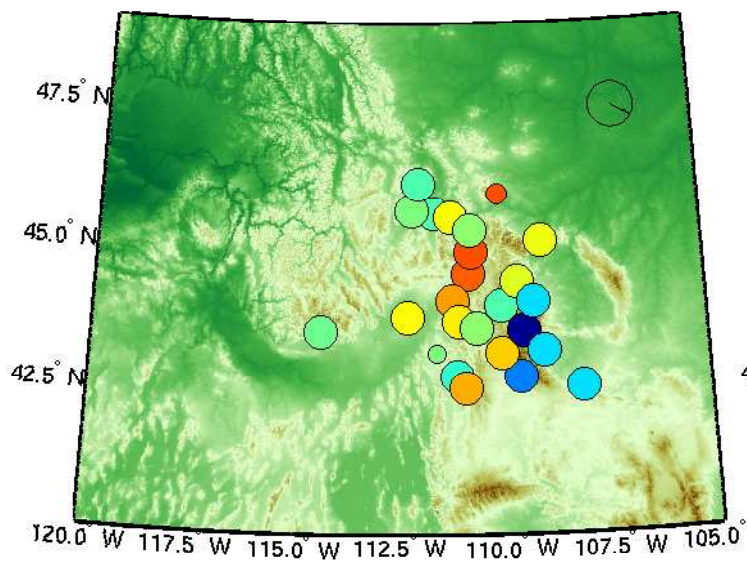
Event\_2001\_145\_00\_40\_50



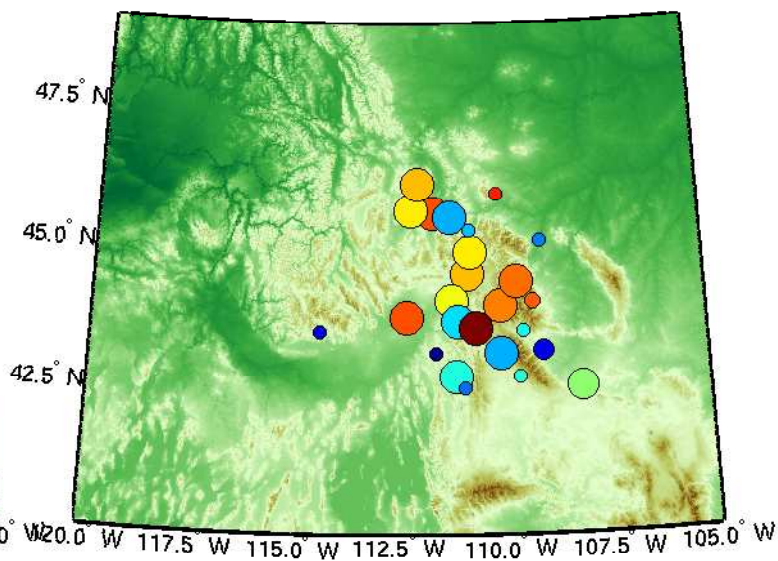
Baz = 302.348  
 Mean xcor value = 0.77269  
 Range of  $t^*$  values is 1.6738  
 Median  $t^*$  err is 0.162  
 Slope = 0.12977 +/- 0.21661



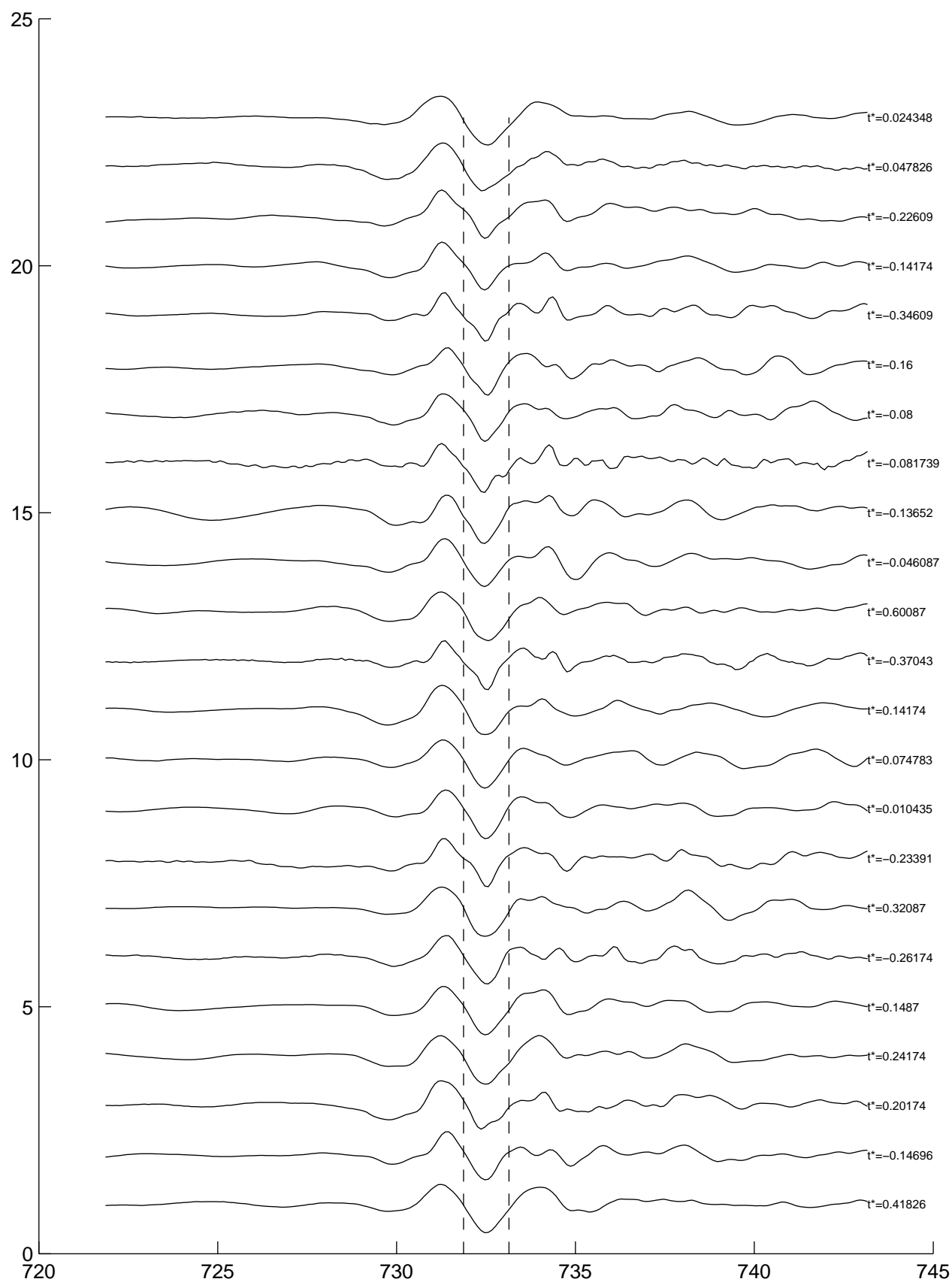
travel time residuals



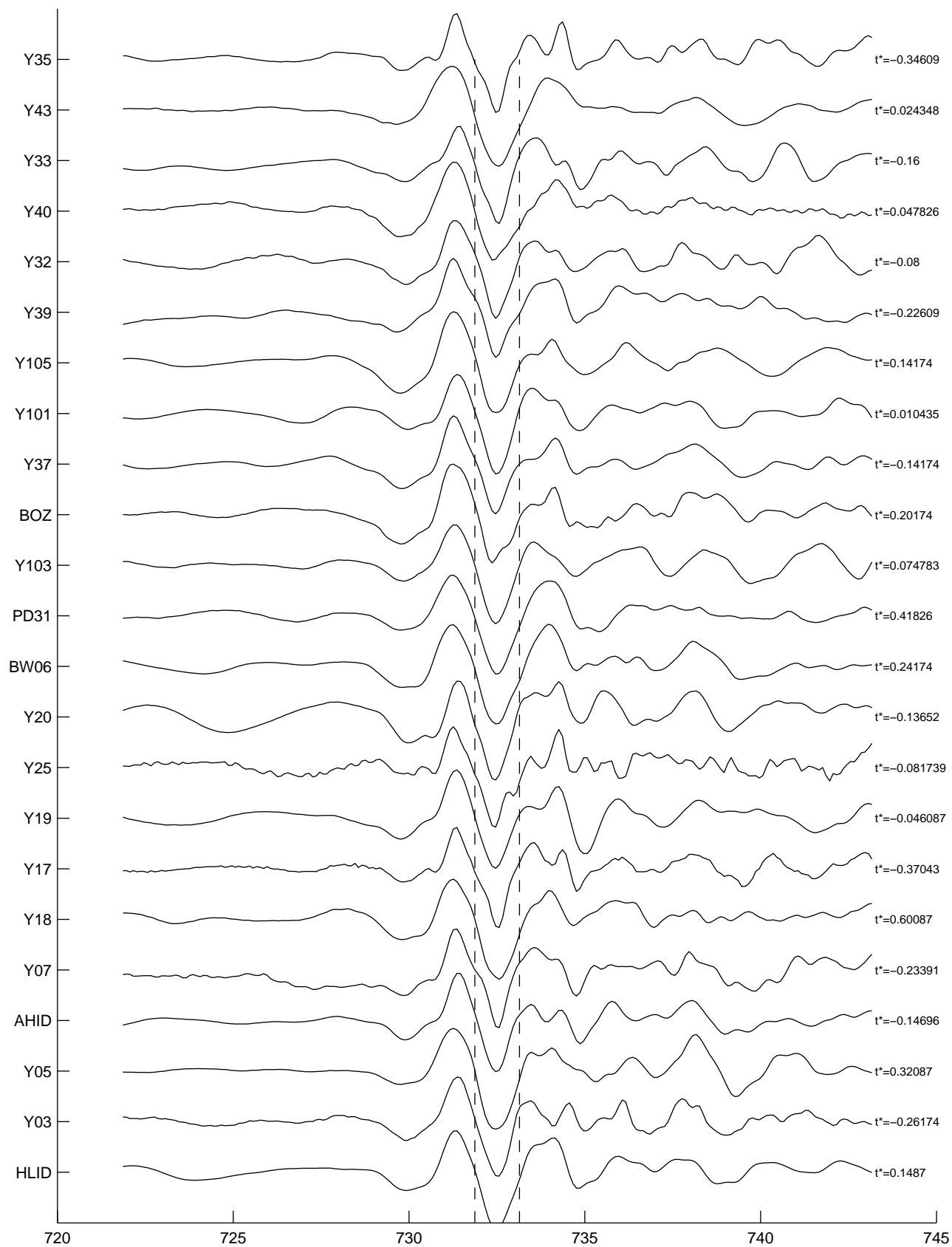
$t^*$  values



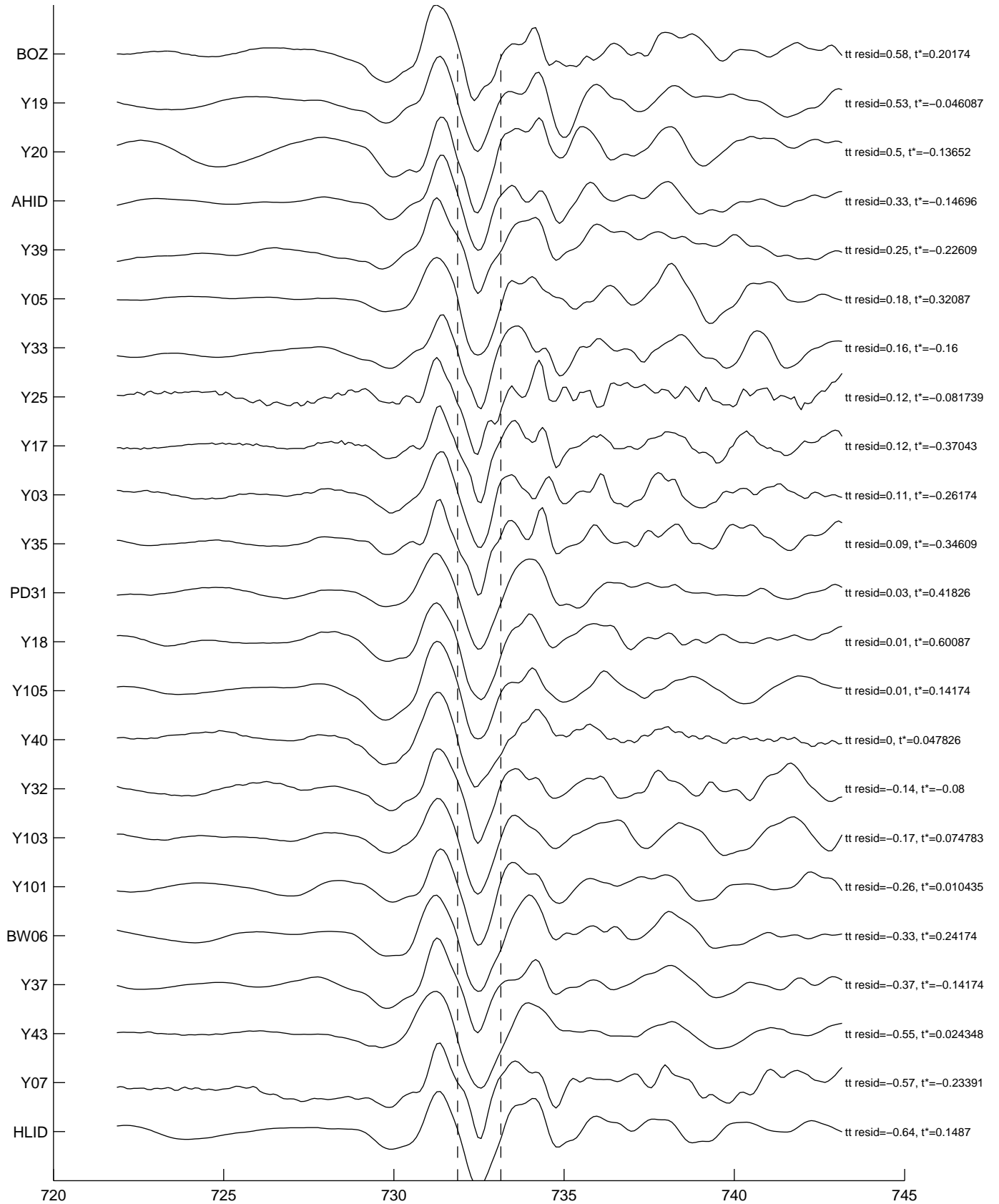
# Event\_2001\_146\_10\_57\_26



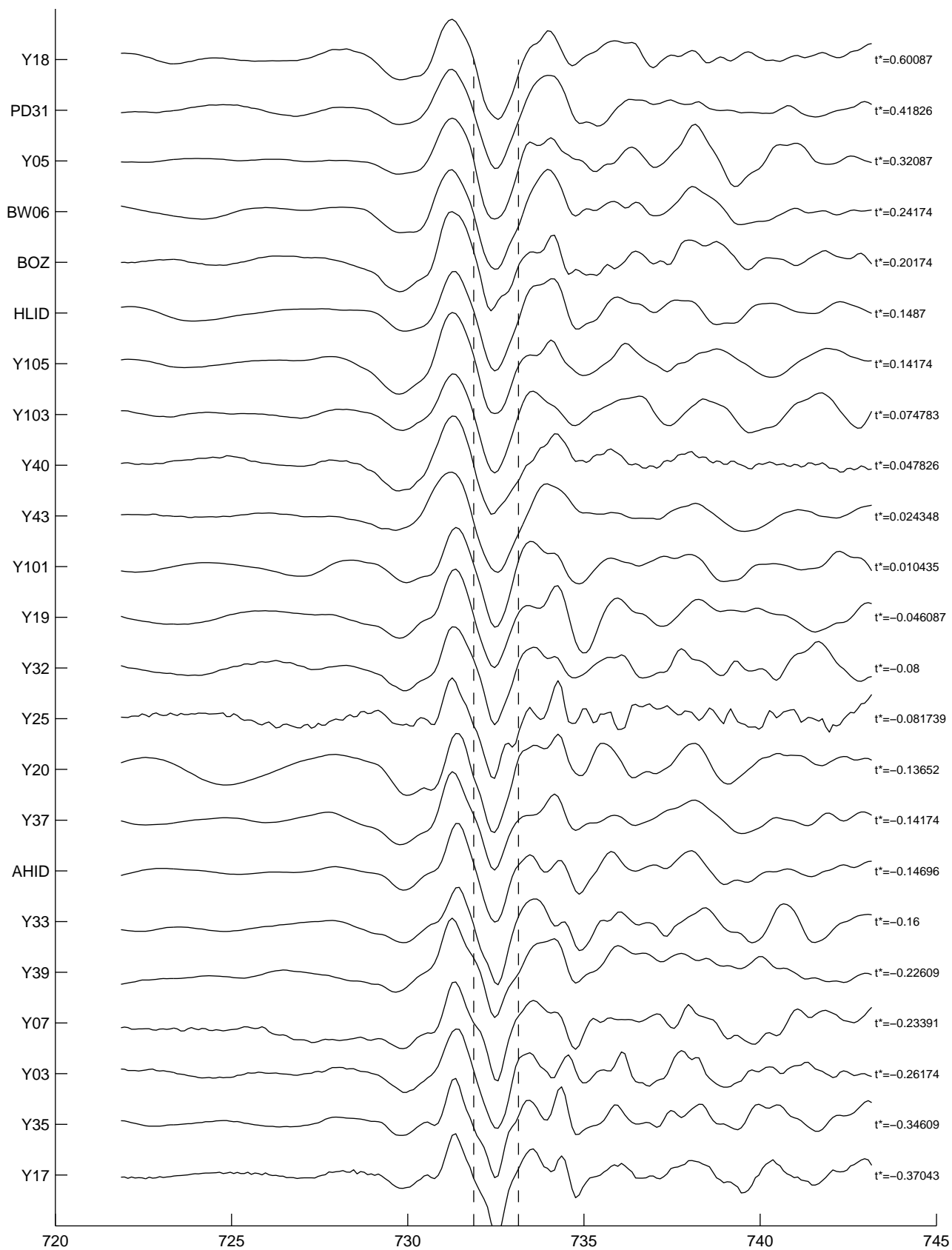
# Sorted by Delta:Event\_2001\_146\_10\_57\_26



# Sorted by travel time: Event\_2001\_146\_10\_57\_26

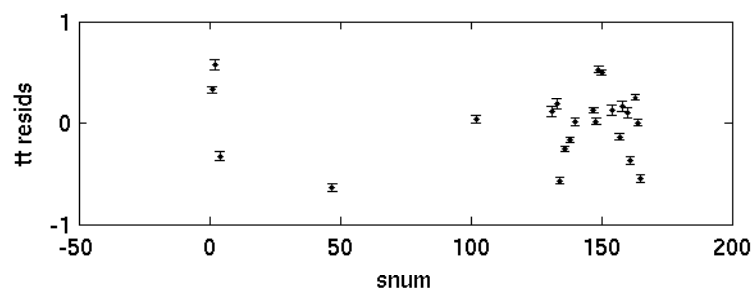
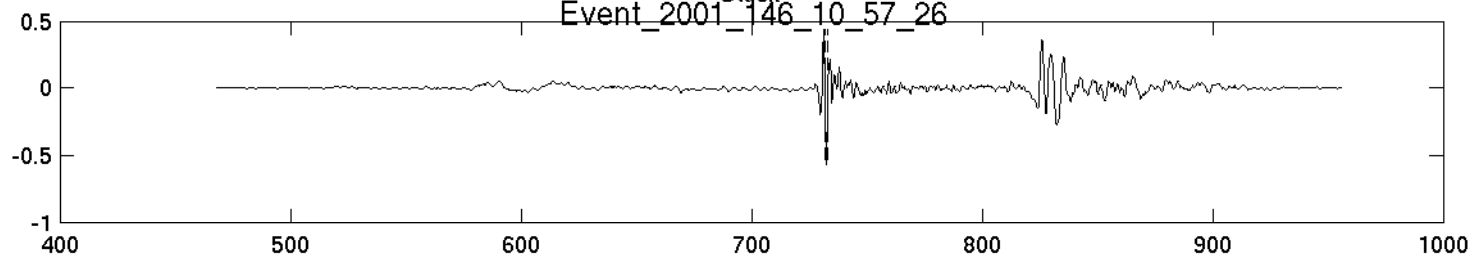


# Sorted by $t^*$ :Event\_2001\_146\_10\_57\_26

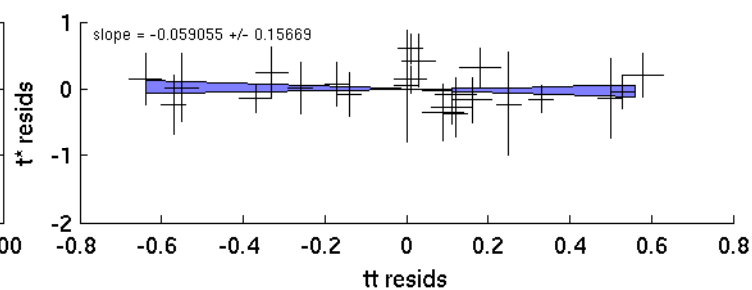
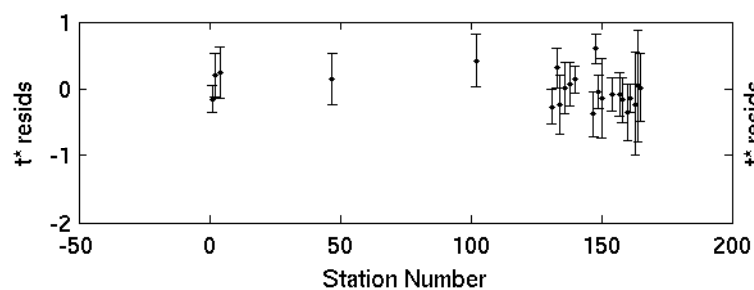


Event\_2001\_146\_10\_57\_26

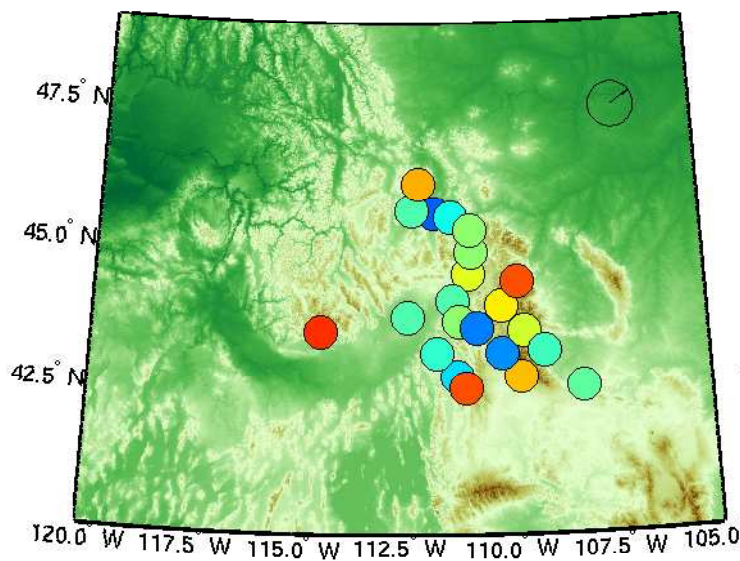
Stack



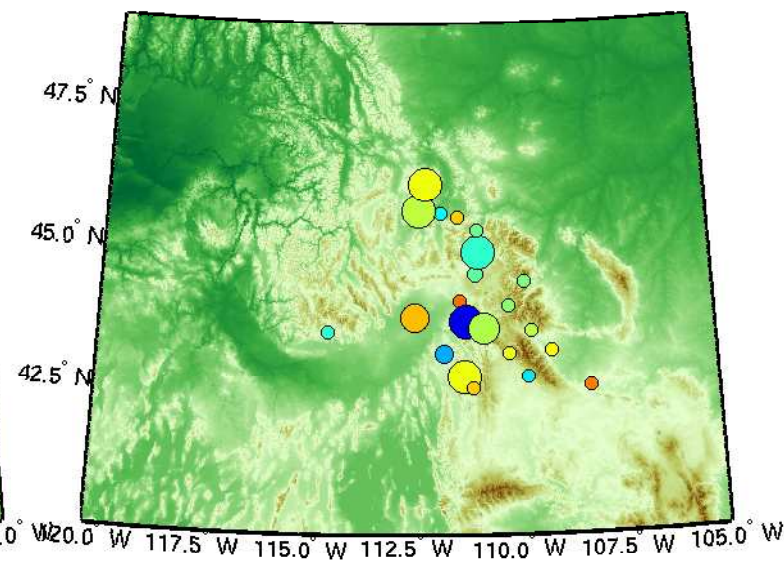
Baz = 235.7213  
Mean xcor value = 0.67652  
Range of  $t^*$  values is 0.9713  
Median  $t^*$  err is 0.3307  
Slope = -0.059055 +/- 0.15669



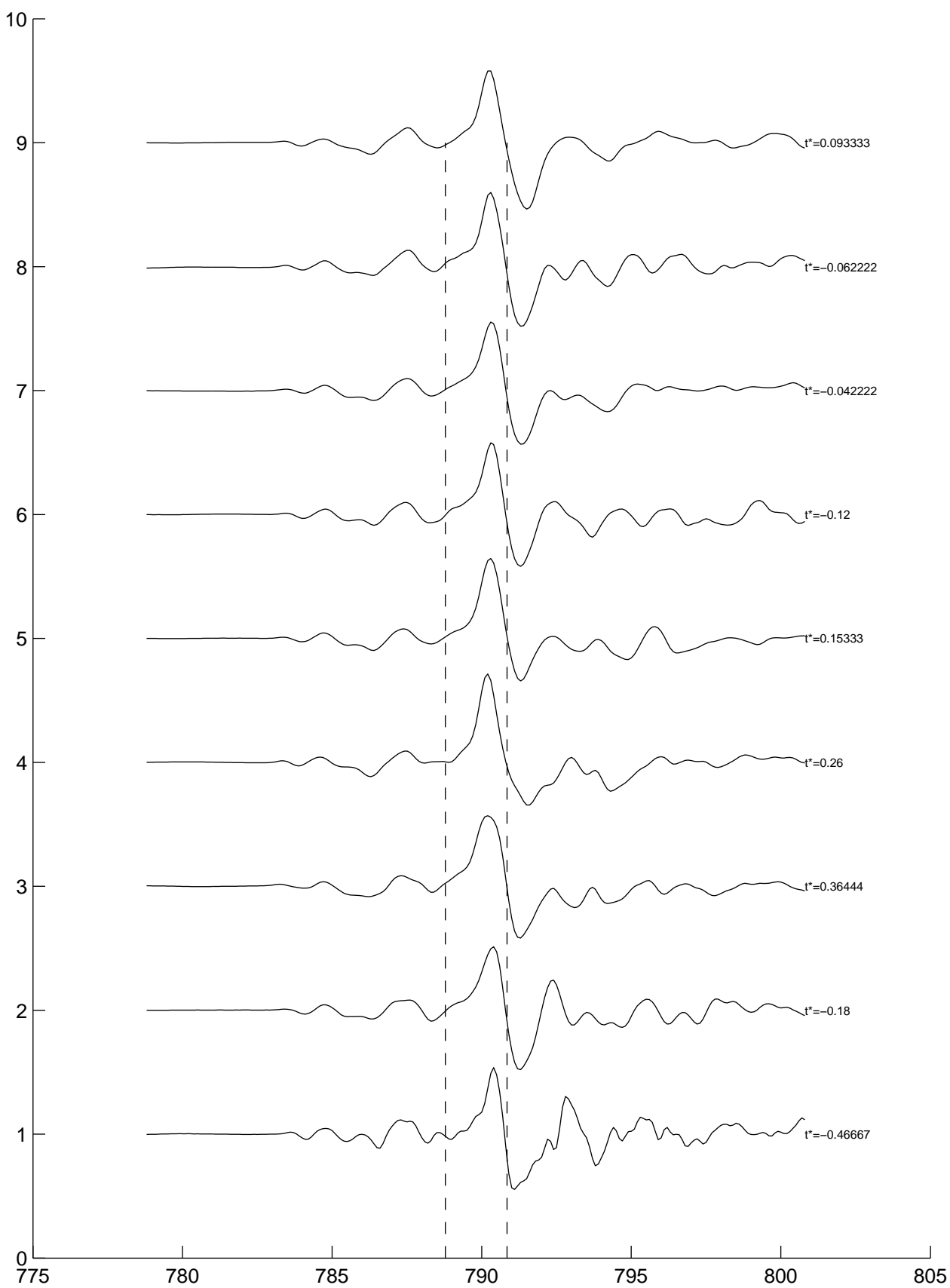
travel time residuals



$t^*$  values

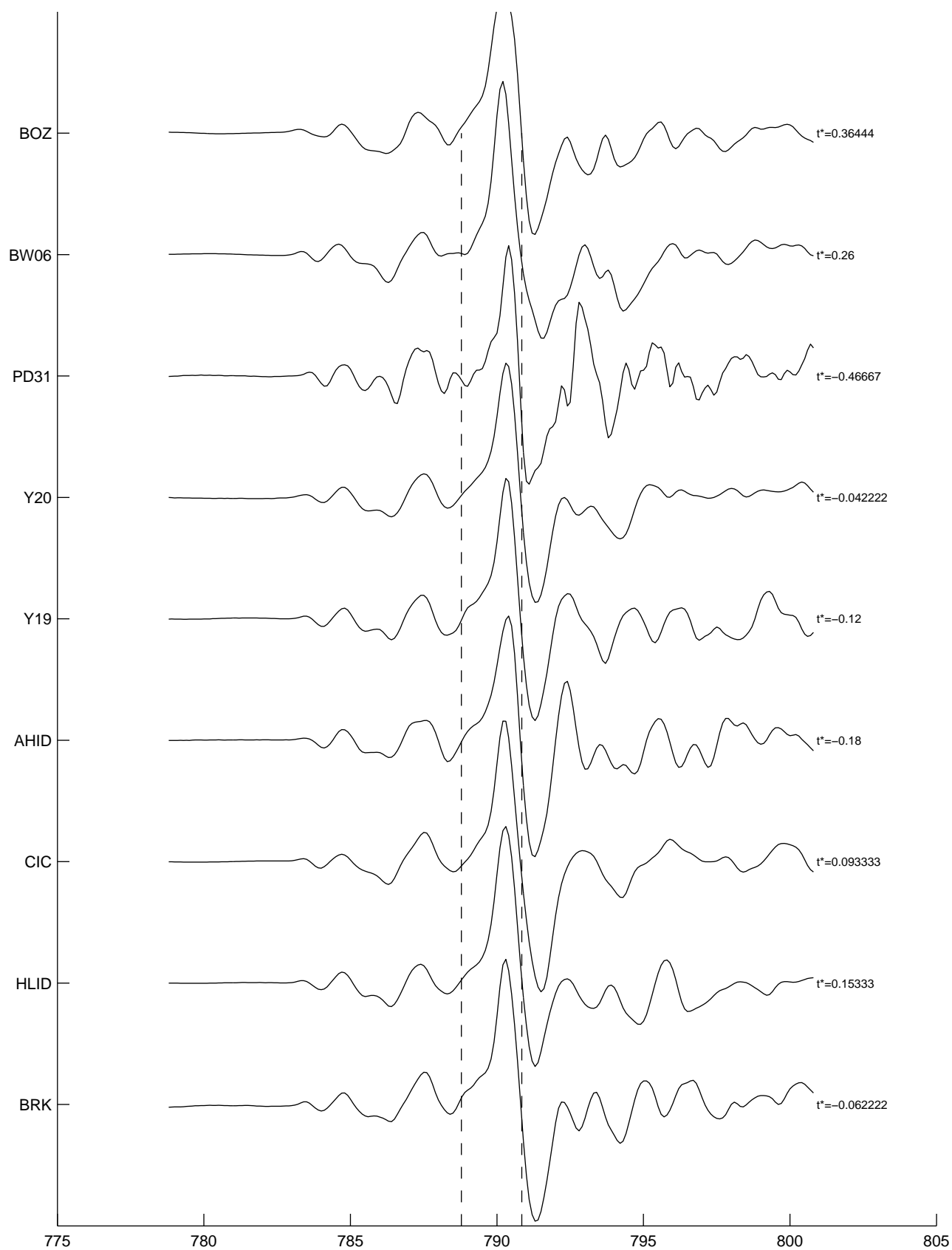


# Event\_2001\_154\_02\_41\_57

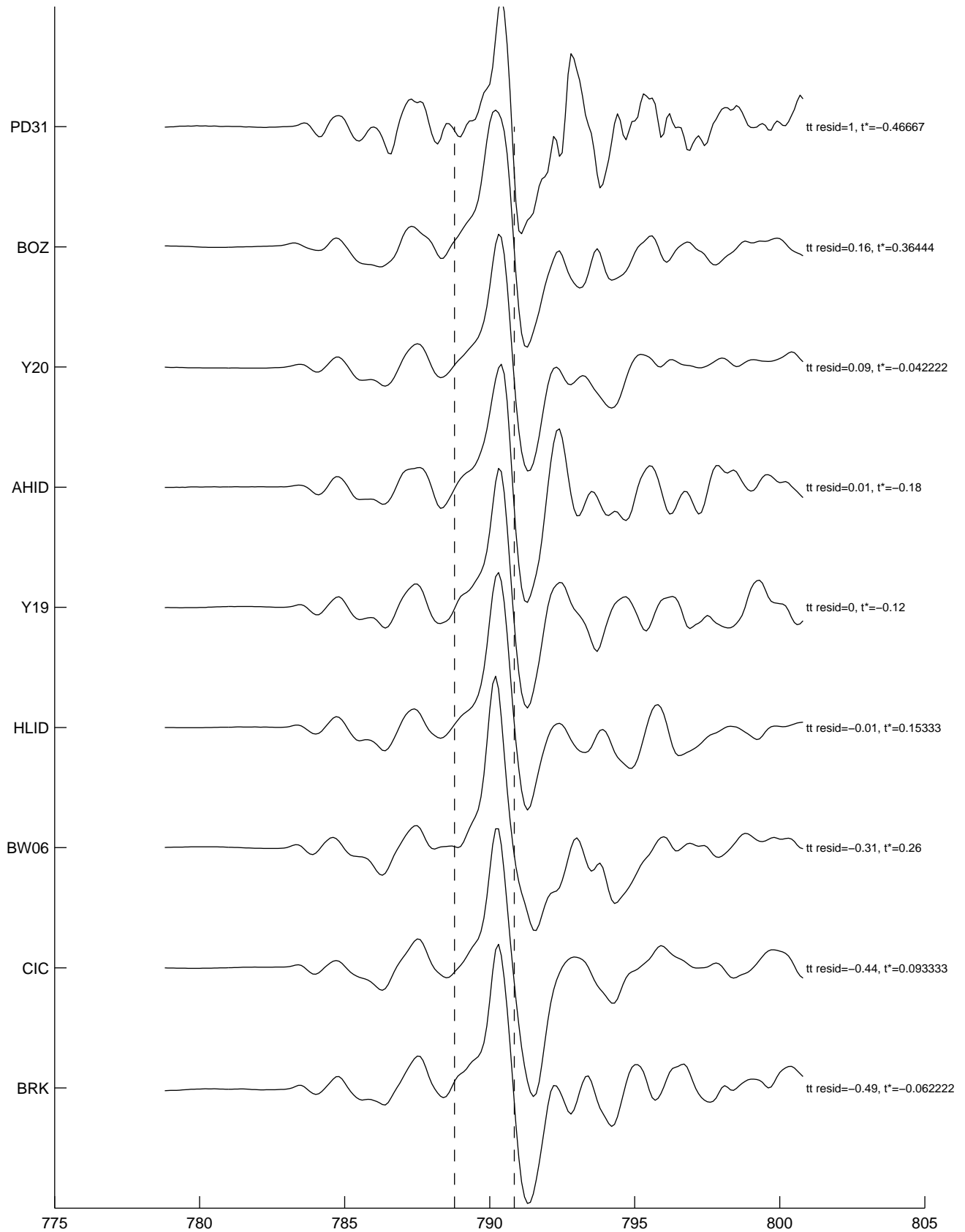




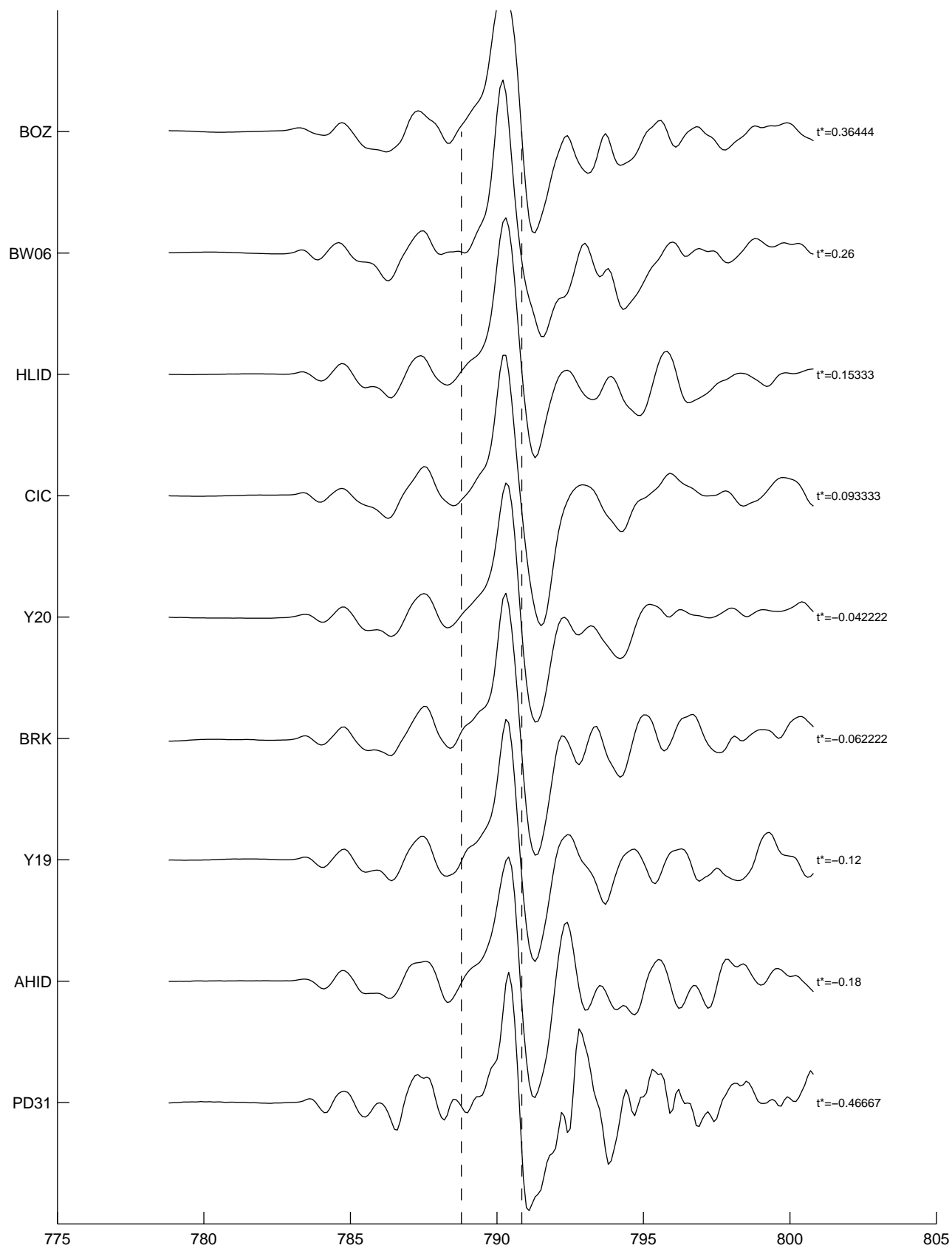
# Sorted by Delta:Event\_2001\_154\_02\_41\_57



# Sorted by travel time: Event\_2001\_154\_02\_41\_57

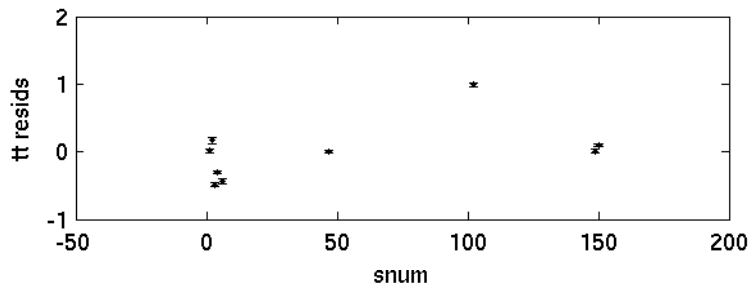
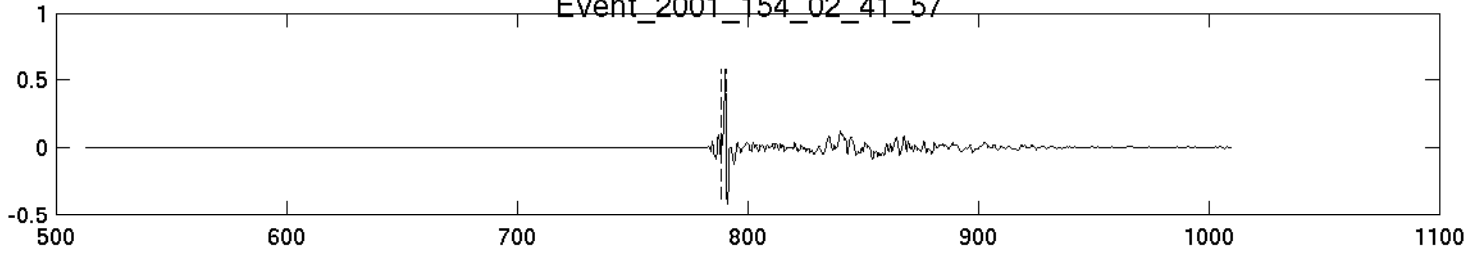


Sorted by  $t^*$ :Event\_2001\_154\_02\_41\_57

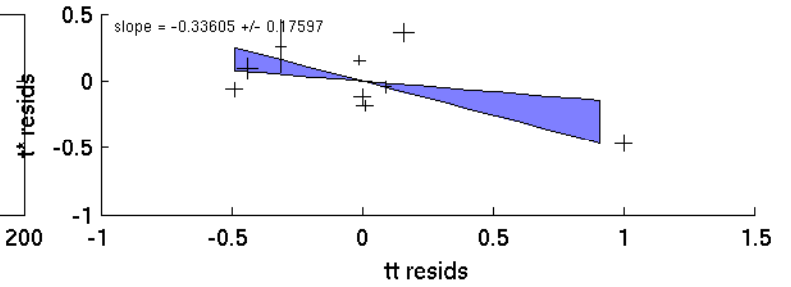
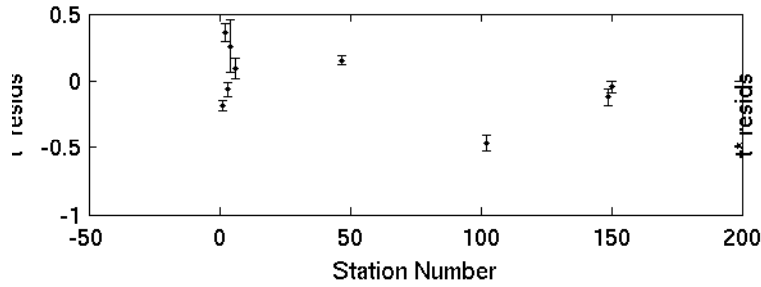


Event\_2001\_154\_02\_41\_57

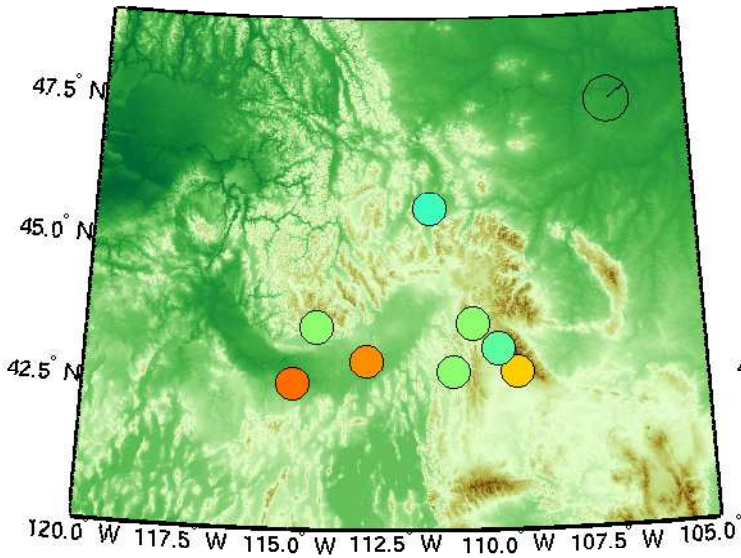
Stack



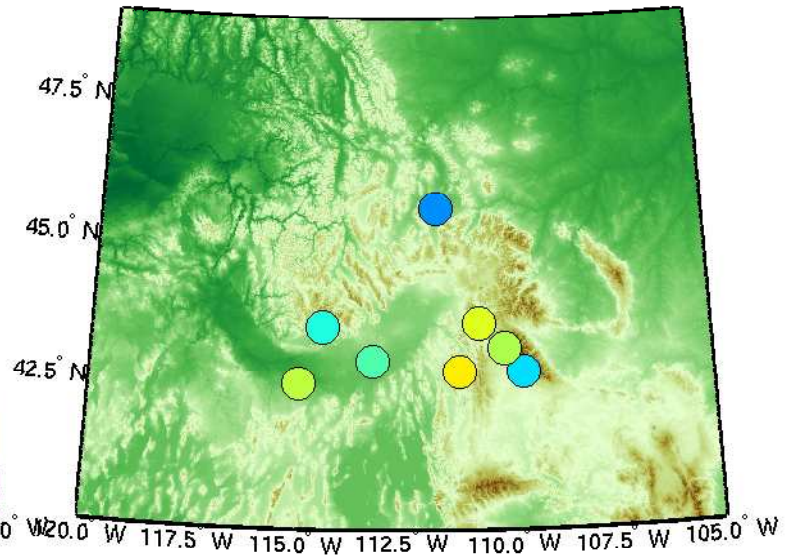
Baz = 233.2653  
Mean  $xcor$  value = 0.76222  
Range of  $t^*$  values is 0.83111  
Median  $t^*$  err is 0.062977  
Slope = -0.33605 +/- 0.17597



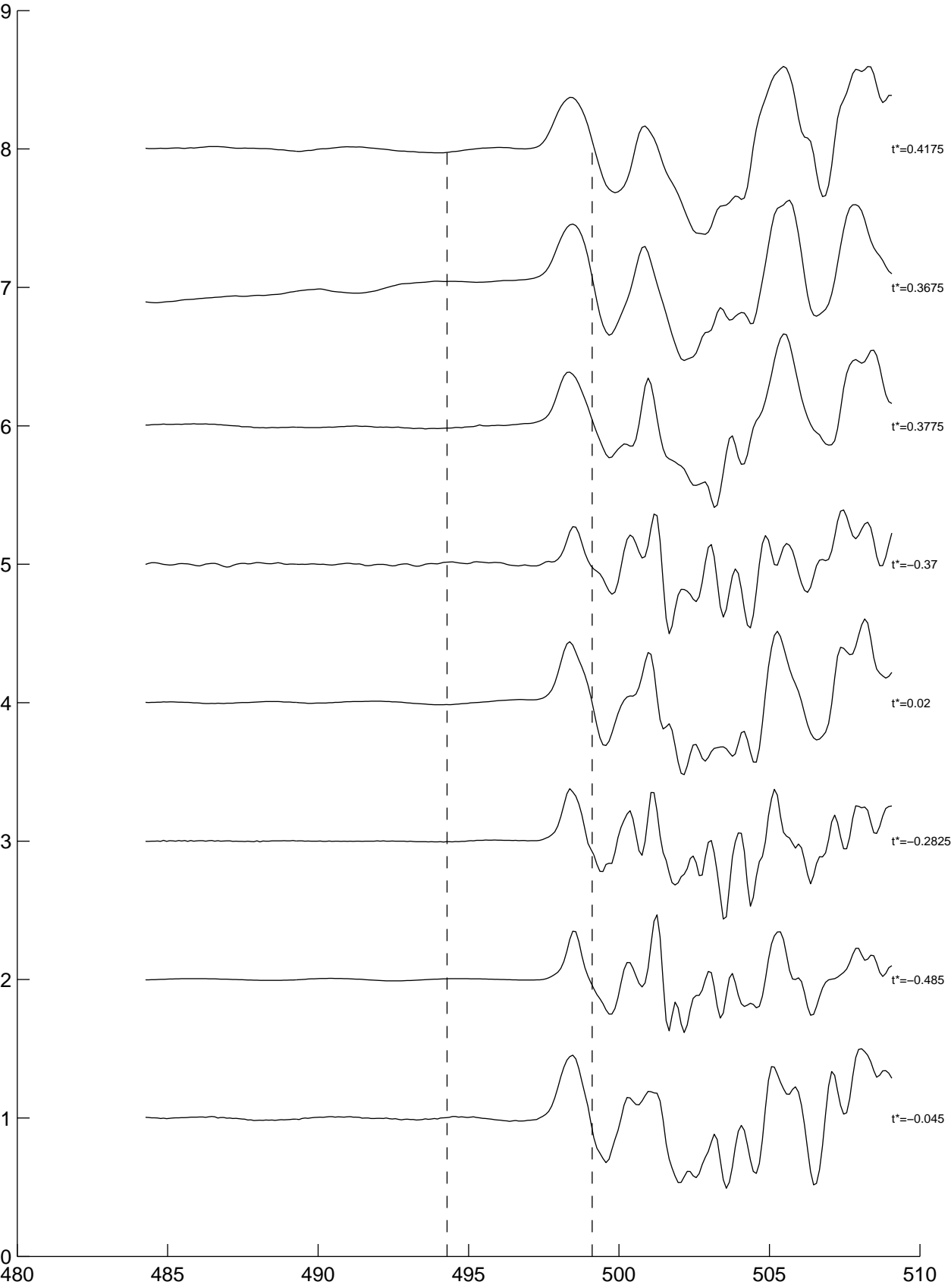
travel time residuals



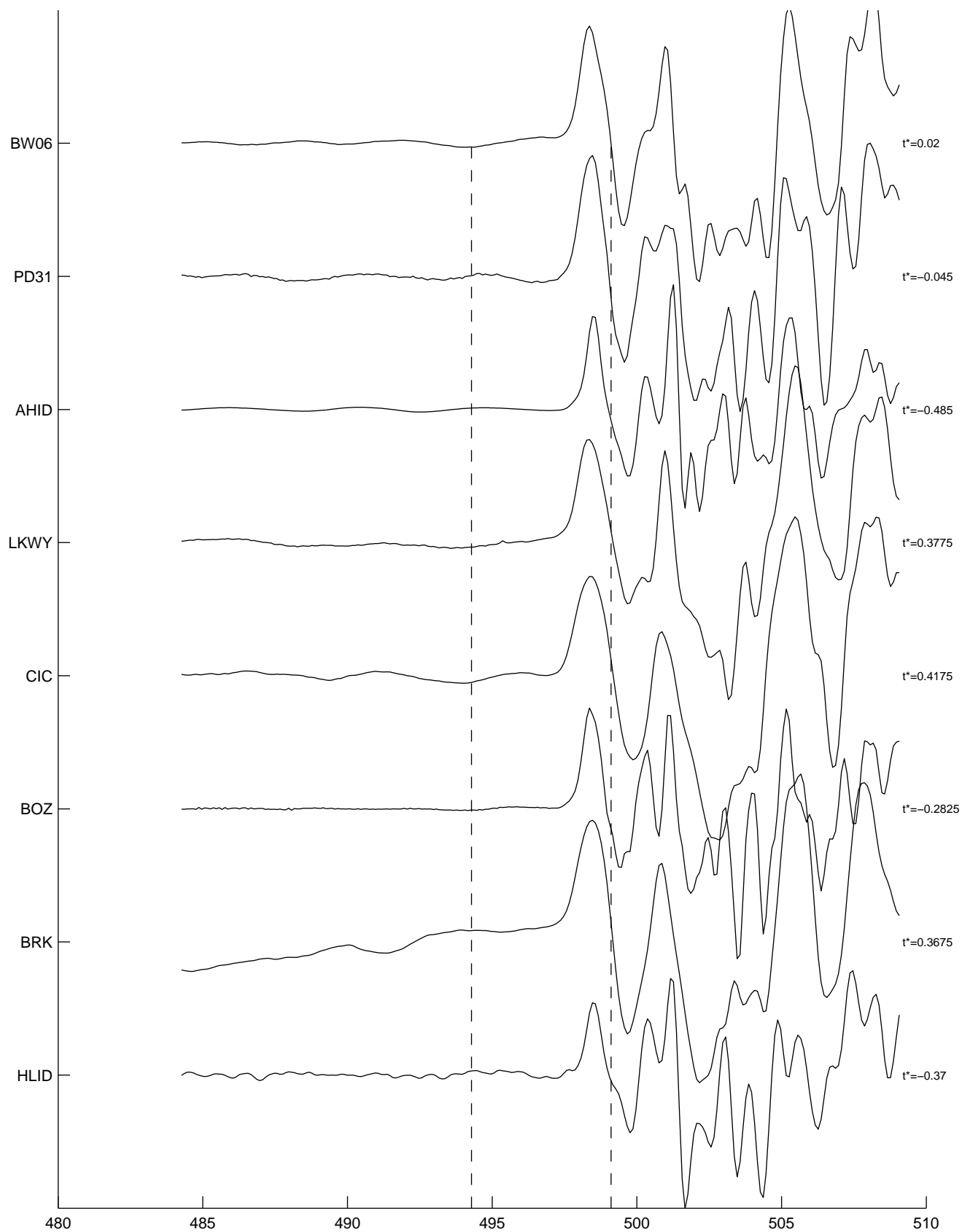
$t^*$  values



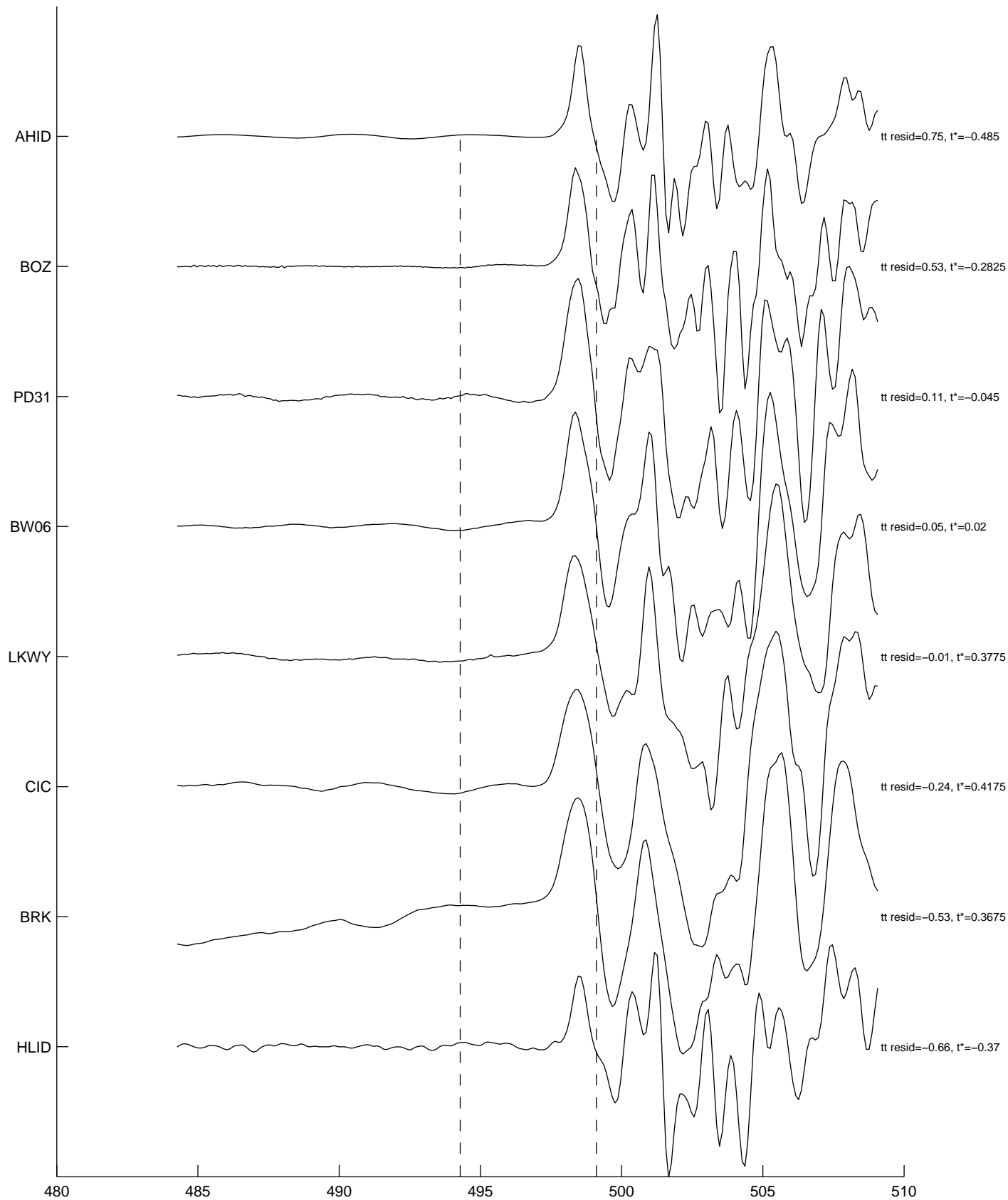
Event\_2001\_165\_19\_48\_47



# Sorted by Delta:Event\_2001\_165\_19\_48\_47

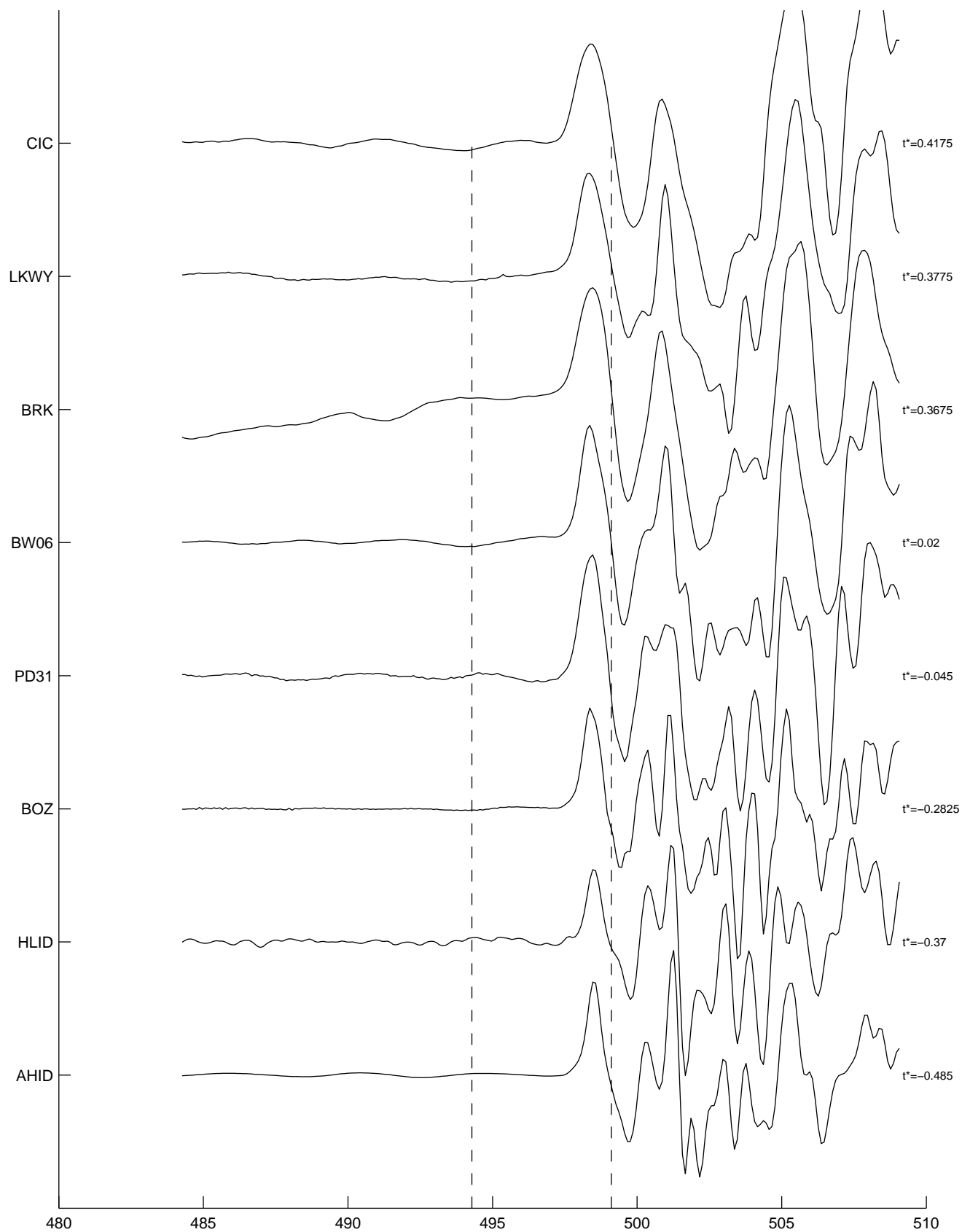


# Sorted by travel time:Event\_2001\_165\_19\_48\_47



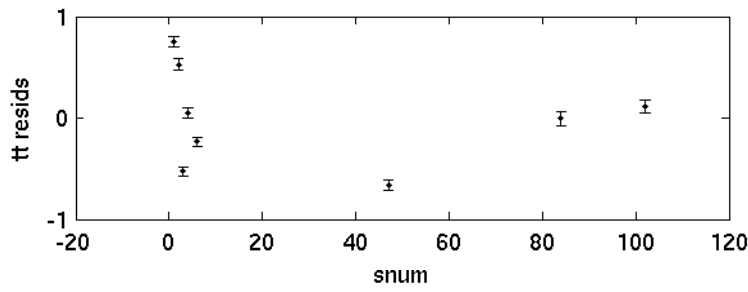
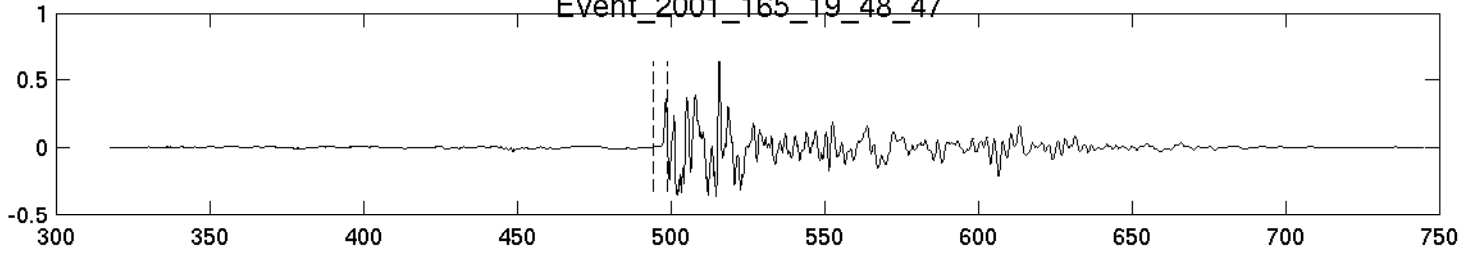


Sorted by  $t^*$ :Event\_2001\_165\_19\_48\_47

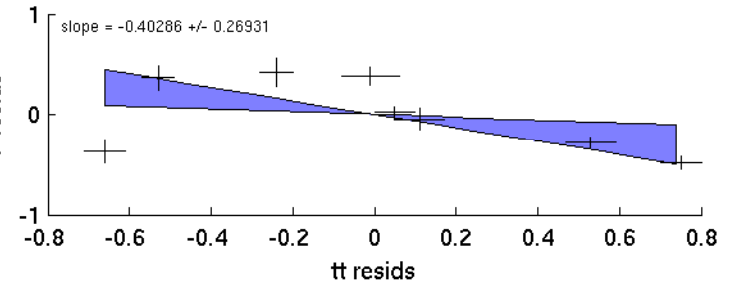
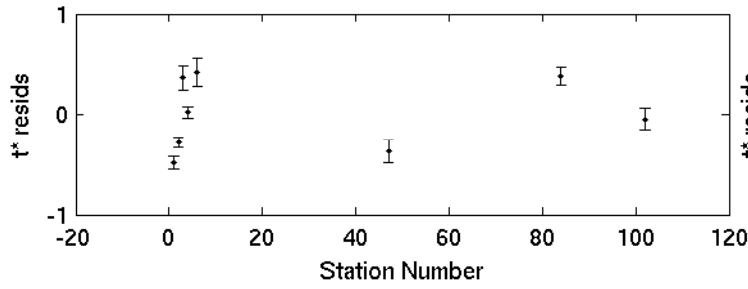


# Event\_2001\_165\_19\_48\_47

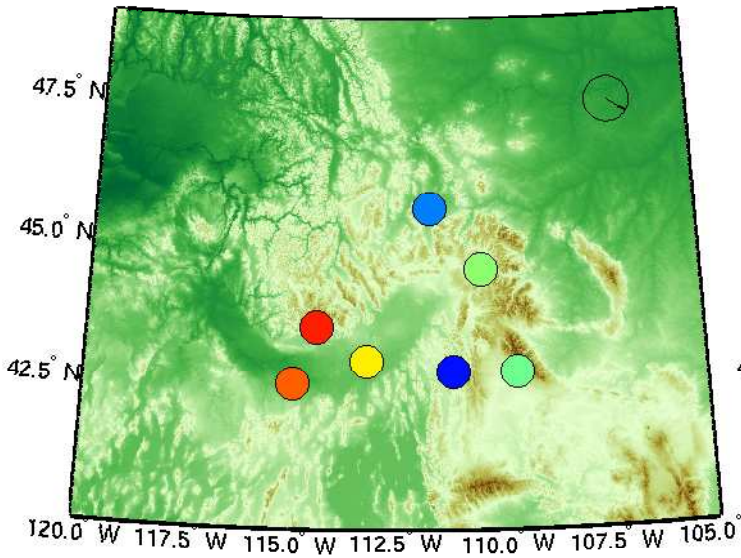
Stack



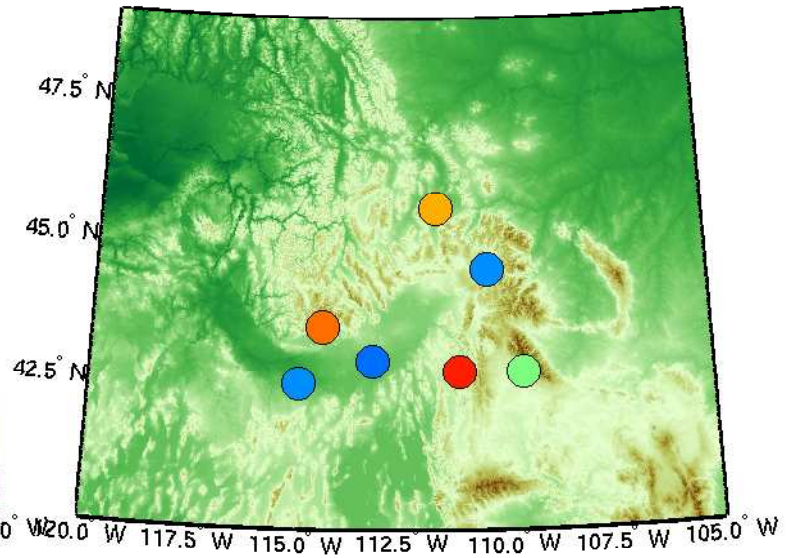
Baz = 304.7697  
 Mean xcor value = 0.67375  
 Range of t\* values is 0.9025  
 Median t\* err is 0.0963  
 Slope = -0.40286 +/- 0.26931



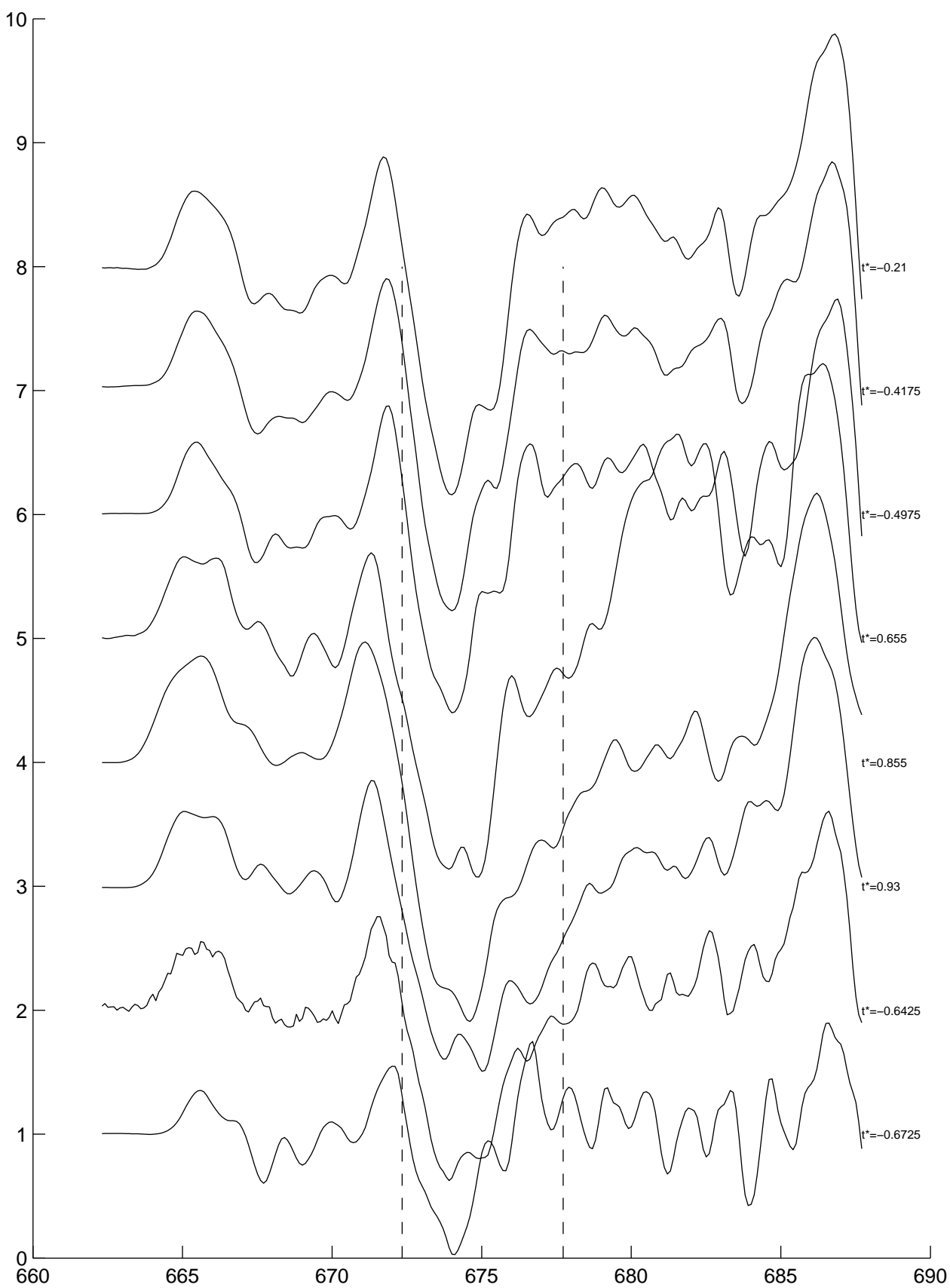
travel time residuals



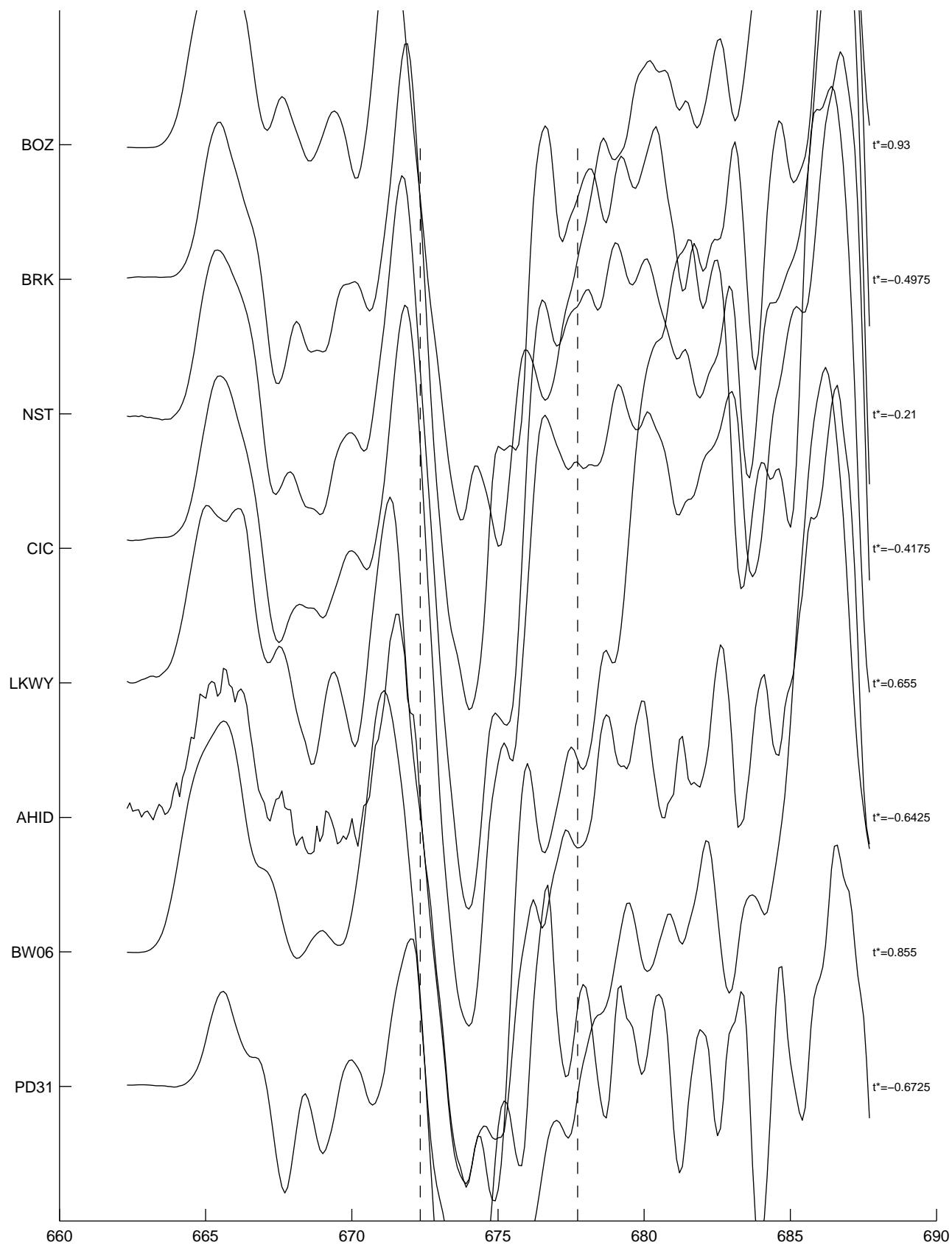
t\* values



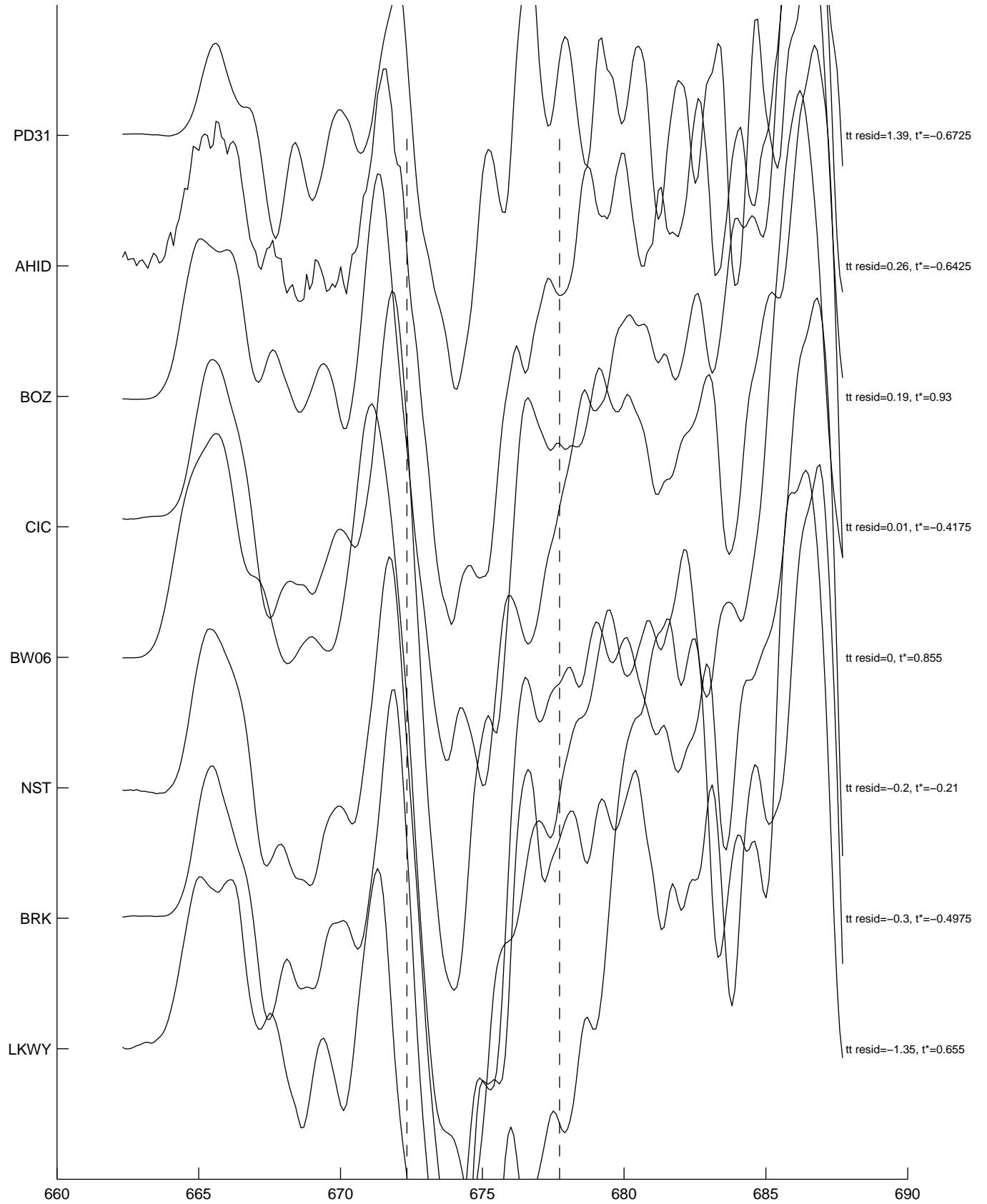
# Event\_2001\_174\_20\_33\_14



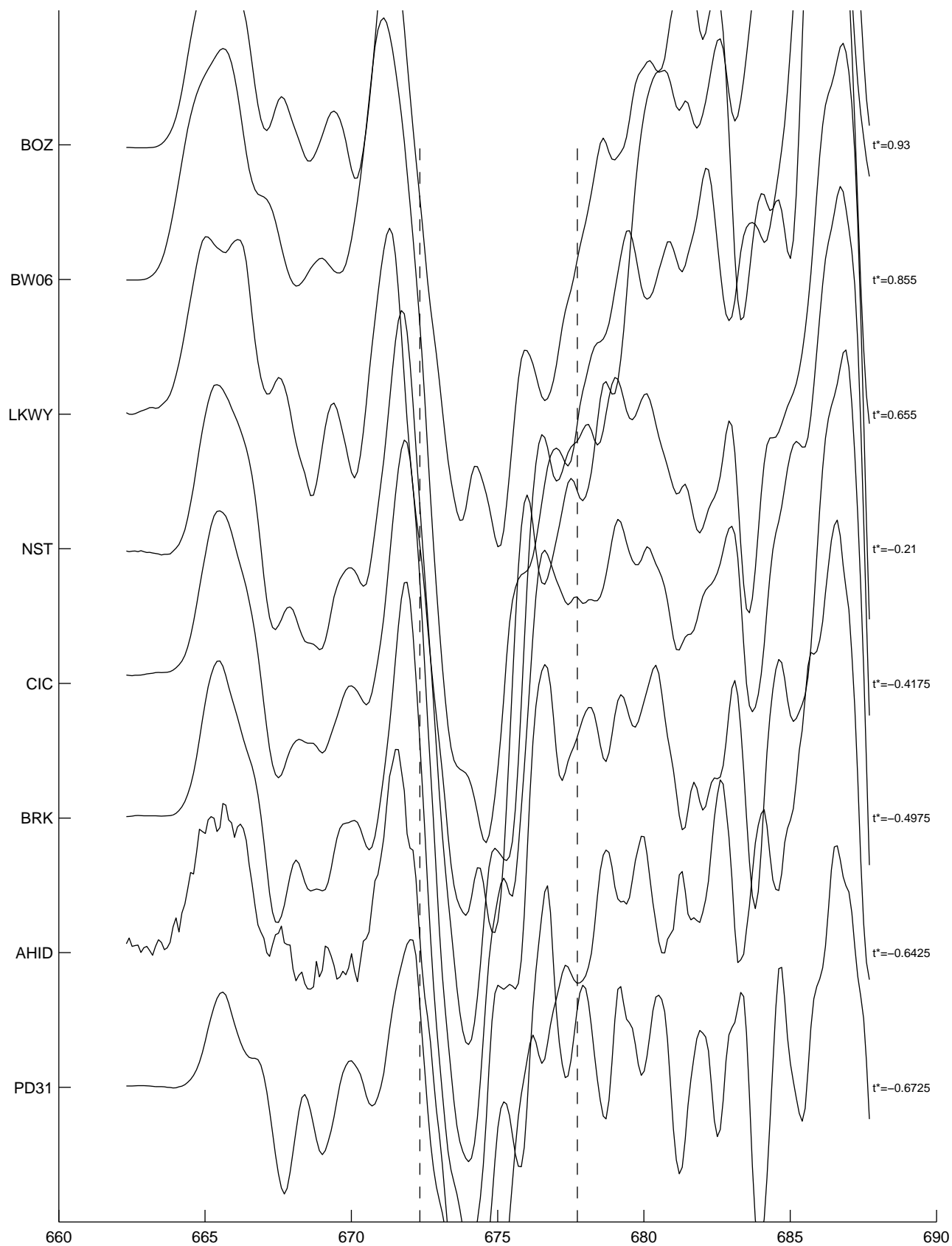
# Sorted by Delta:Event\_2001\_174\_20\_33\_14



# Sorted by travel time:Event\_2001\_174\_20\_33\_14

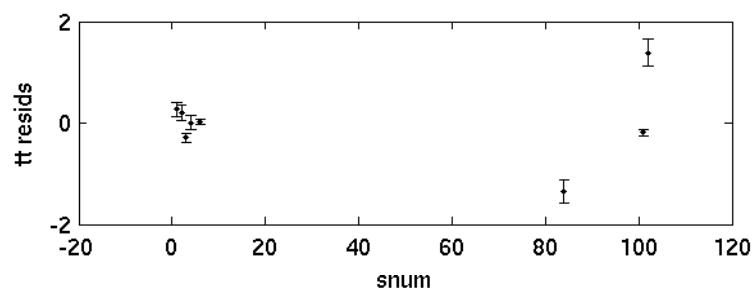
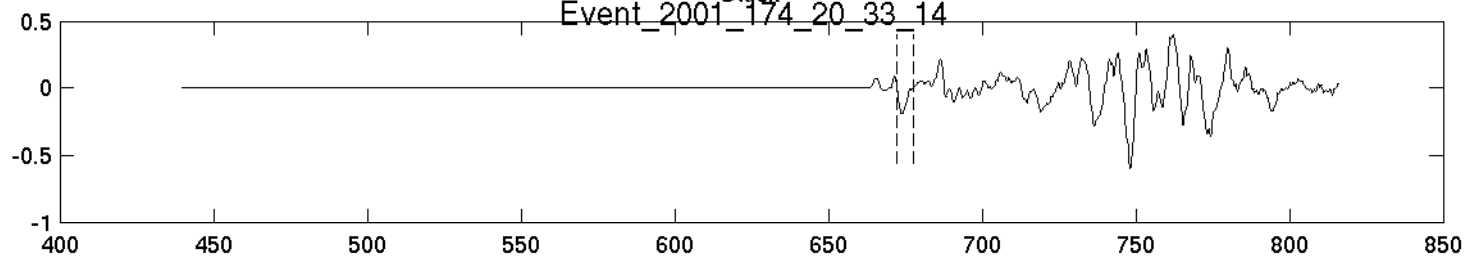


Sorted by  $t^*$ :Event\_2001\_174\_20\_33\_14

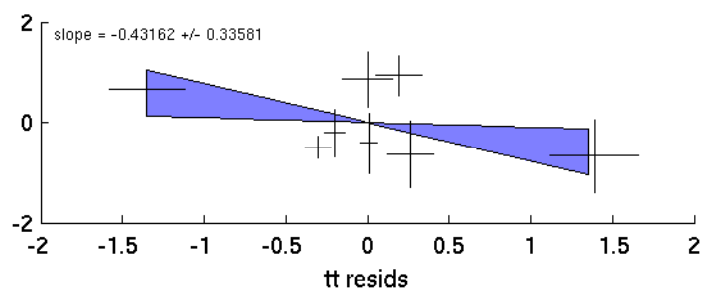
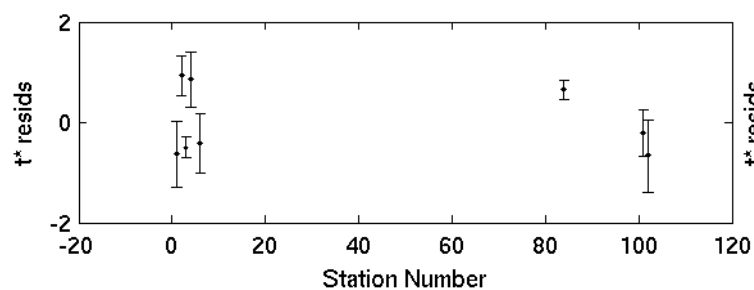


Event\_2001\_174\_20\_33\_14

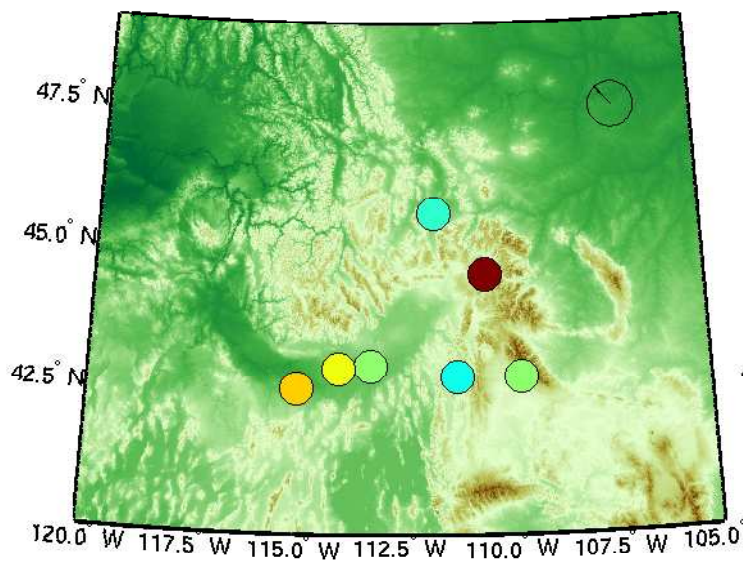
Stack



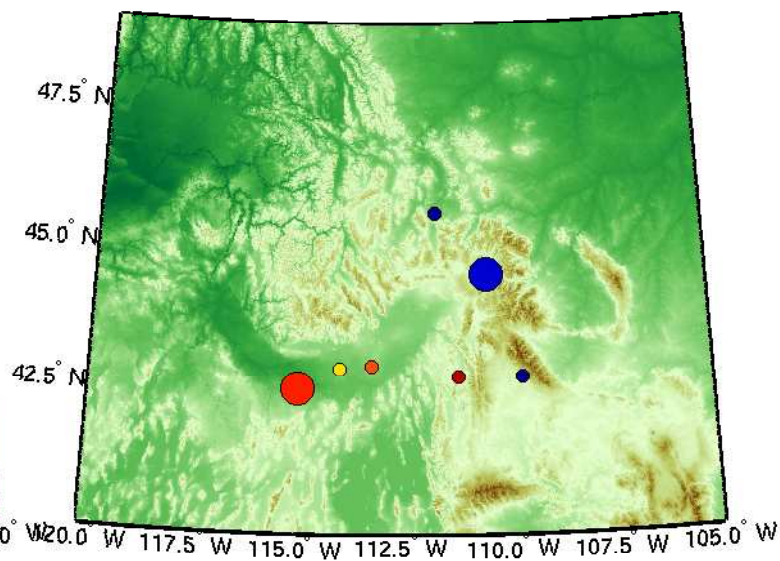
Baz = 140.6029  
Mean xcor value = 0.82375  
Range of  $t^*$  values is 1.6025  
Median  $t^*$  err is 0.51005  
Slope = -0.43162 +/- 0.33581



travel time residuals

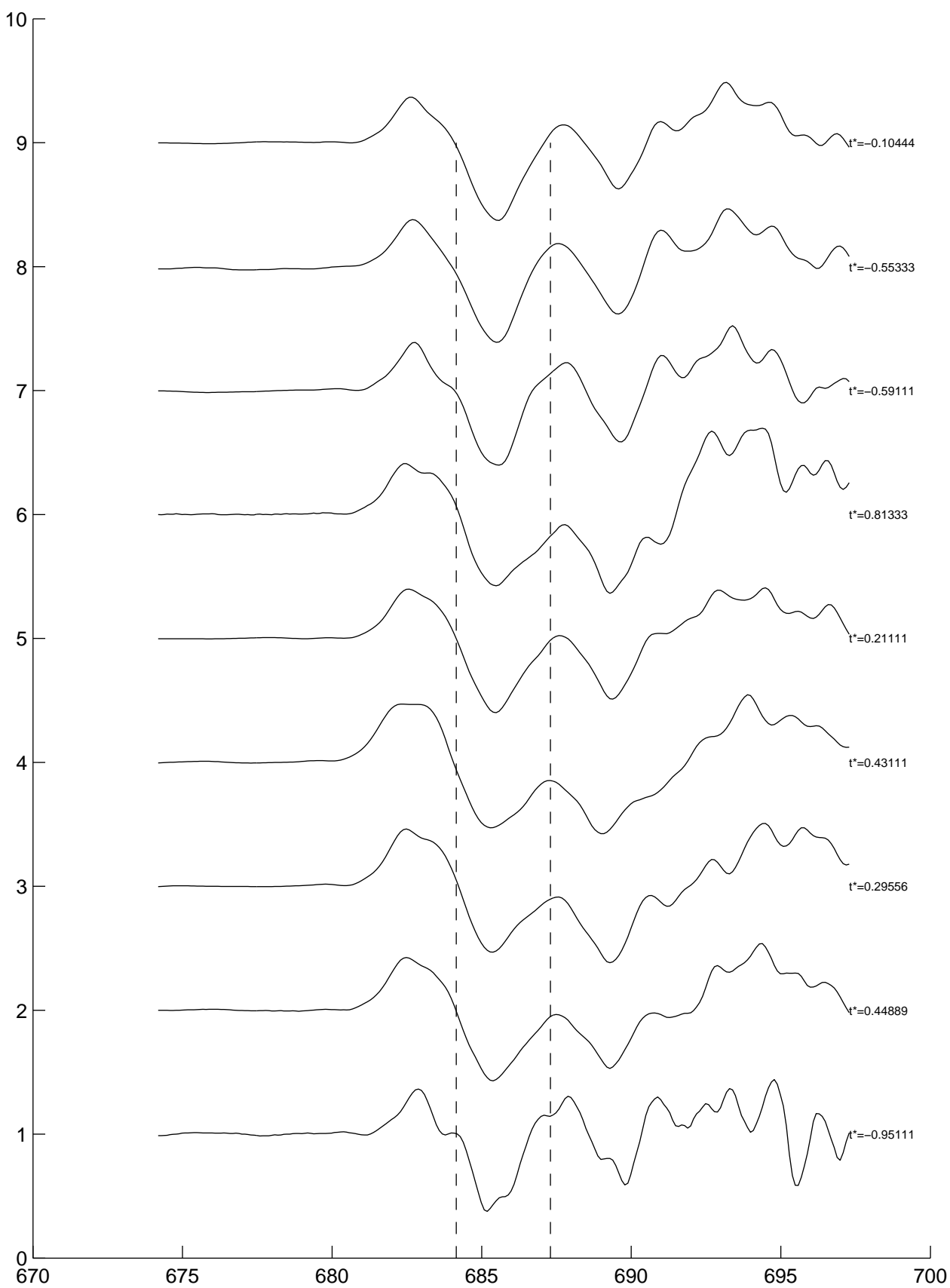


$t^*$  values

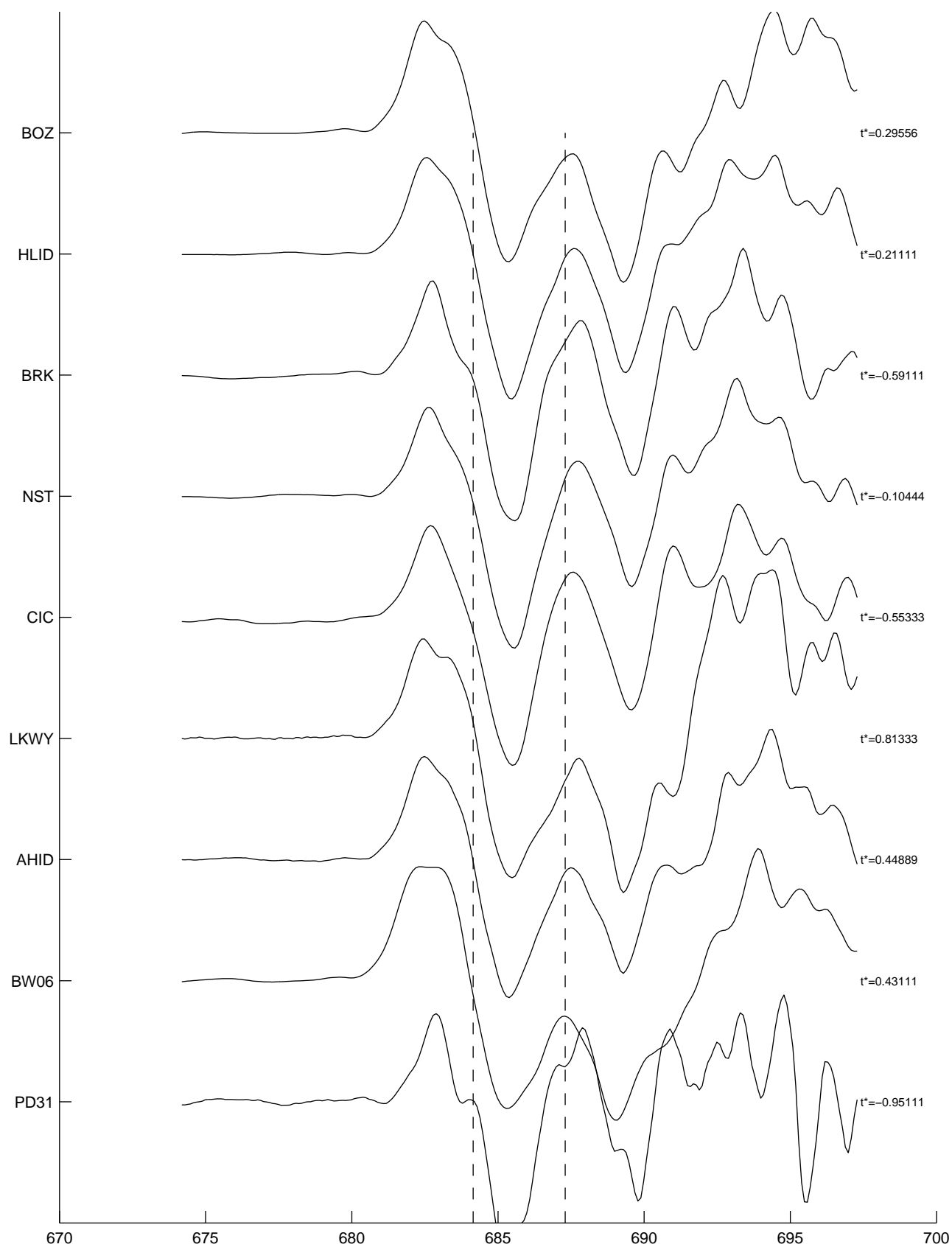




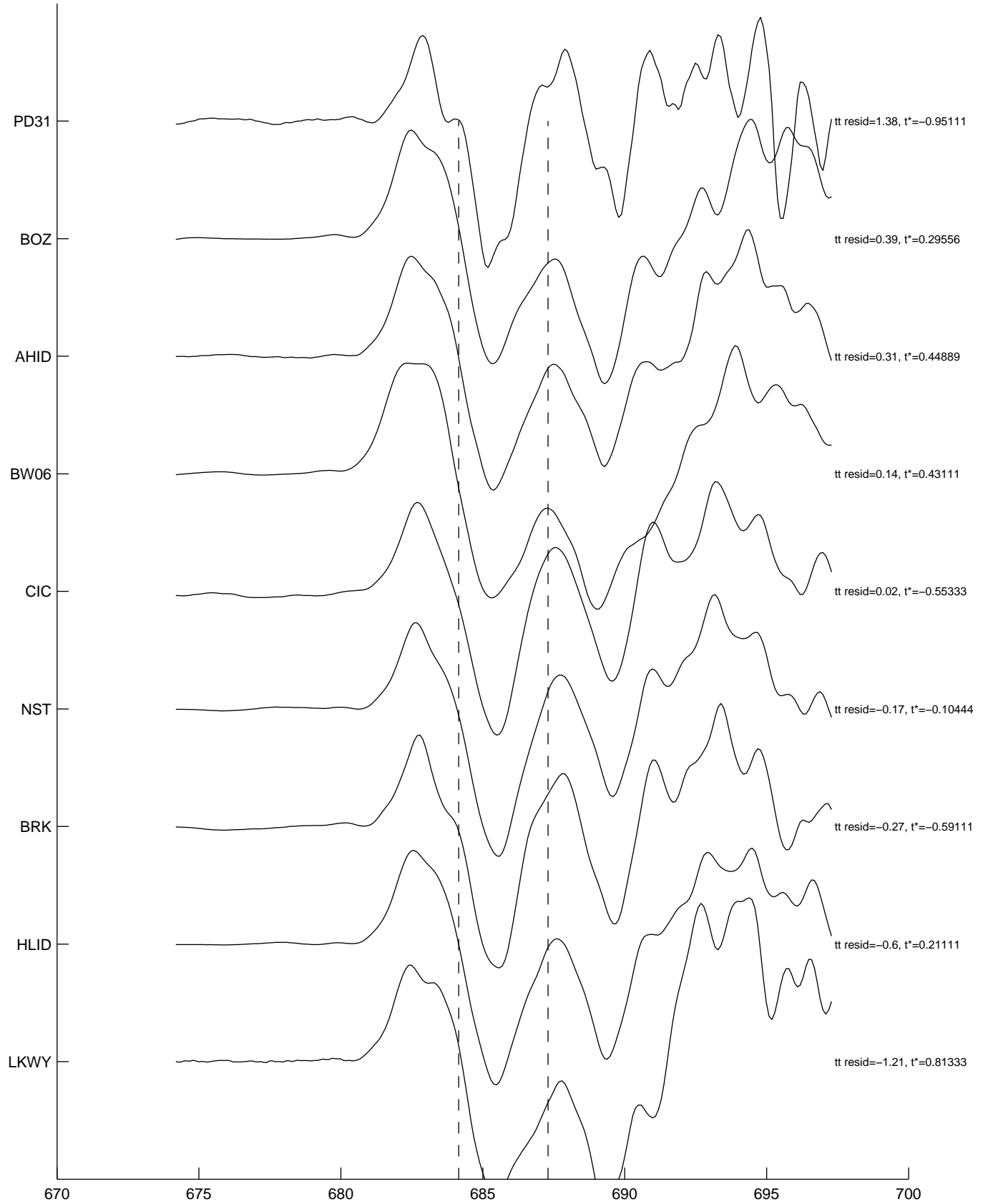
# Event\_2001\_177\_04\_18\_31



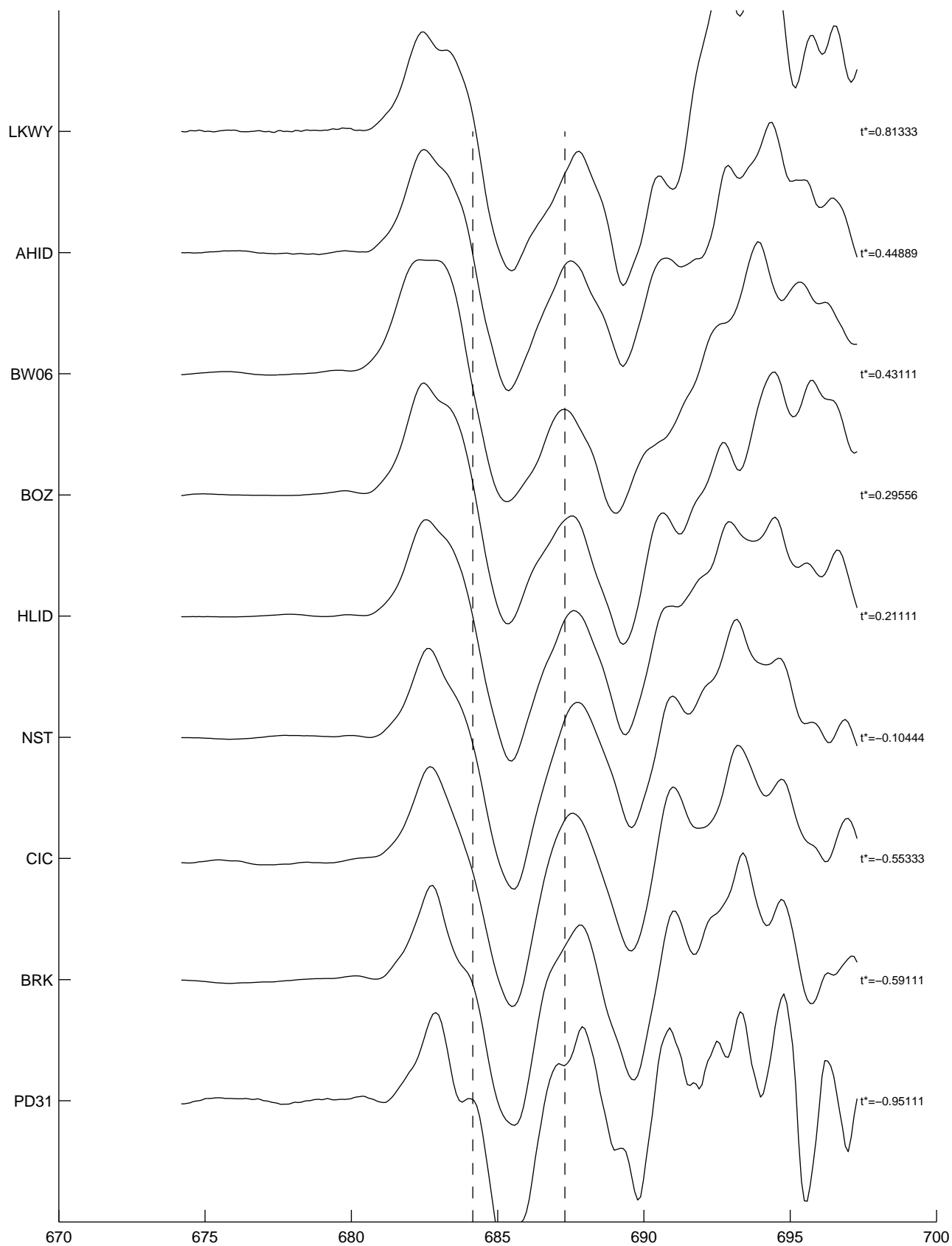
# Sorted by Delta:Event\_2001\_177\_04\_18\_31



# Sorted by travel time:Event\_2001\_177\_04\_18\_31

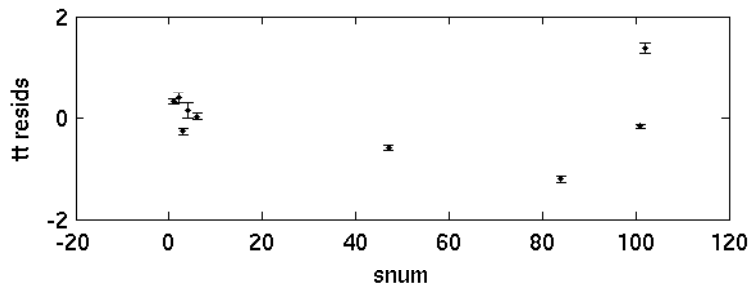
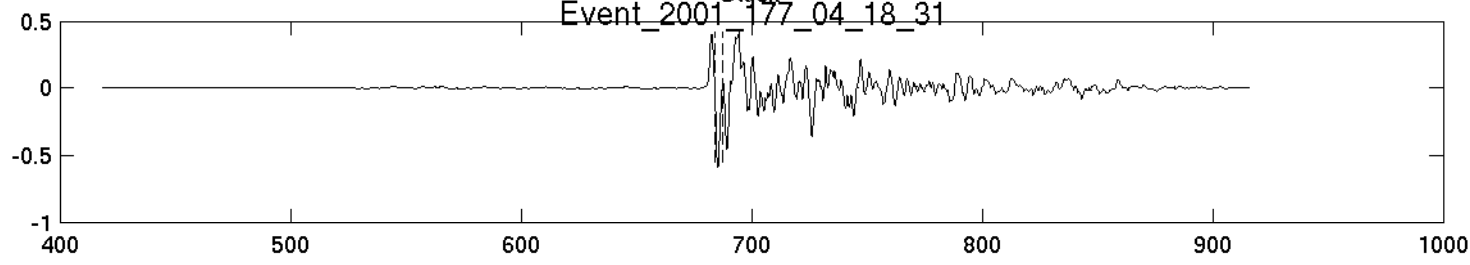


Sorted by  $t^*$ :Event\_2001\_177\_04\_18\_31

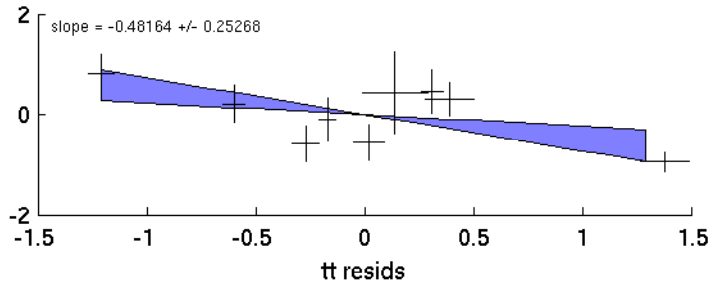
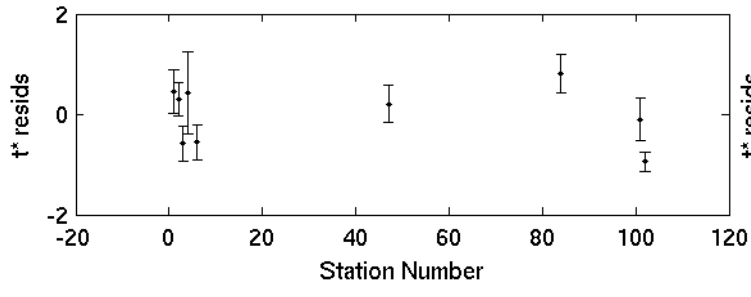


Event\_2001\_07\_04\_18\_31

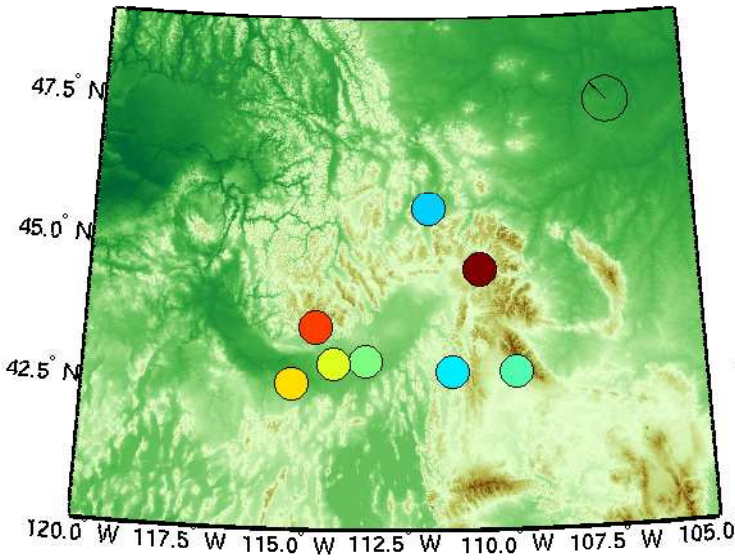
Stack



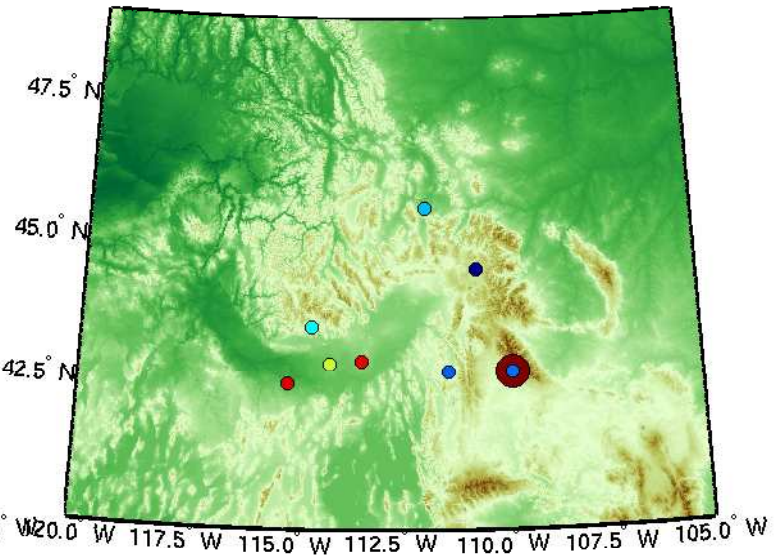
Baz = 139.3554  
Mean xcor value = 0.84111  
Range of  $t^*$  values is 1.7644  
Median  $t^*$  err is 0.37069  
Slope = -0.48164 +/- 0.25268



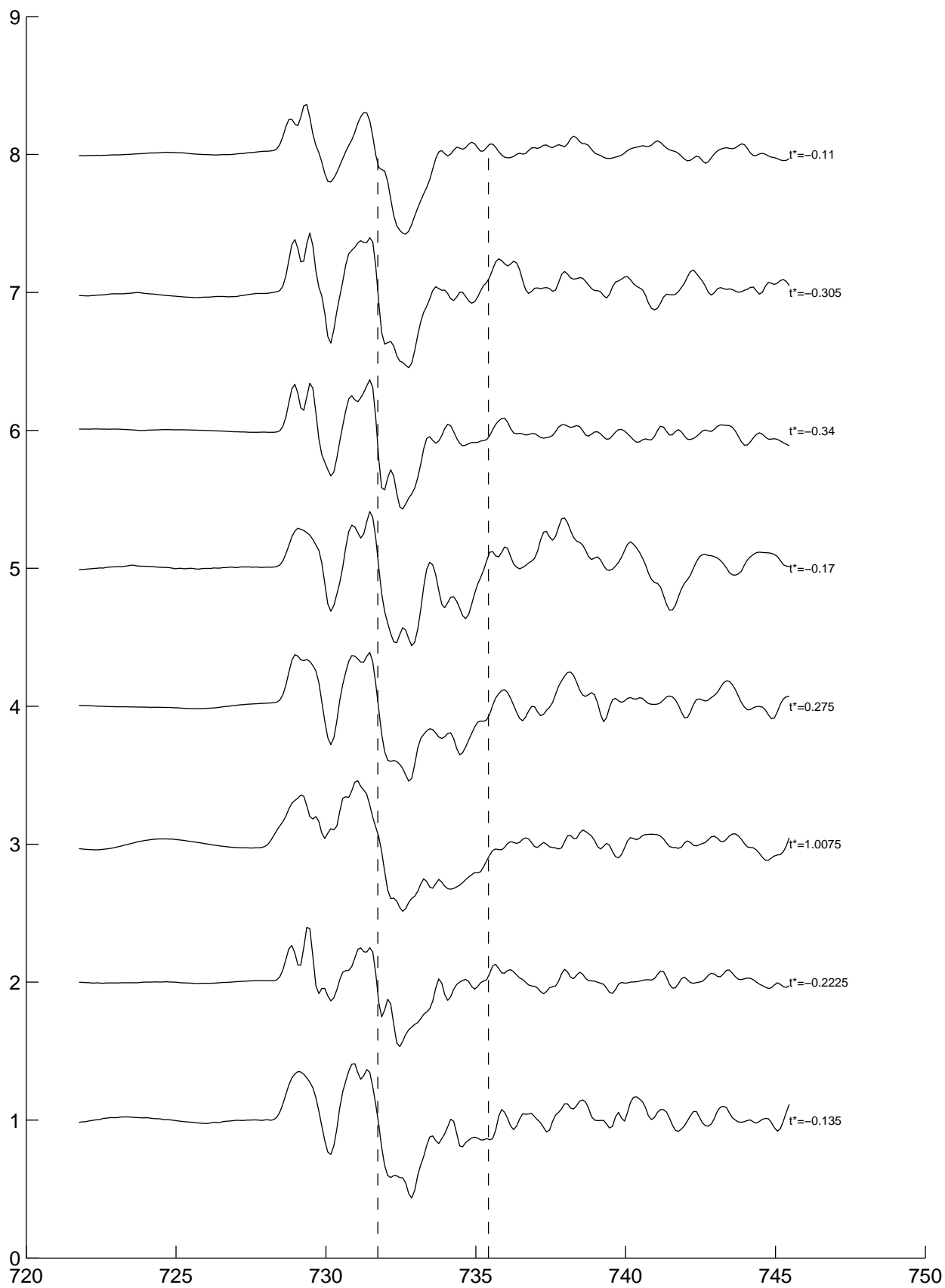
travel time residuals



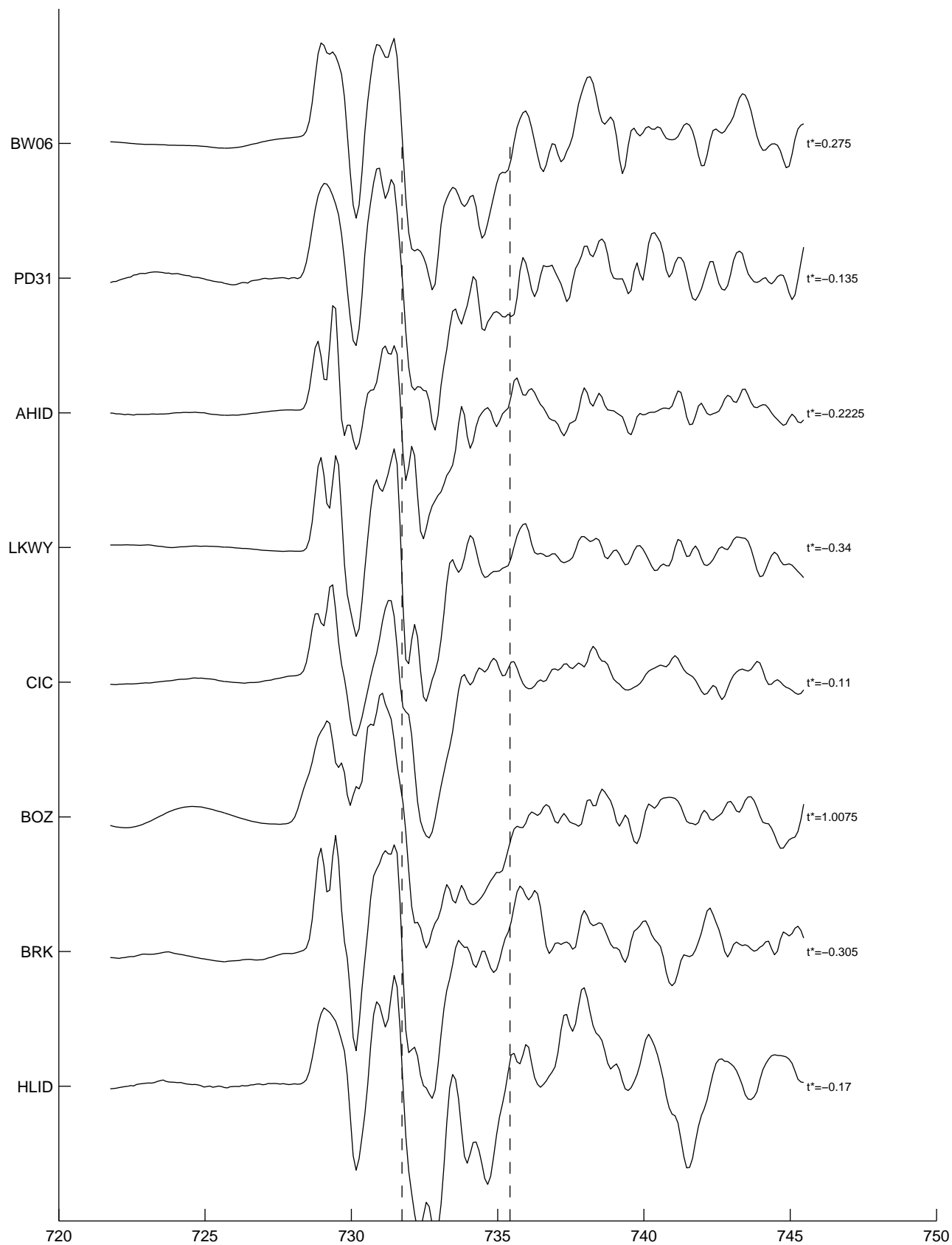
$t^*$  values



# Event\_2001\_184\_13\_10\_42

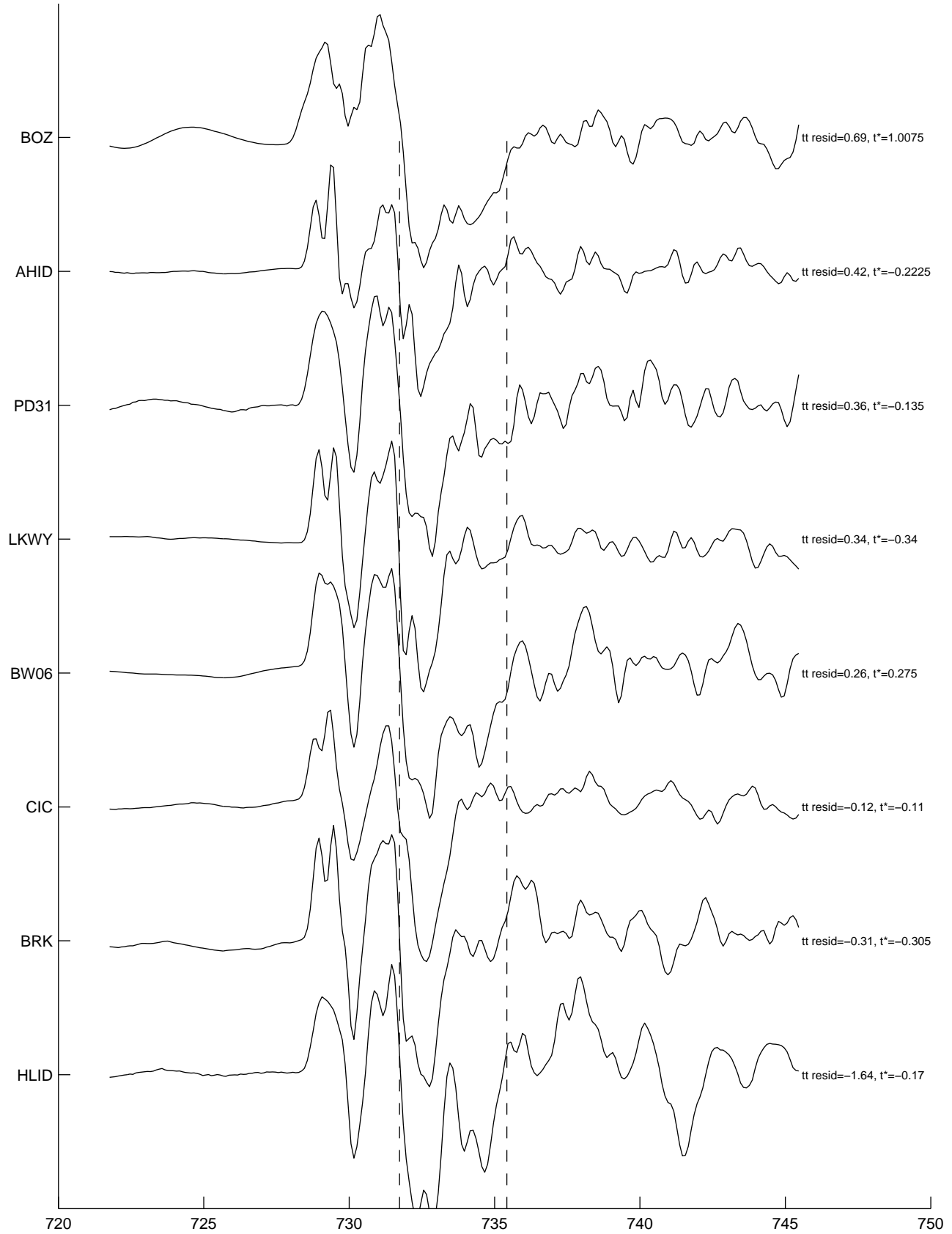


# Sorted by Delta:Event\_2001\_184\_13\_10\_42

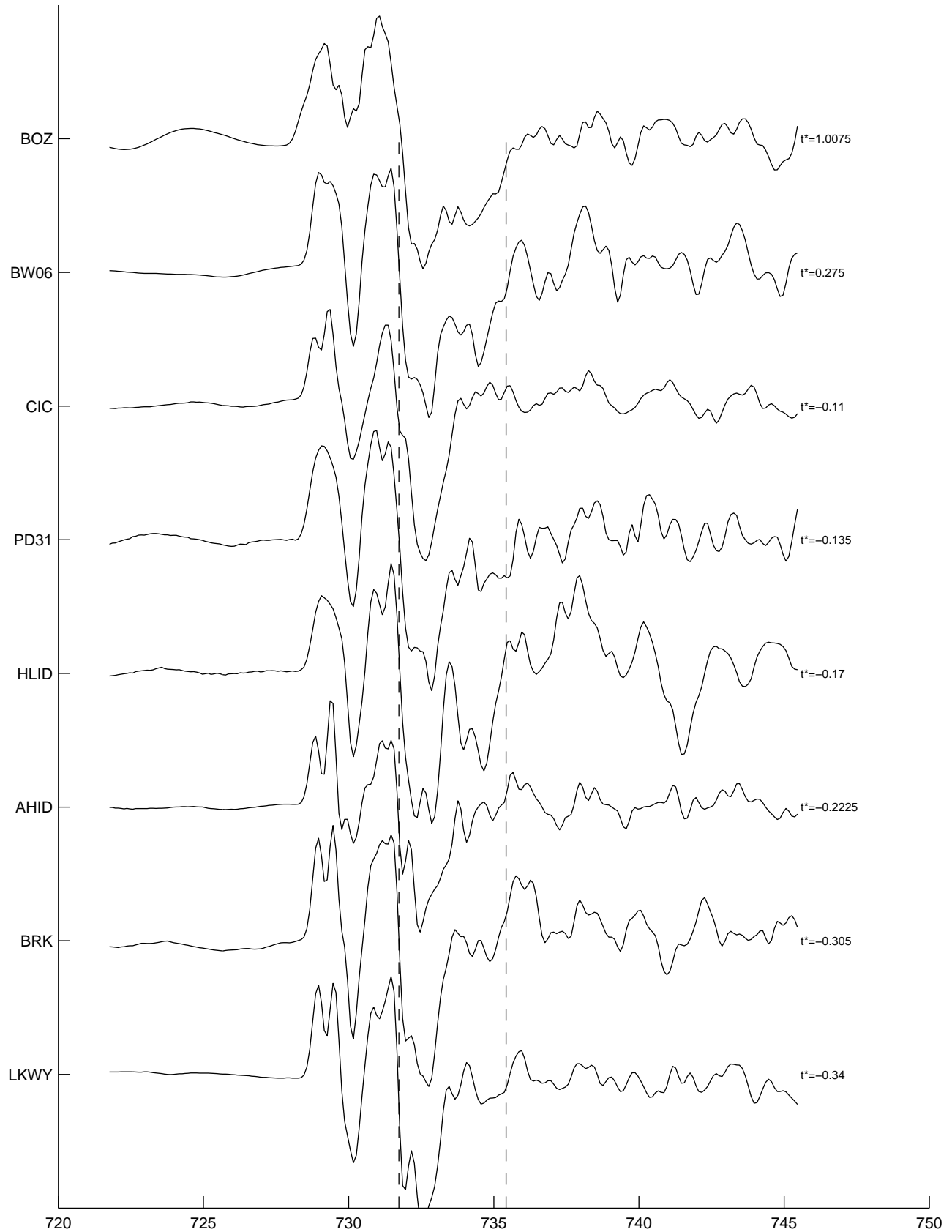




# Sorted by travel time:Event\_2001\_184\_13\_10\_42

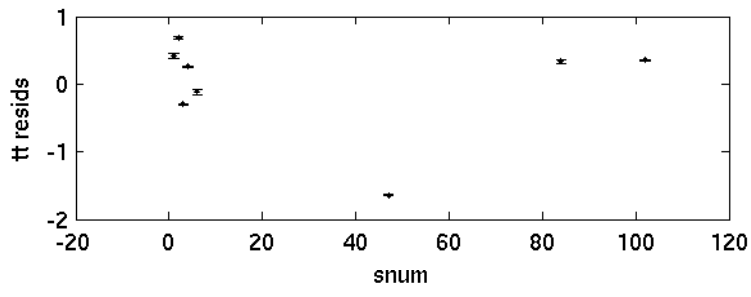
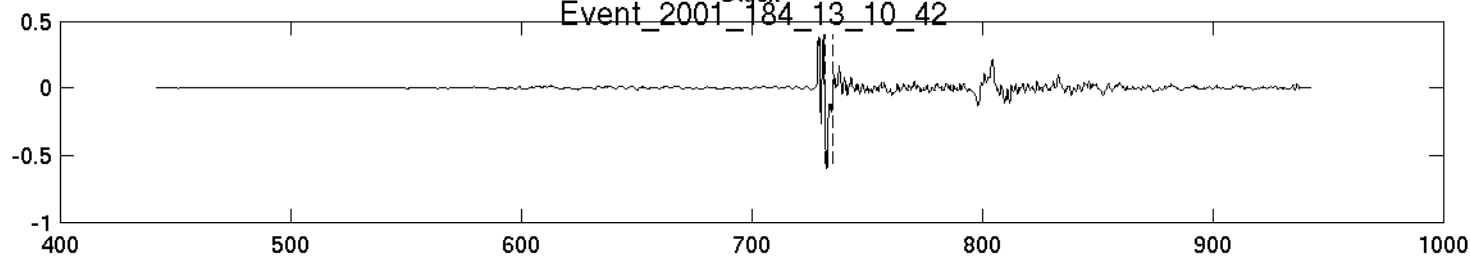


Sorted by  $t^*$ :Event\_2001\_184\_13\_10\_42

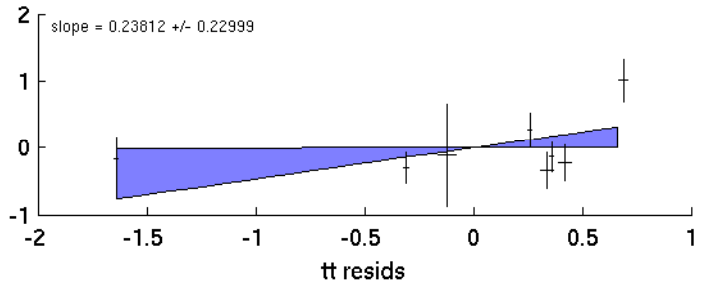
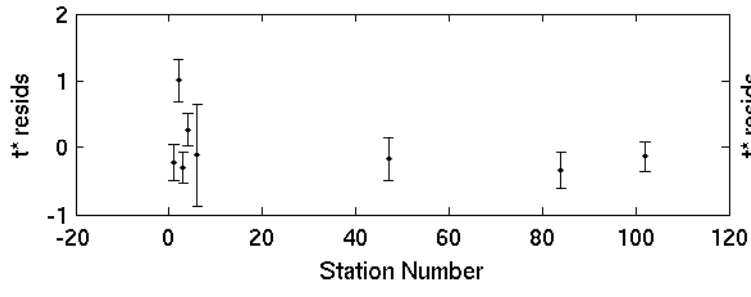


Event\_2001\_184\_13\_10\_42

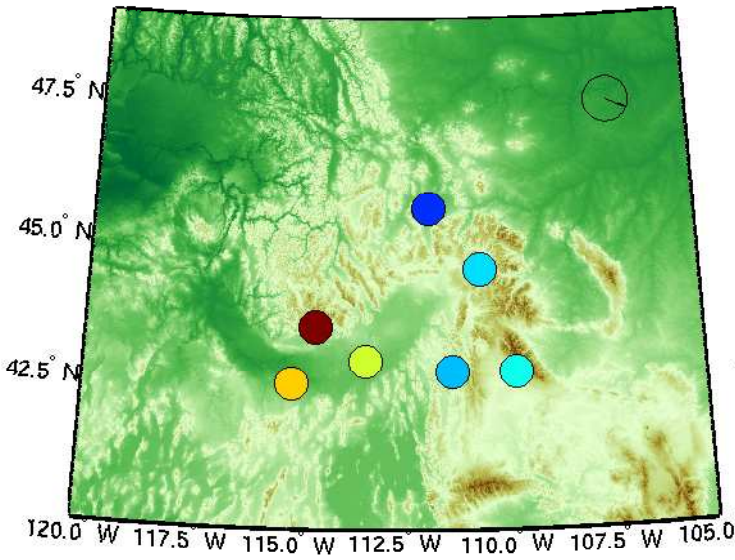
Stack



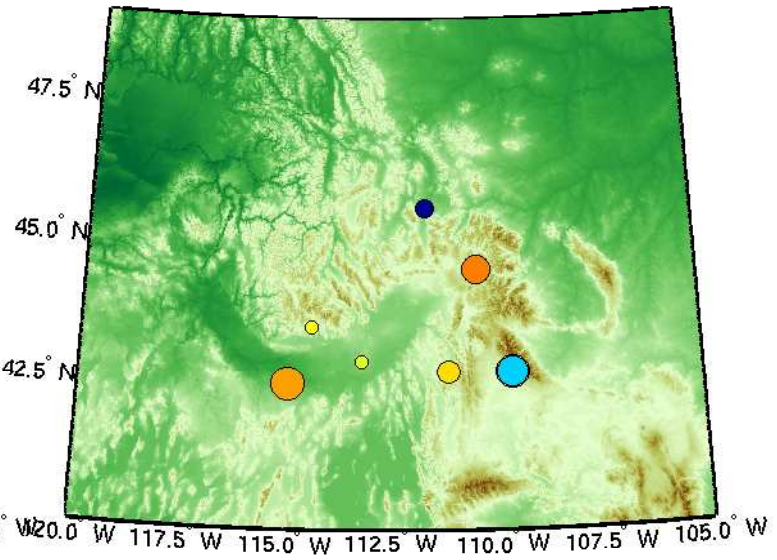
Baz = 295.7169  
Mean xcor value = 0.75875  
Range of  $t^*$  values is 1.3475  
Median  $t^*$  err is 0.26704  
Slope = 0.23812 +/- 0.22999



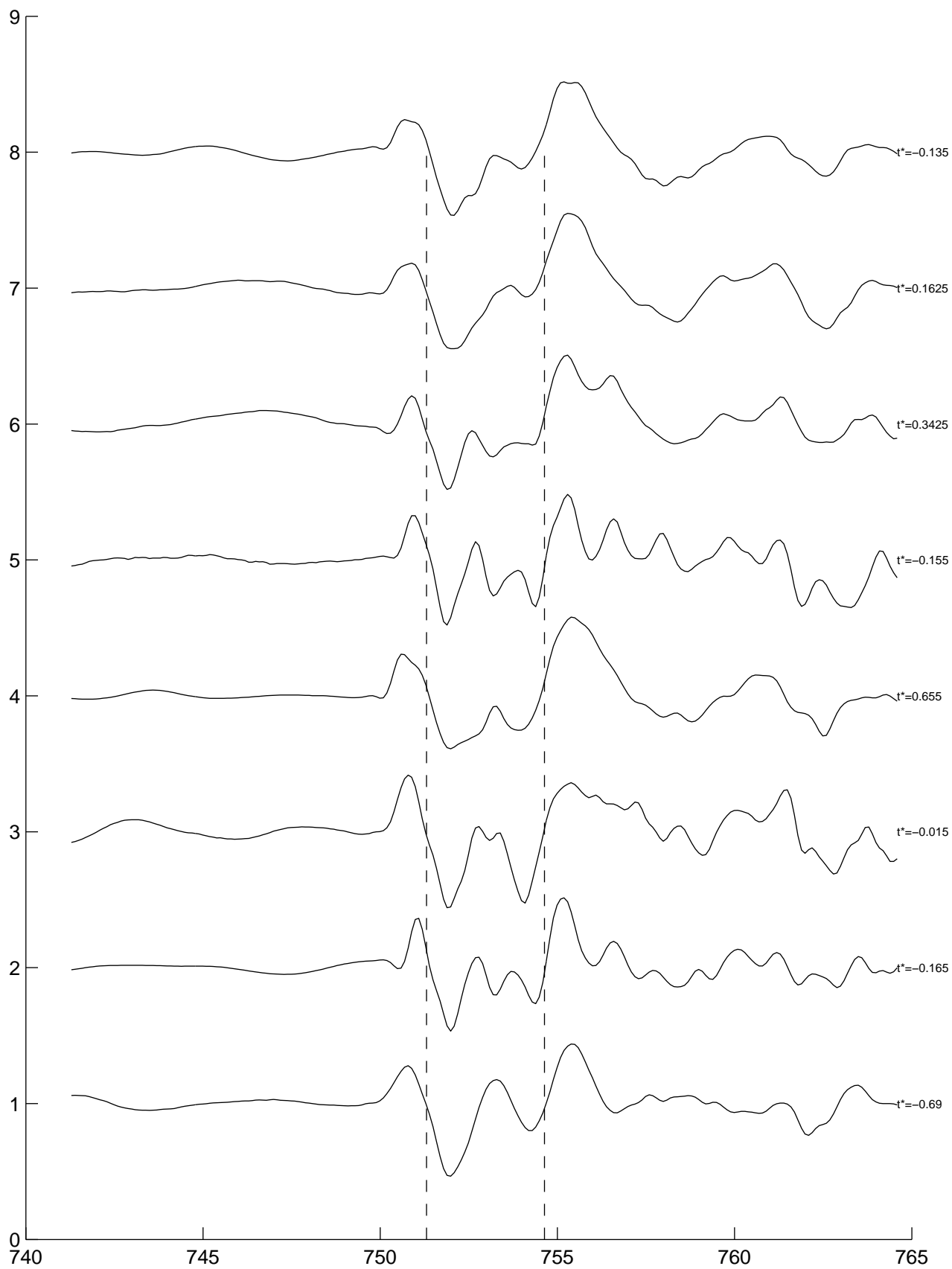
travel time residuals



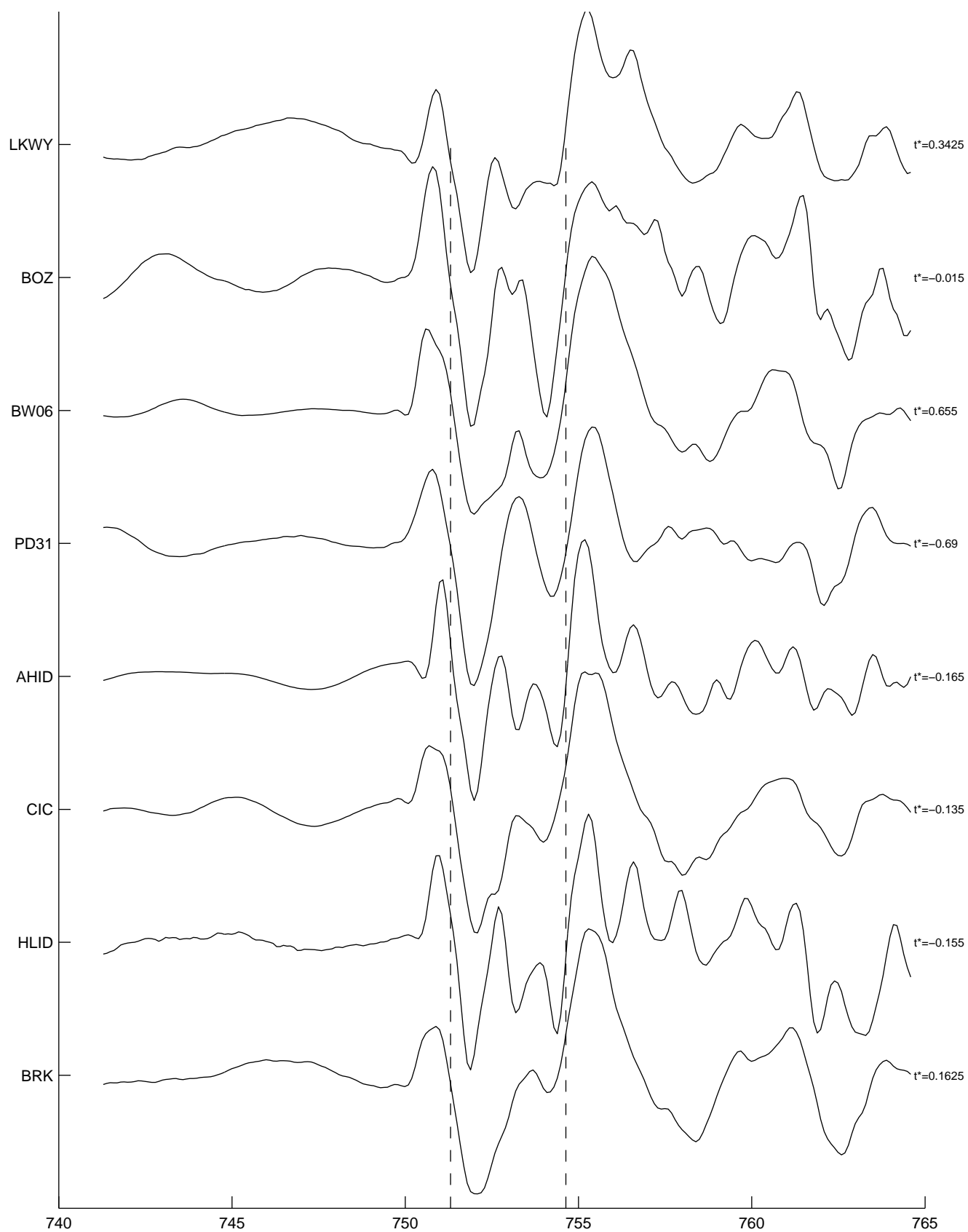
$t^*$  values



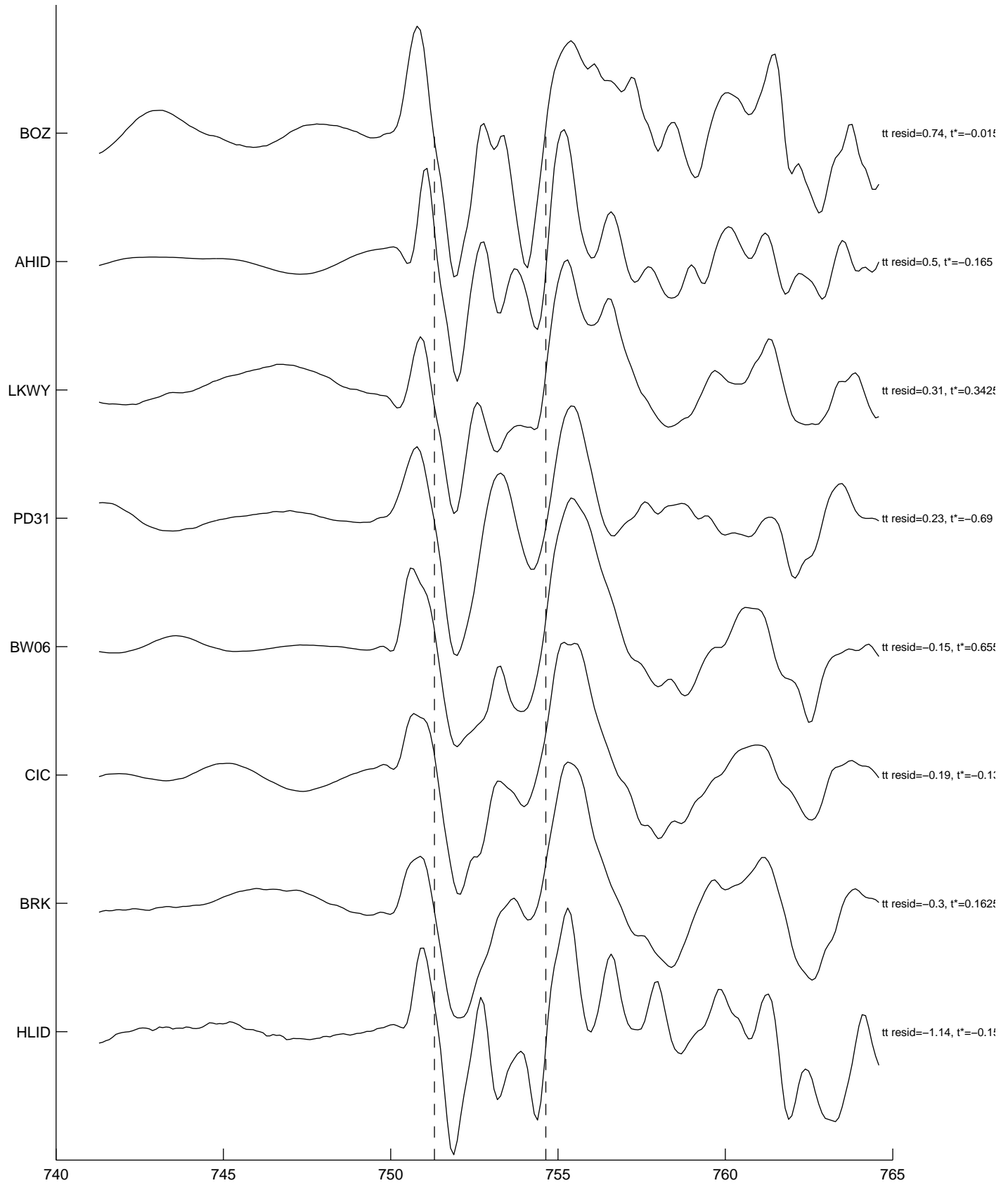
# Event\_2001\_185\_07\_06\_31



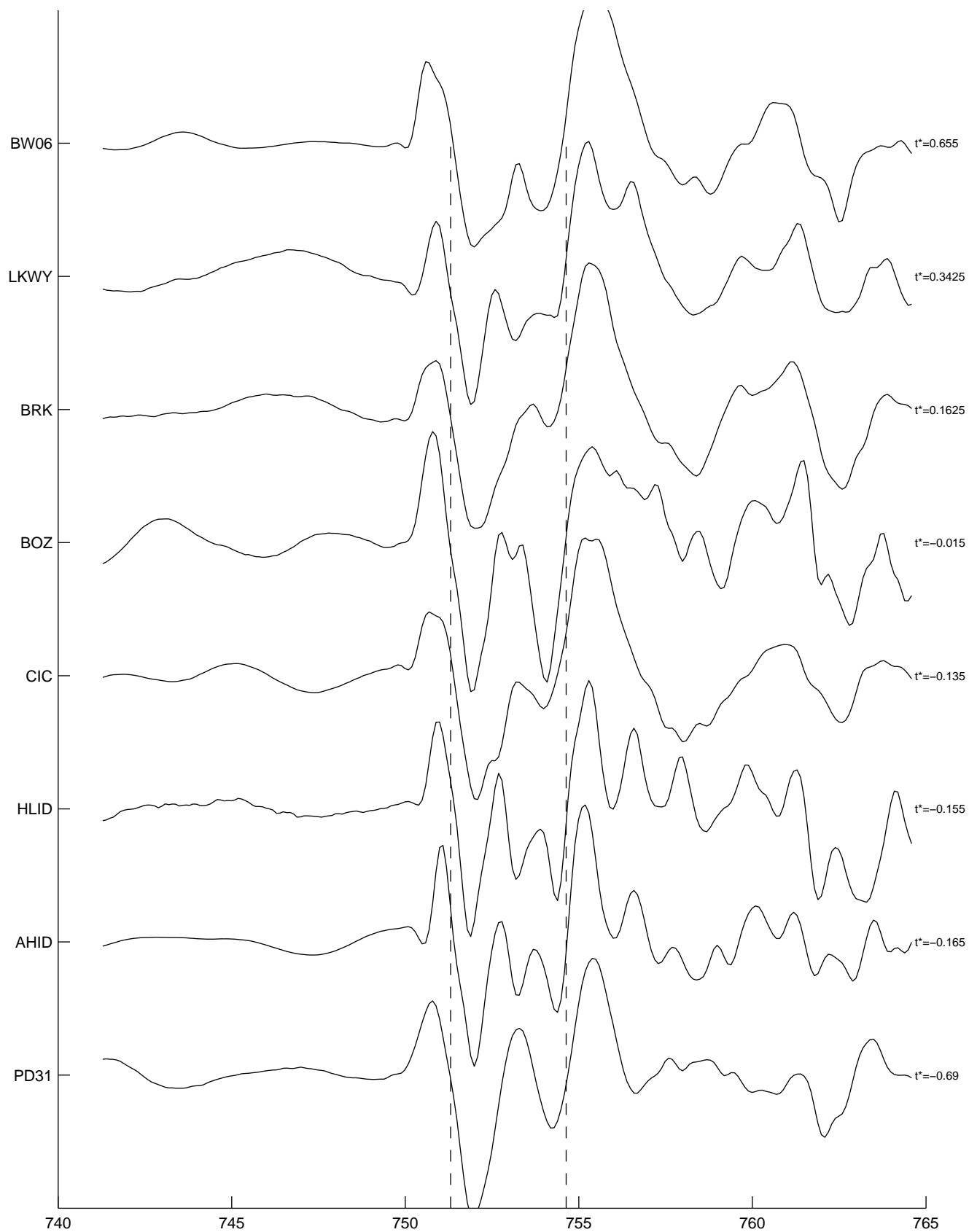
# Sorted by Delta:Event\_2001\_185\_07\_06\_31



# Sorted by travel time:Event\_2001\_185\_07\_06\_31



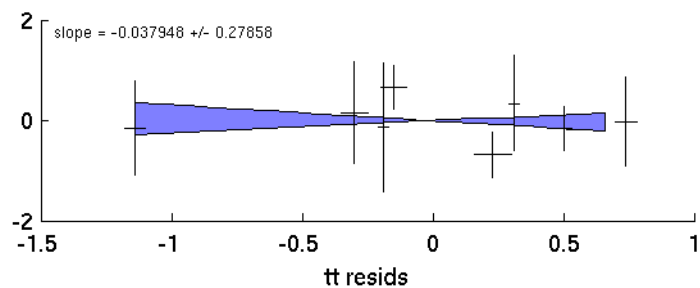
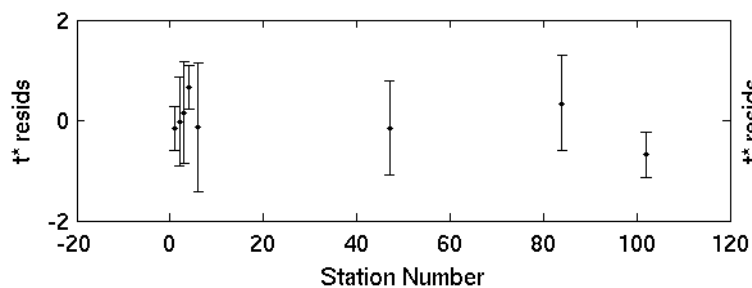
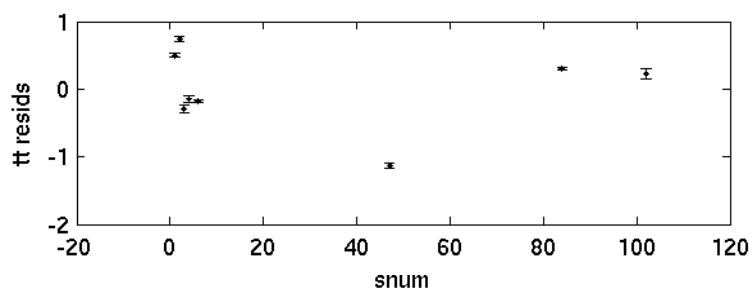
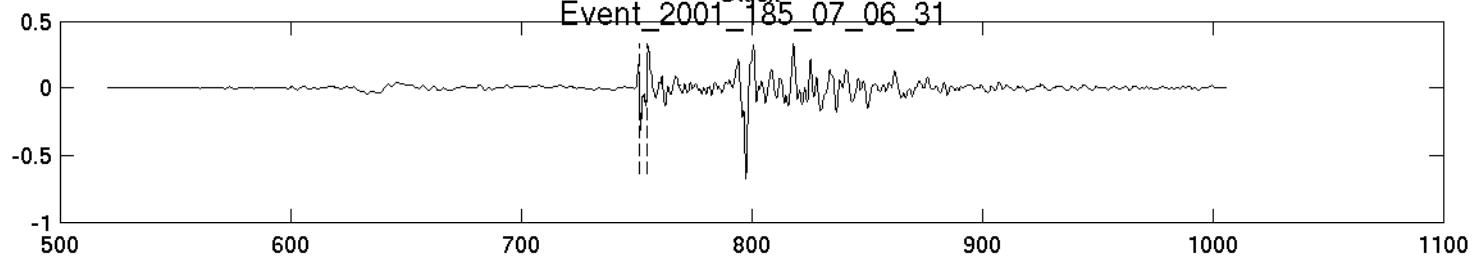
Sorted by  $t^*$ :Event\_2001\_185\_07\_06\_31



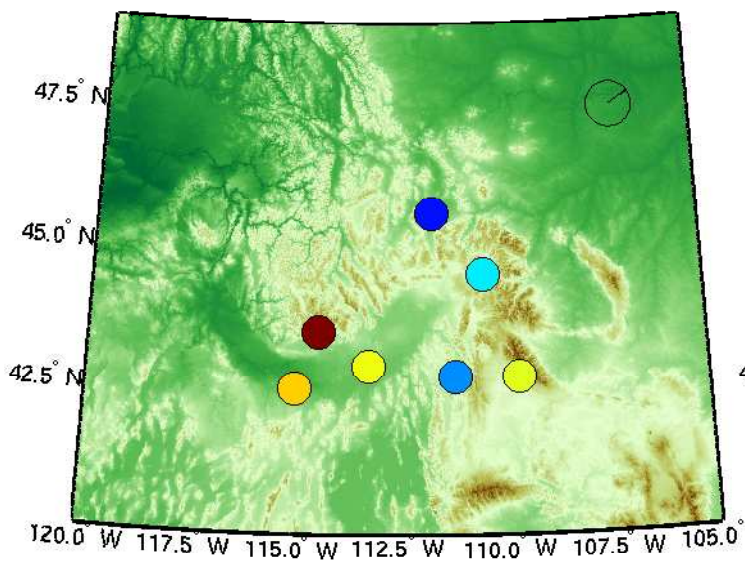


Event\_2001\_185\_07\_06\_31

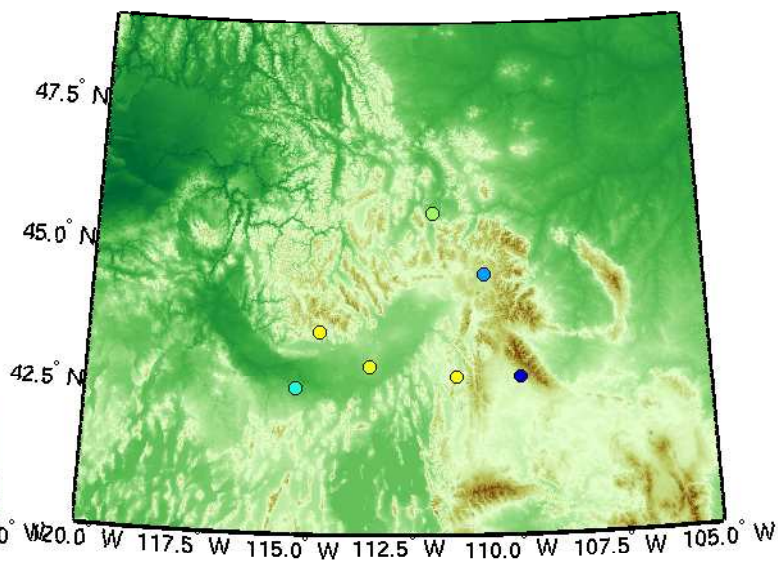
Stack



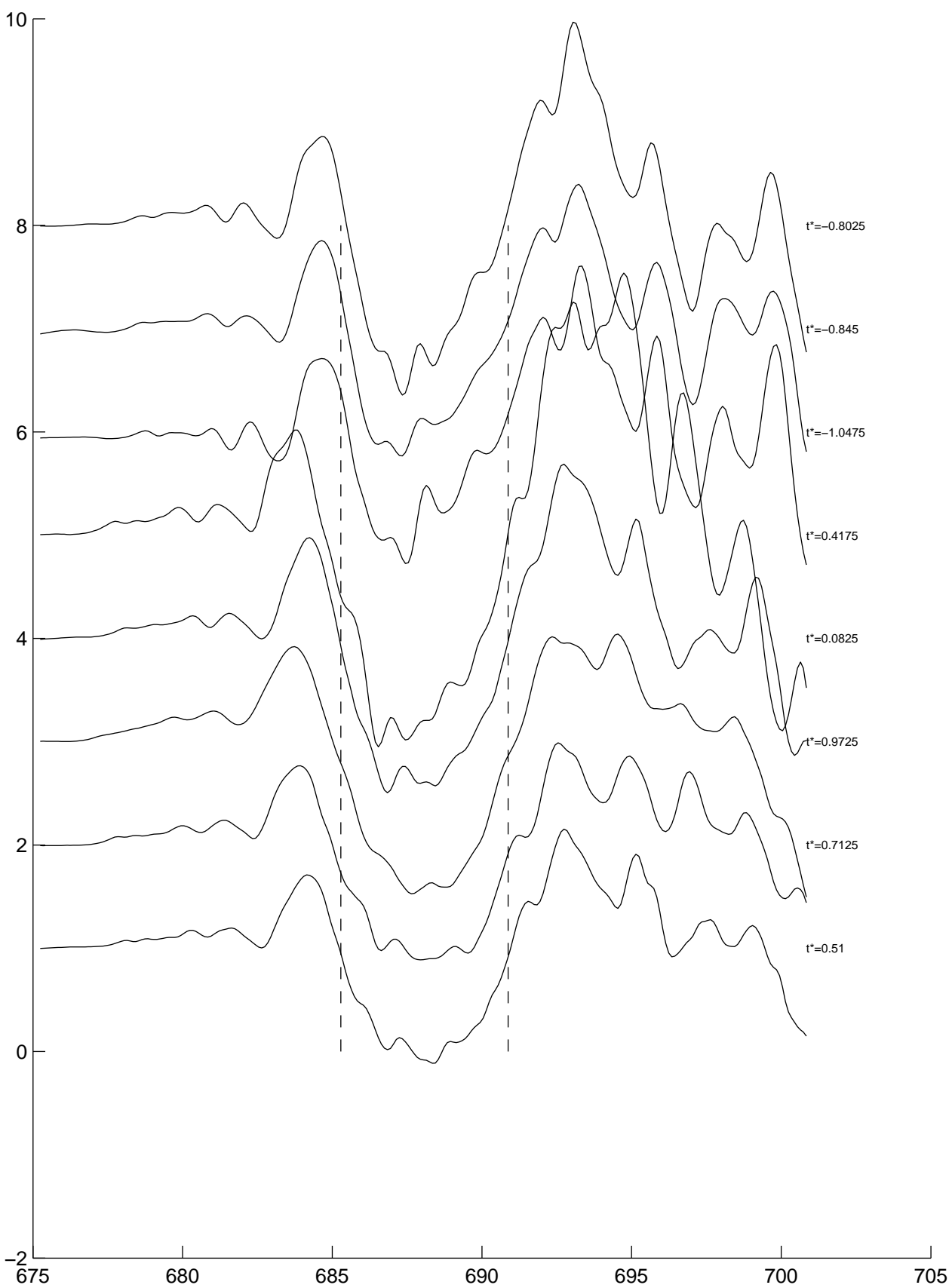
travel time residuals



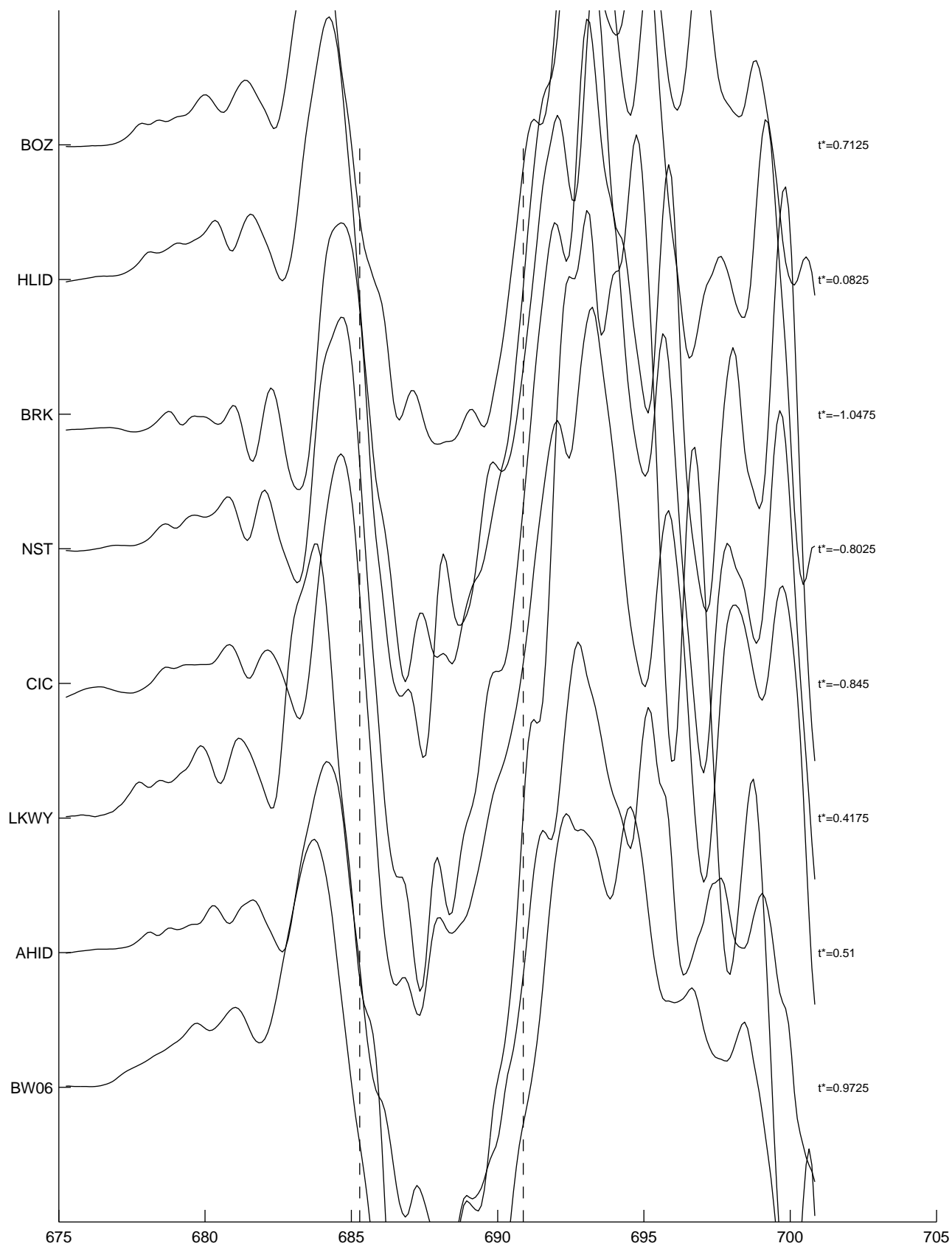
$t^*$  values



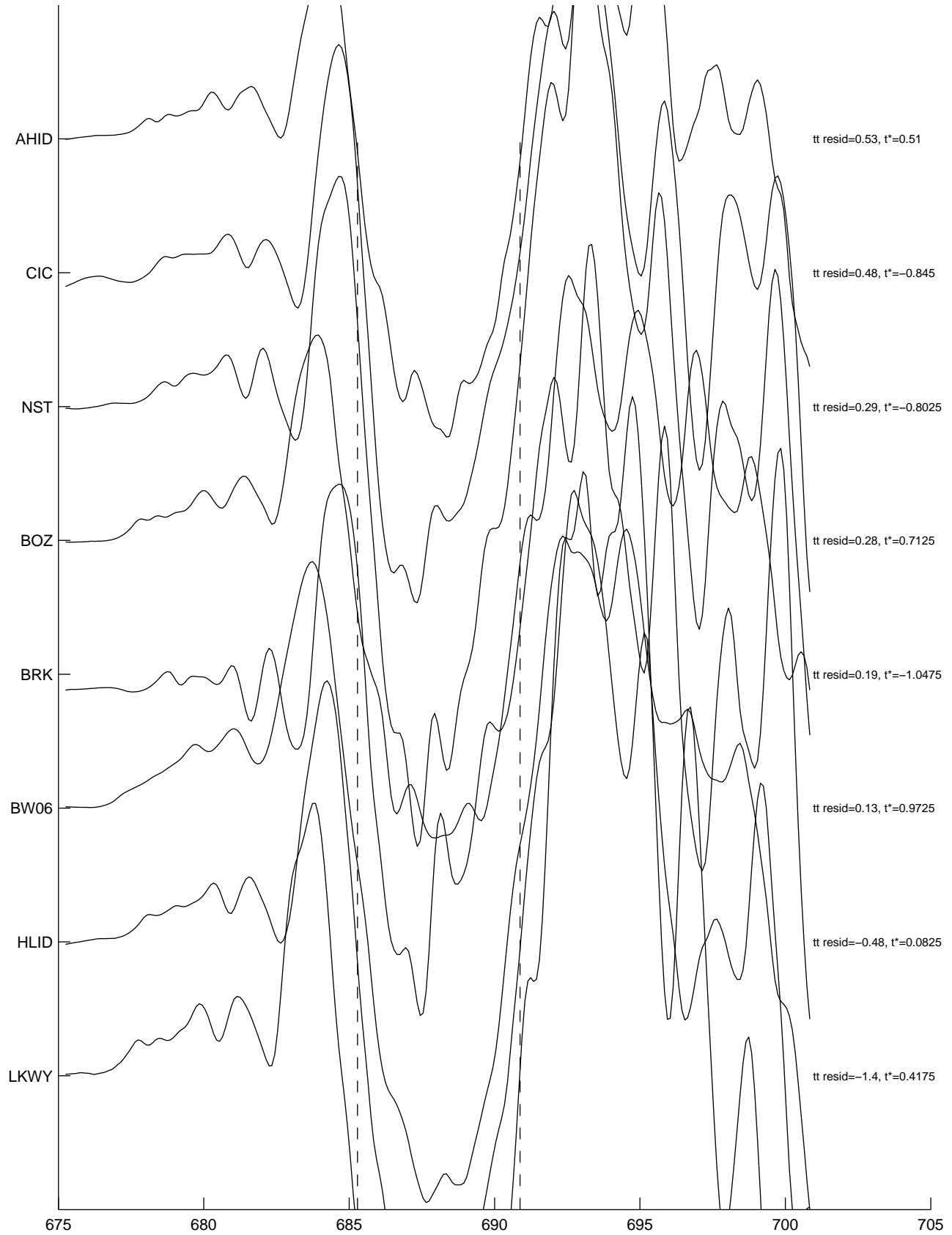
# Event\_2001\_188\_09\_38\_43



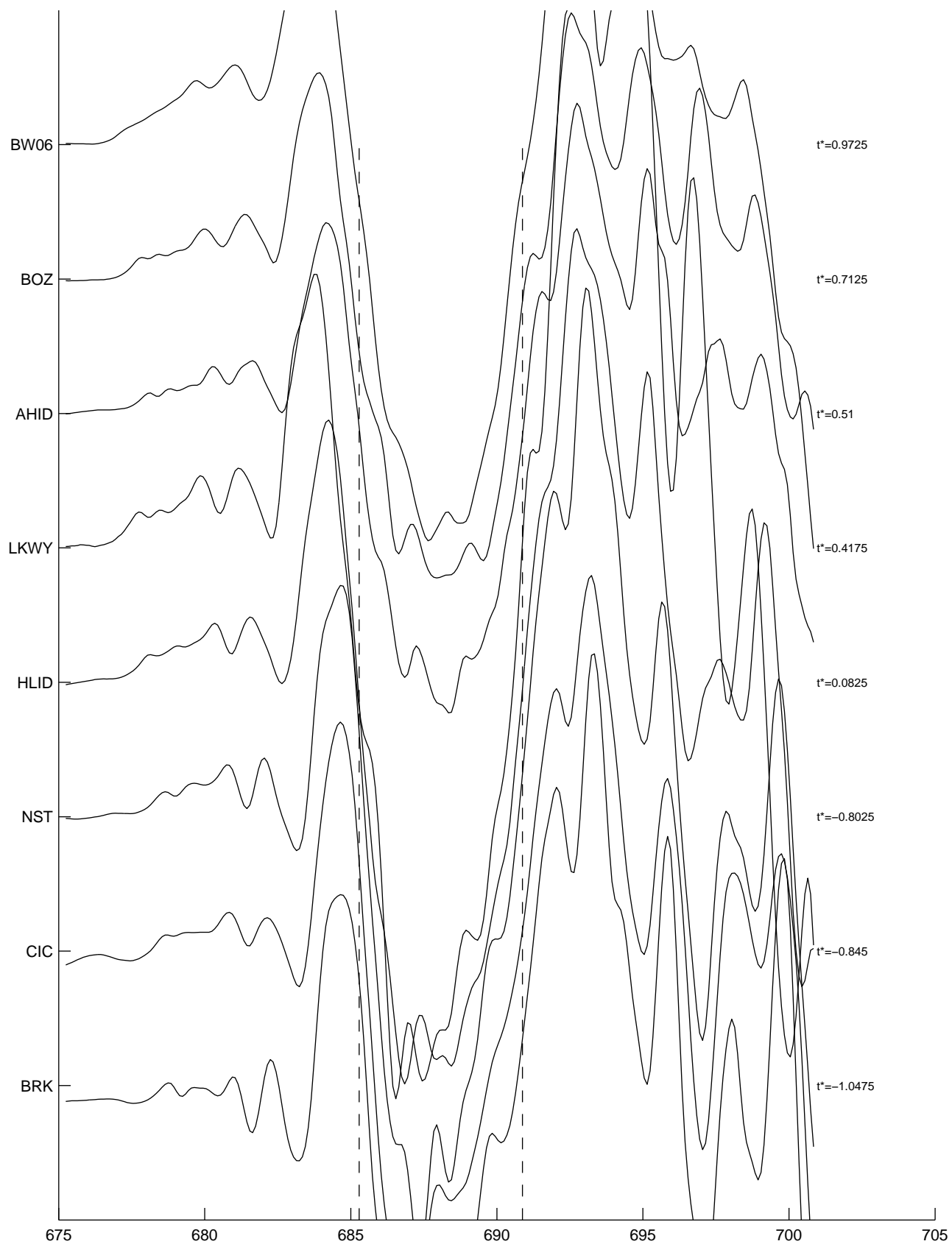
# Sorted by Delta:Event\_2001\_188\_09\_38\_43



# Sorted by travel time: Event\_2001\_188\_09\_38\_43

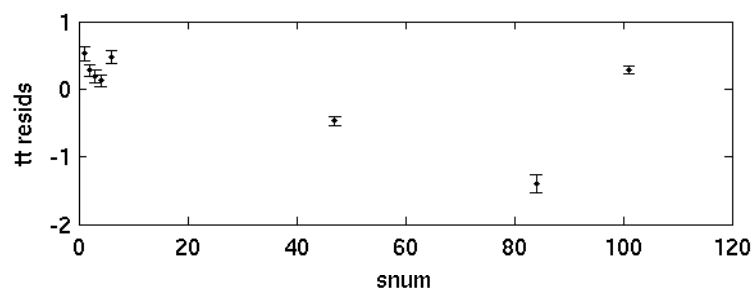
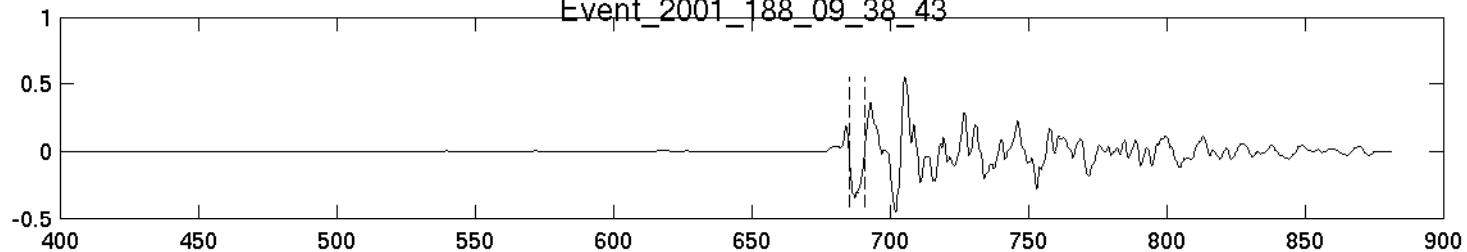


Sorted by  $t^*$ :Event\_2001\_188\_09\_38\_43

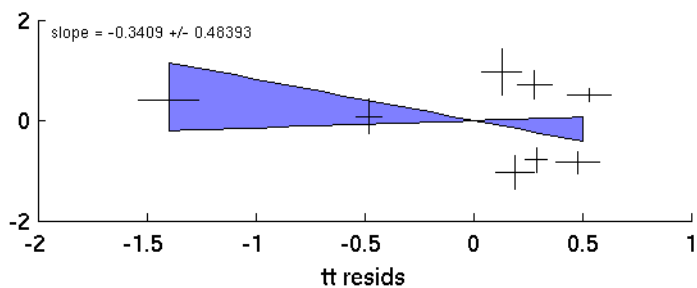
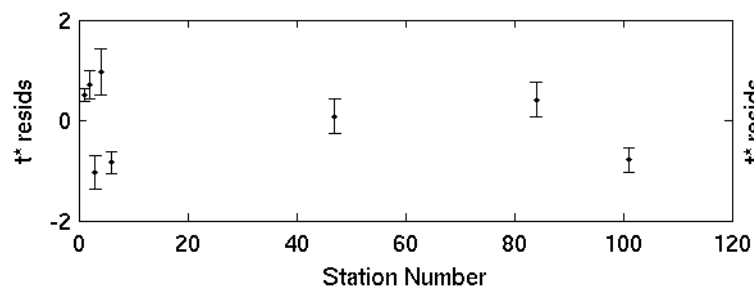


Event\_2001\_188\_09\_38\_43

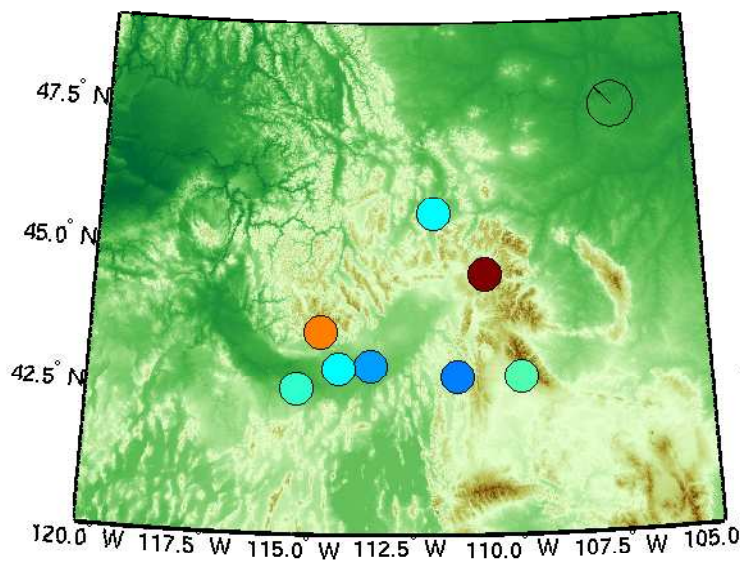
Stack



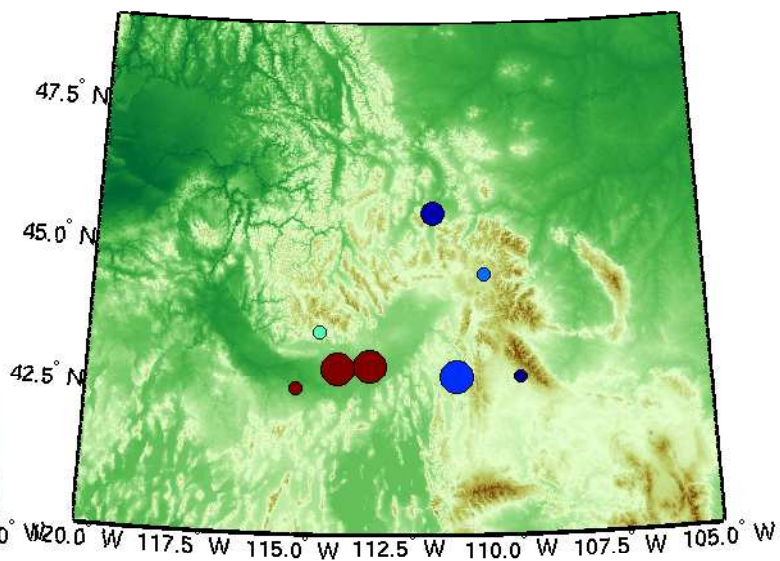
Baz = 139.3624  
Mean xcor value = 0.9125  
Range of  $t^*$  values is 2.02  
Median  $t^*$  err is 0.30286  
Slope = -0.3409 +/- 0.48393



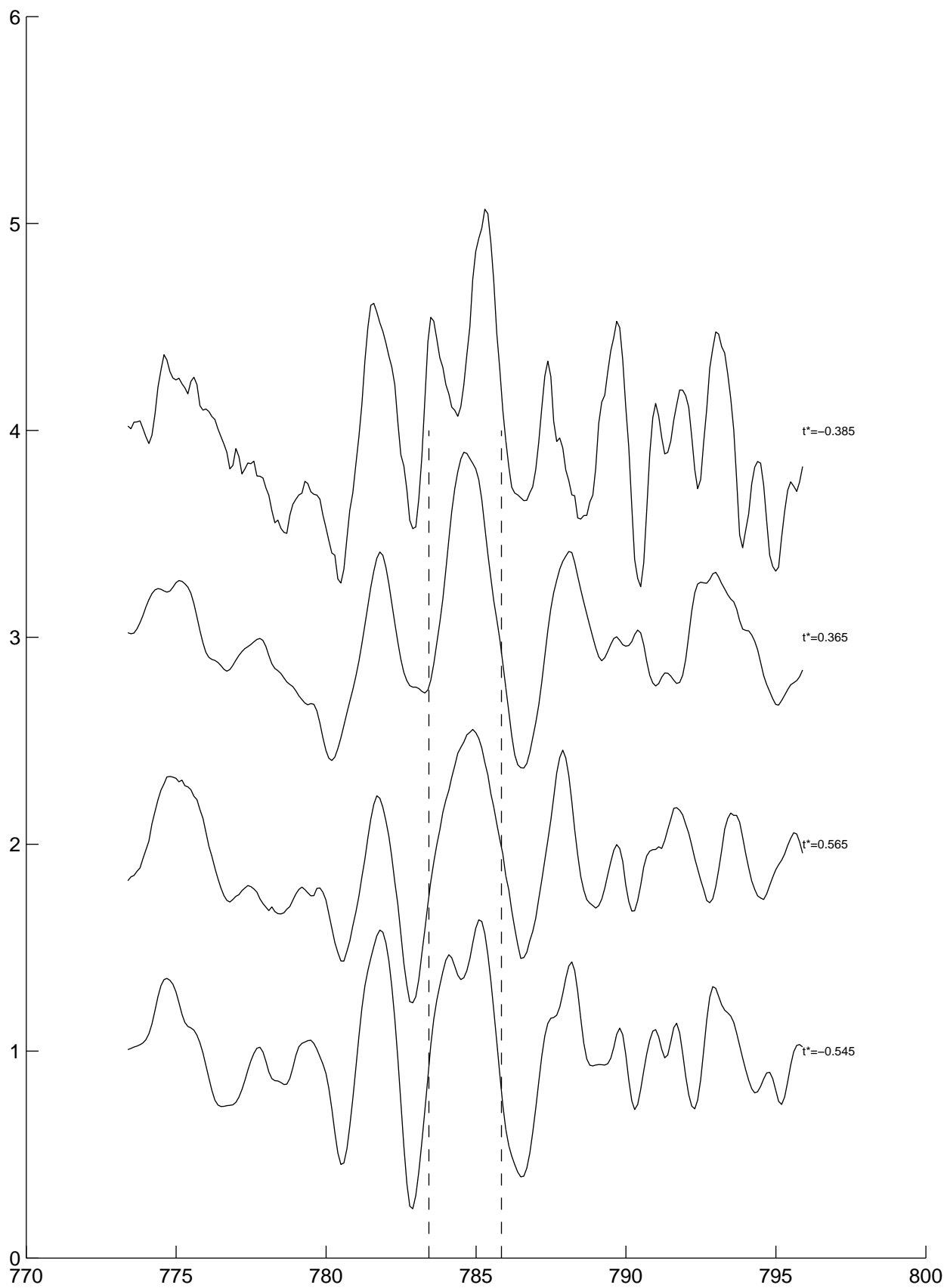
travel time residuals



$t^*$  values

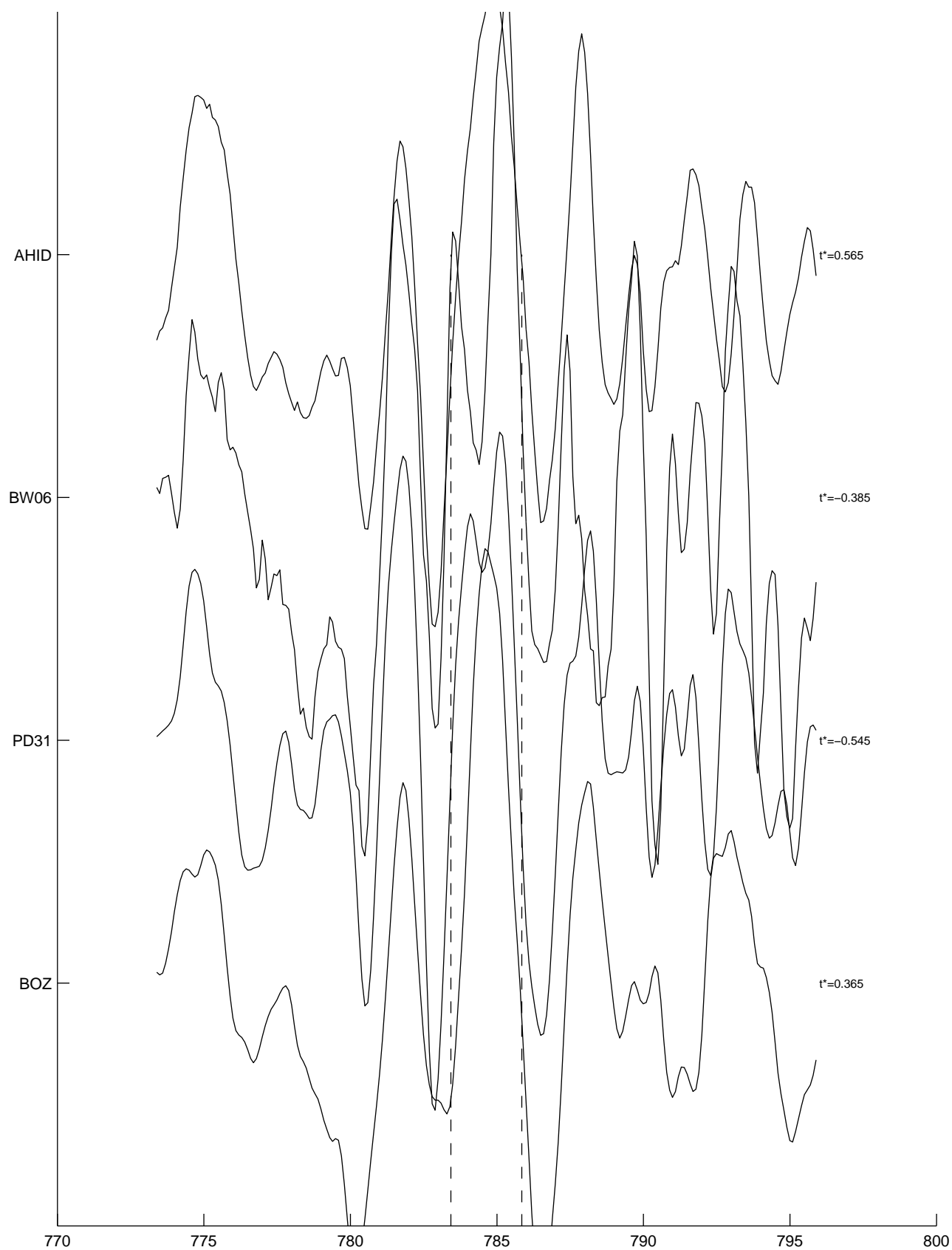


# Event\_2001\_207\_00\_21\_36

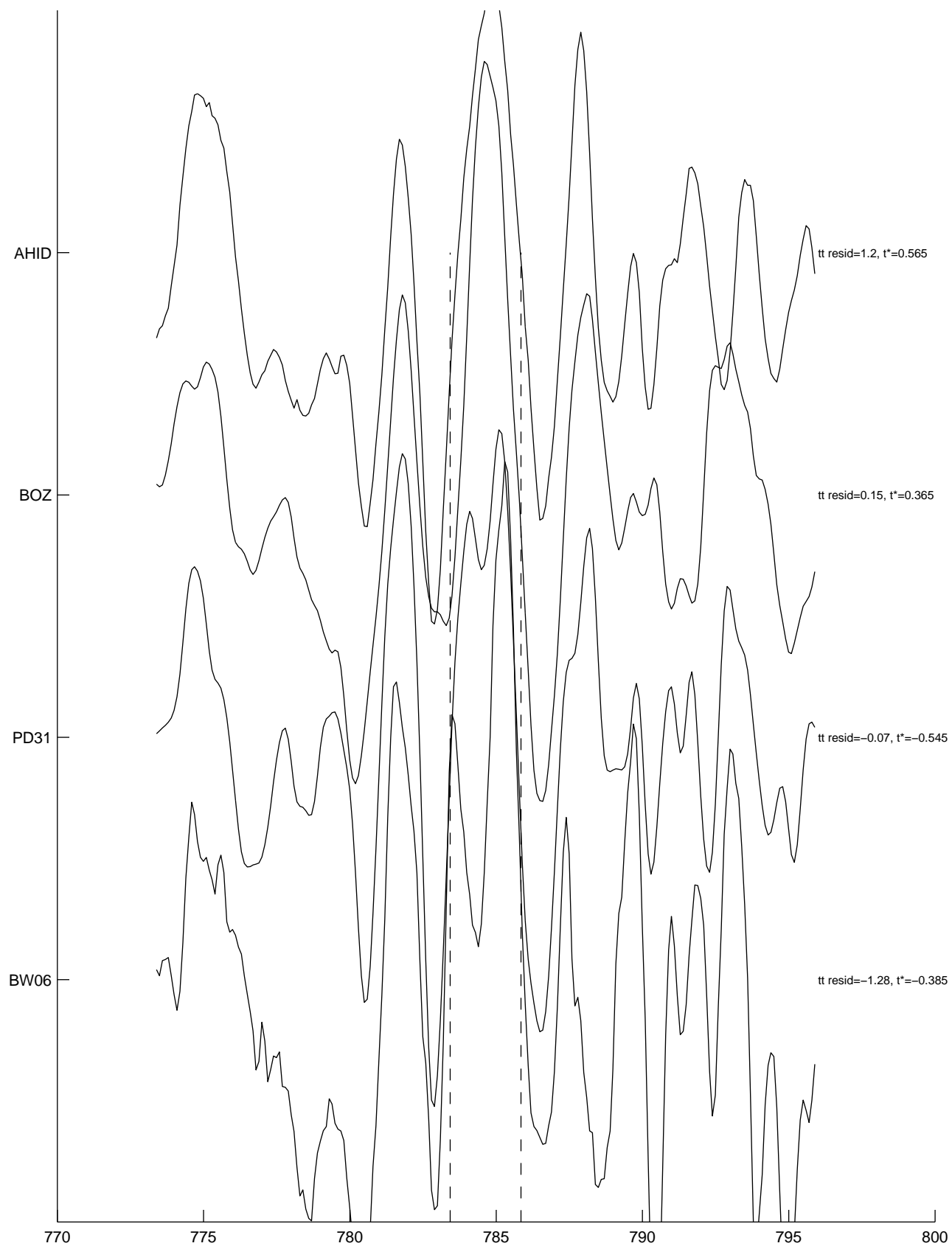




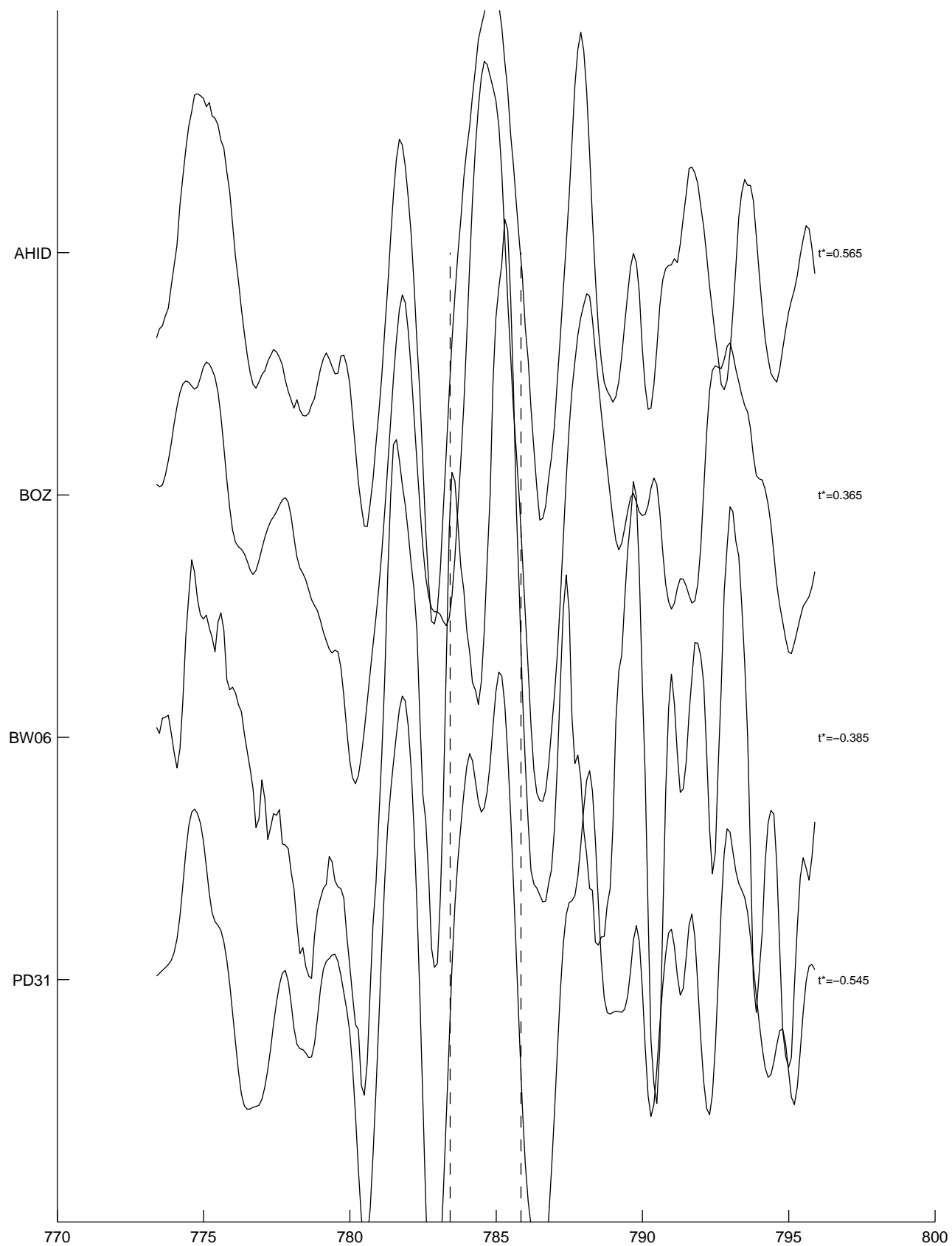
Sorted by Delta:Event\_2001\_207\_00\_21\_36



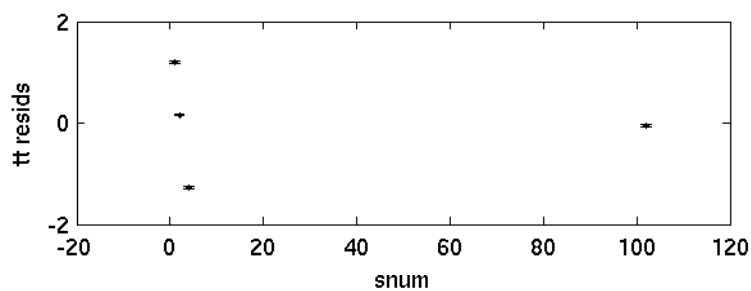
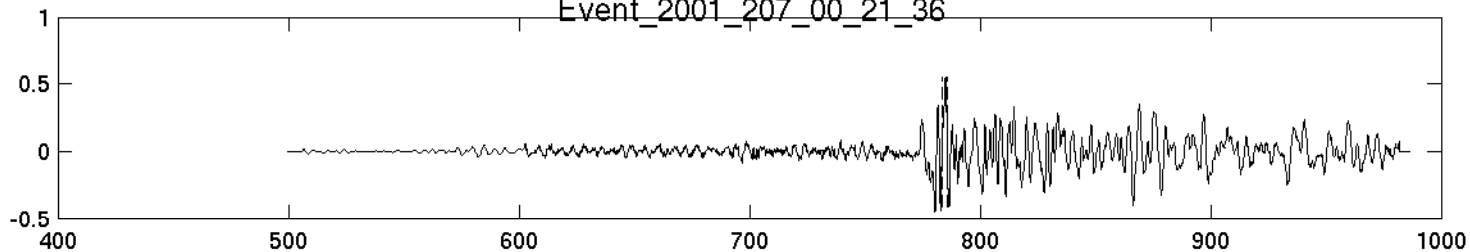
Sorted by travel time:Event\_2001\_207\_00\_21\_36



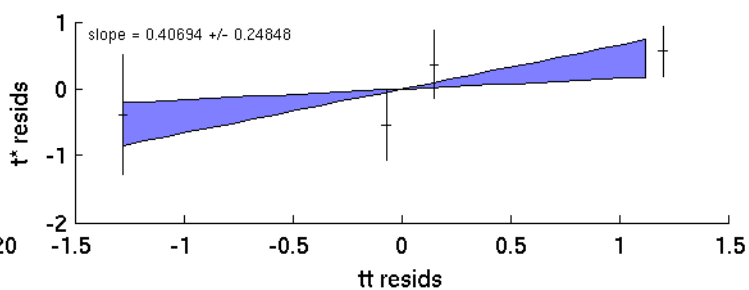
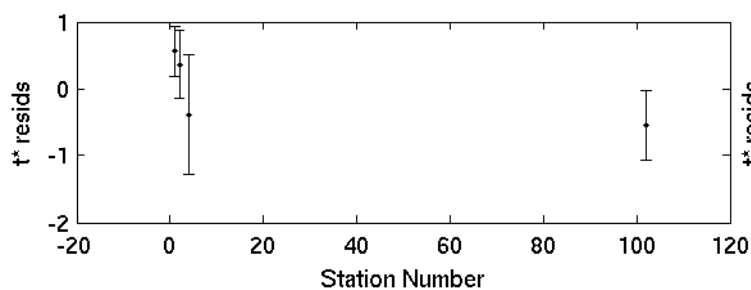
Sorted by t\*:Event\_2001\_207\_00\_21\_36



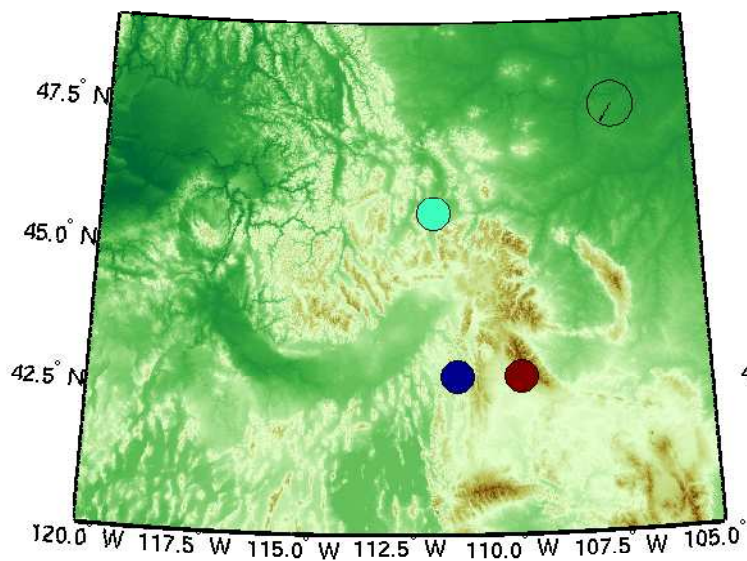
Stack  
Event\_2001\_207\_00\_21\_36



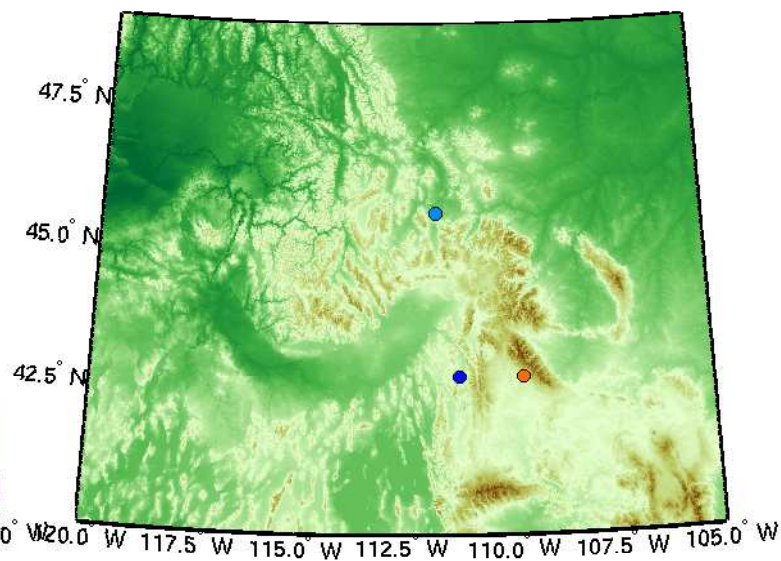
Baz = 33.091  
Mean xcor value = 0.685  
Range of  $t^*$  values is 1.11  
Median  $t^*$  err is 0.51645  
Slope = 0.40694 +/- 0.24848



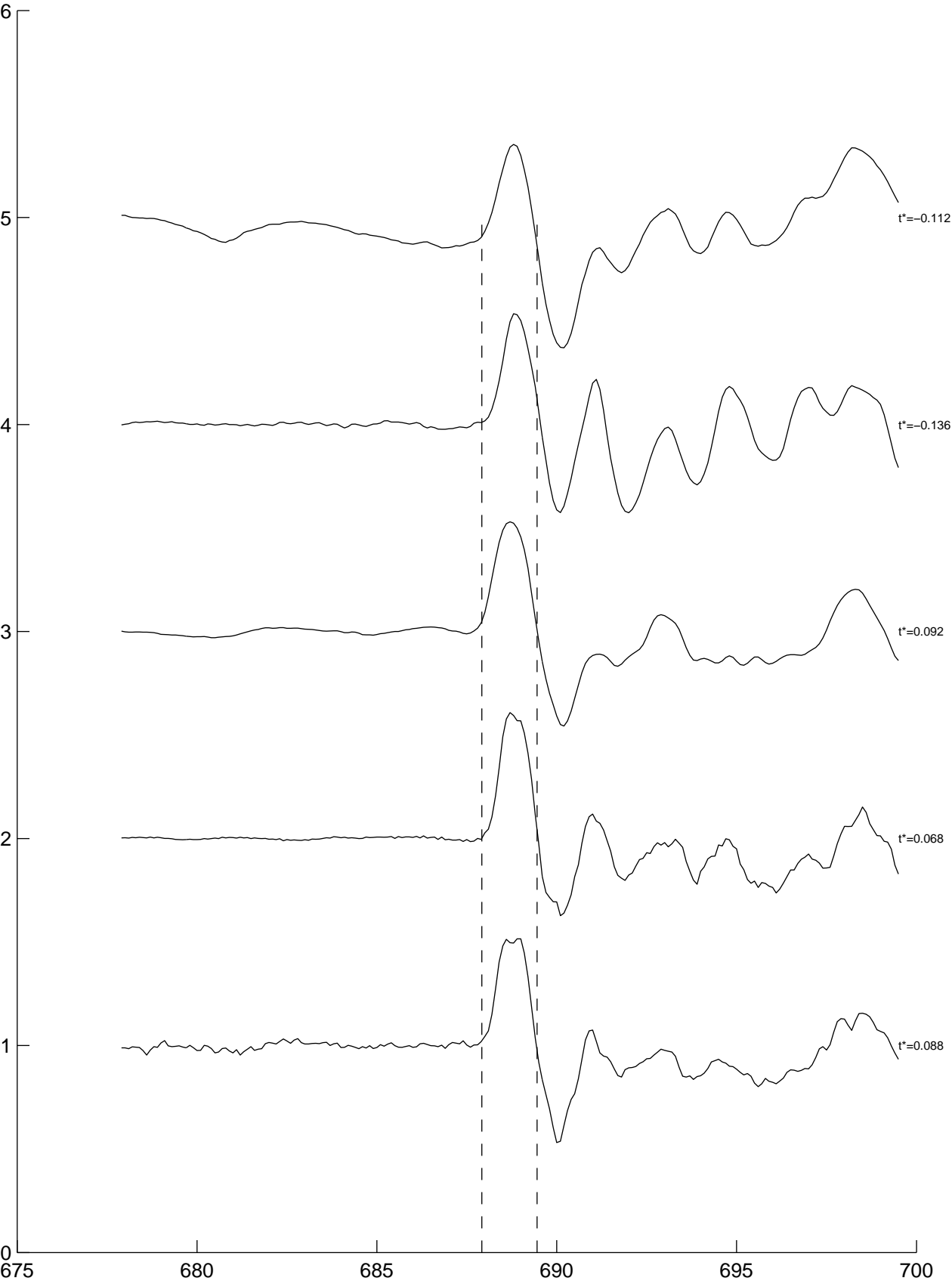
travel time residuals



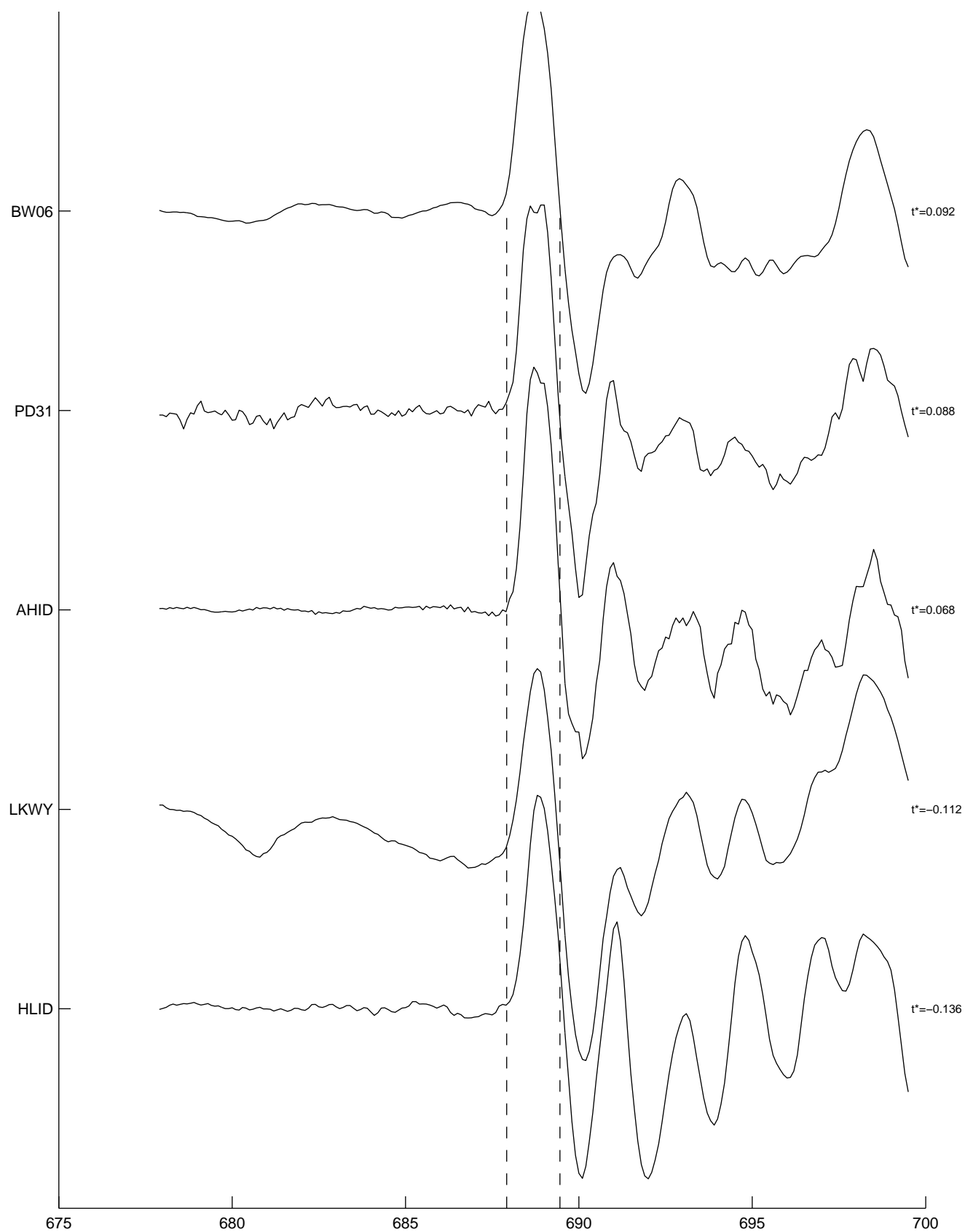
$t^*$  values



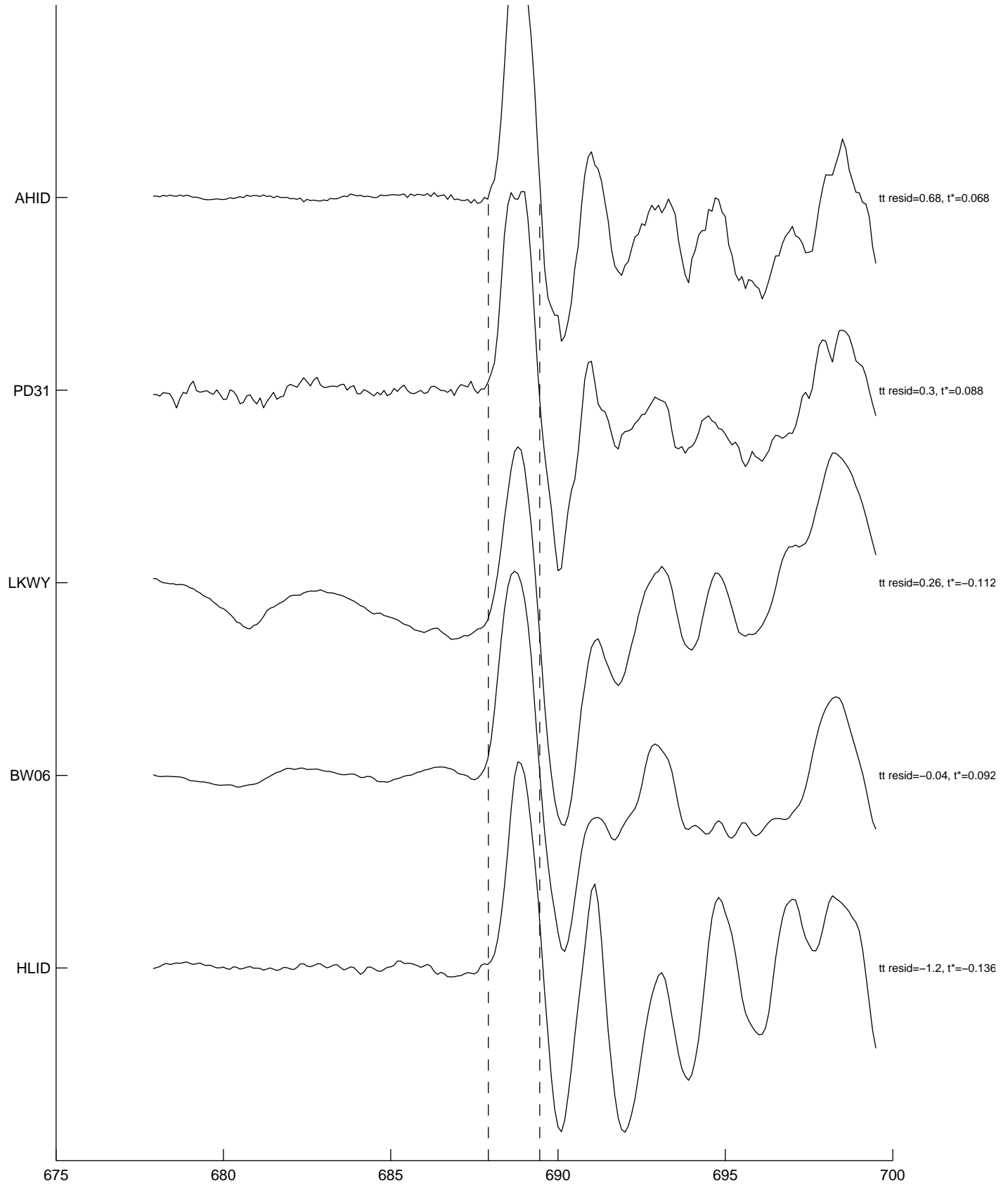
Event\_2001\_225\_20\_11\_23



# Sorted by Delta:Event\_2001\_225\_20\_11\_23

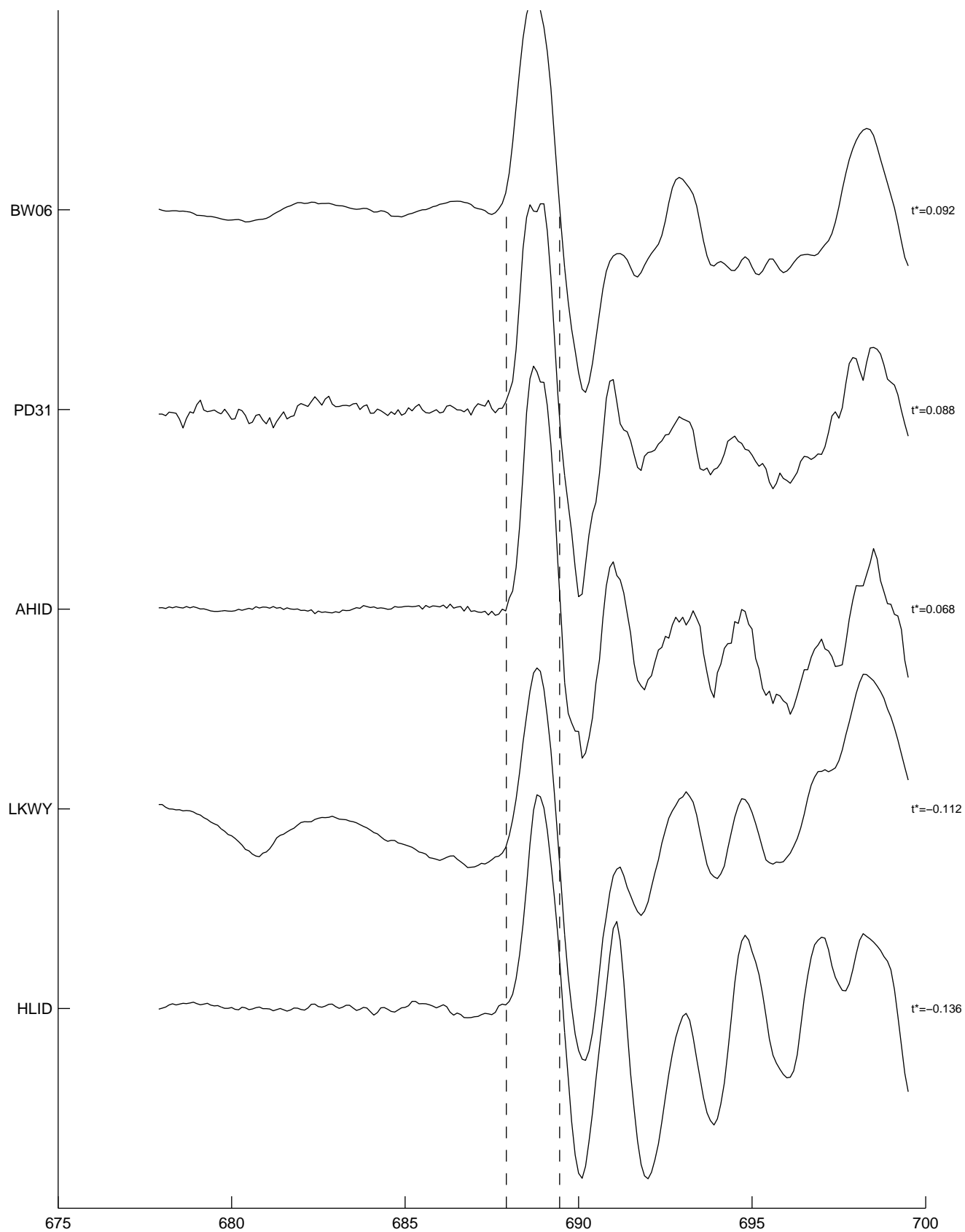


# Sorted by travel time:Event\_2001\_225\_20\_11\_23



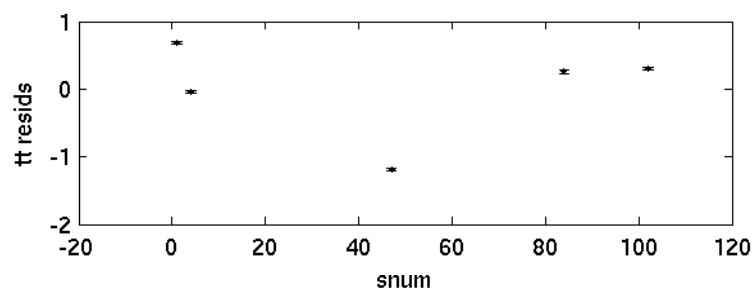
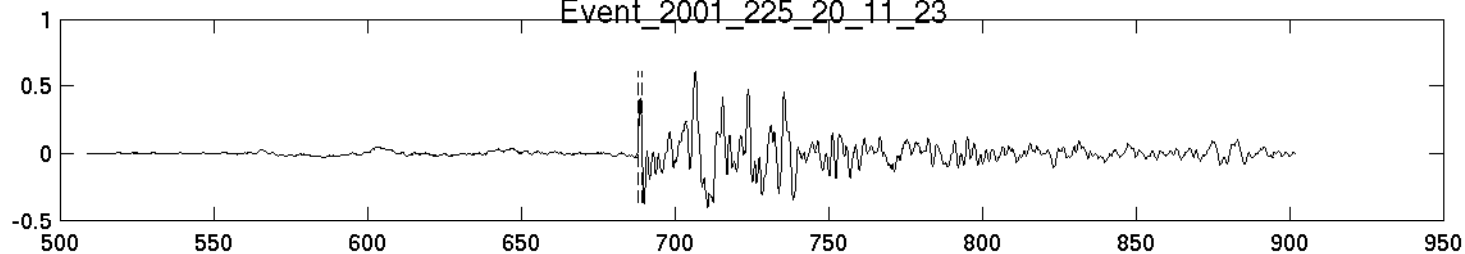


Sorted by  $t^*$ :Event\_2001\_225\_20\_11\_23

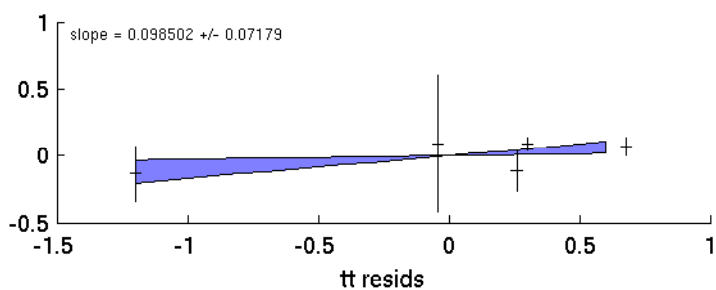
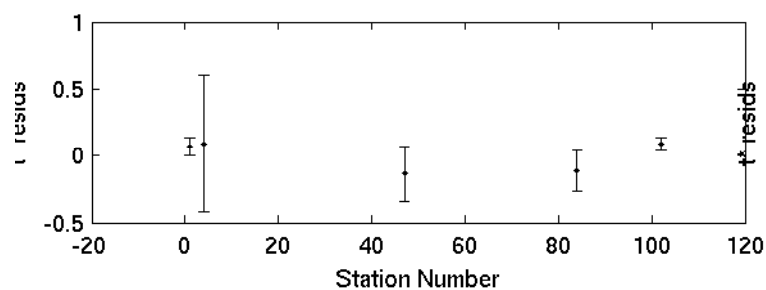


Event\_2001\_225\_20\_11\_23

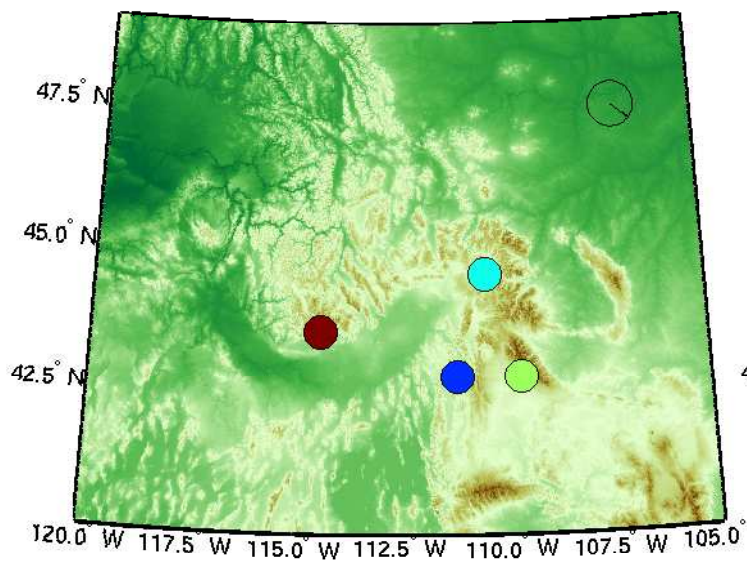
Stack



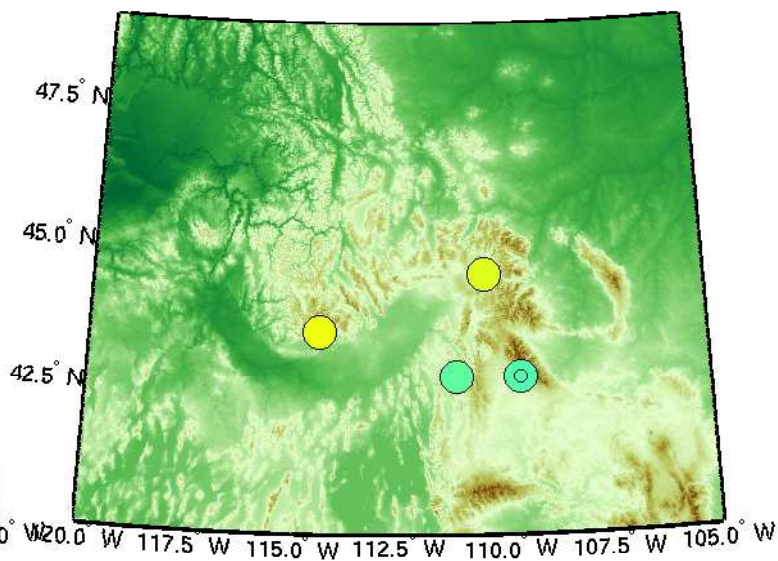
Baz = 310.6128  
Mean xcor value = 0.682  
Range of  $t^*$  values is 0.228  
Median  $t^*$  err is 0.15547  
Slope = 0.098502 +/- 0.07179



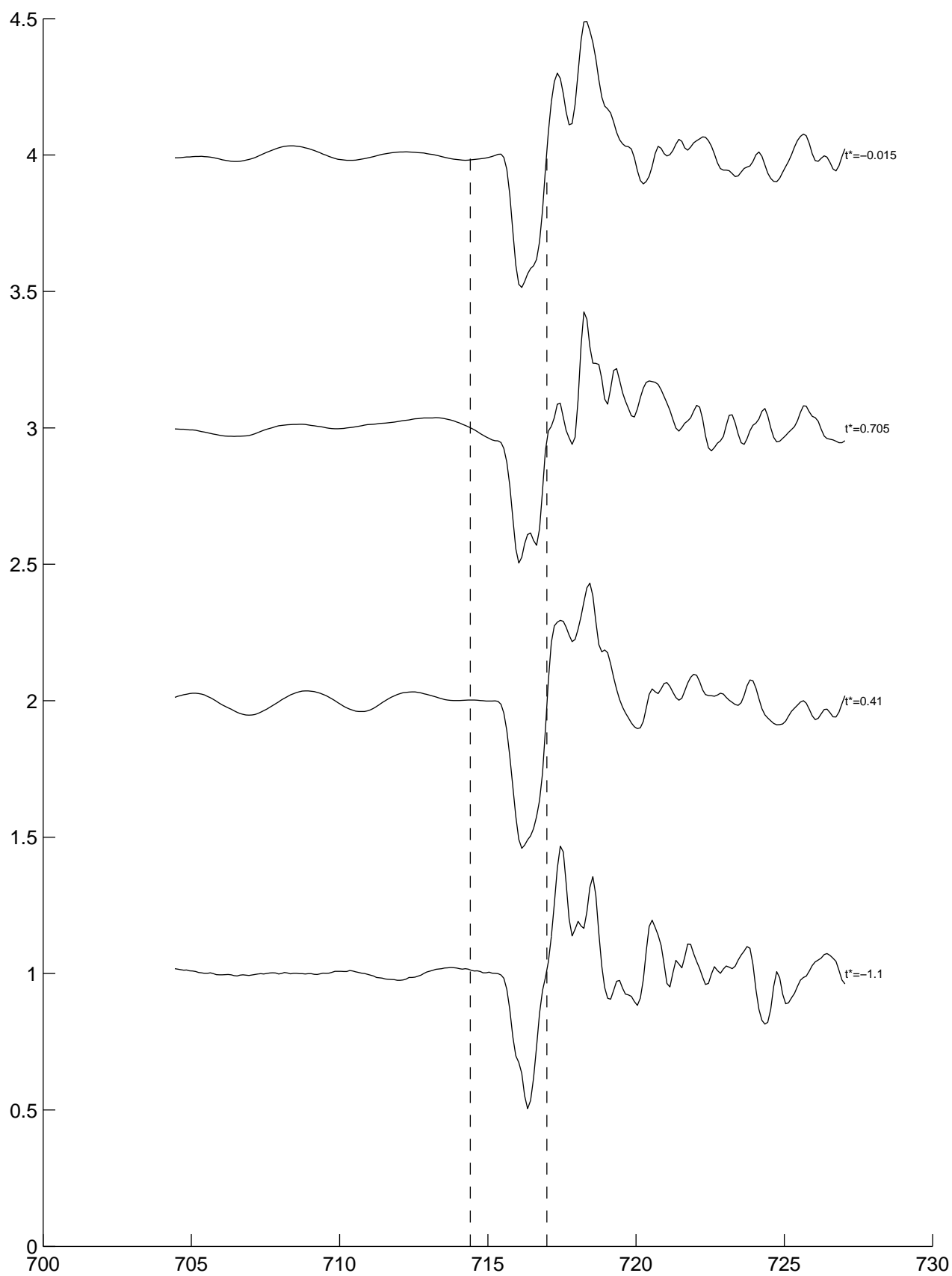
travel time residuals



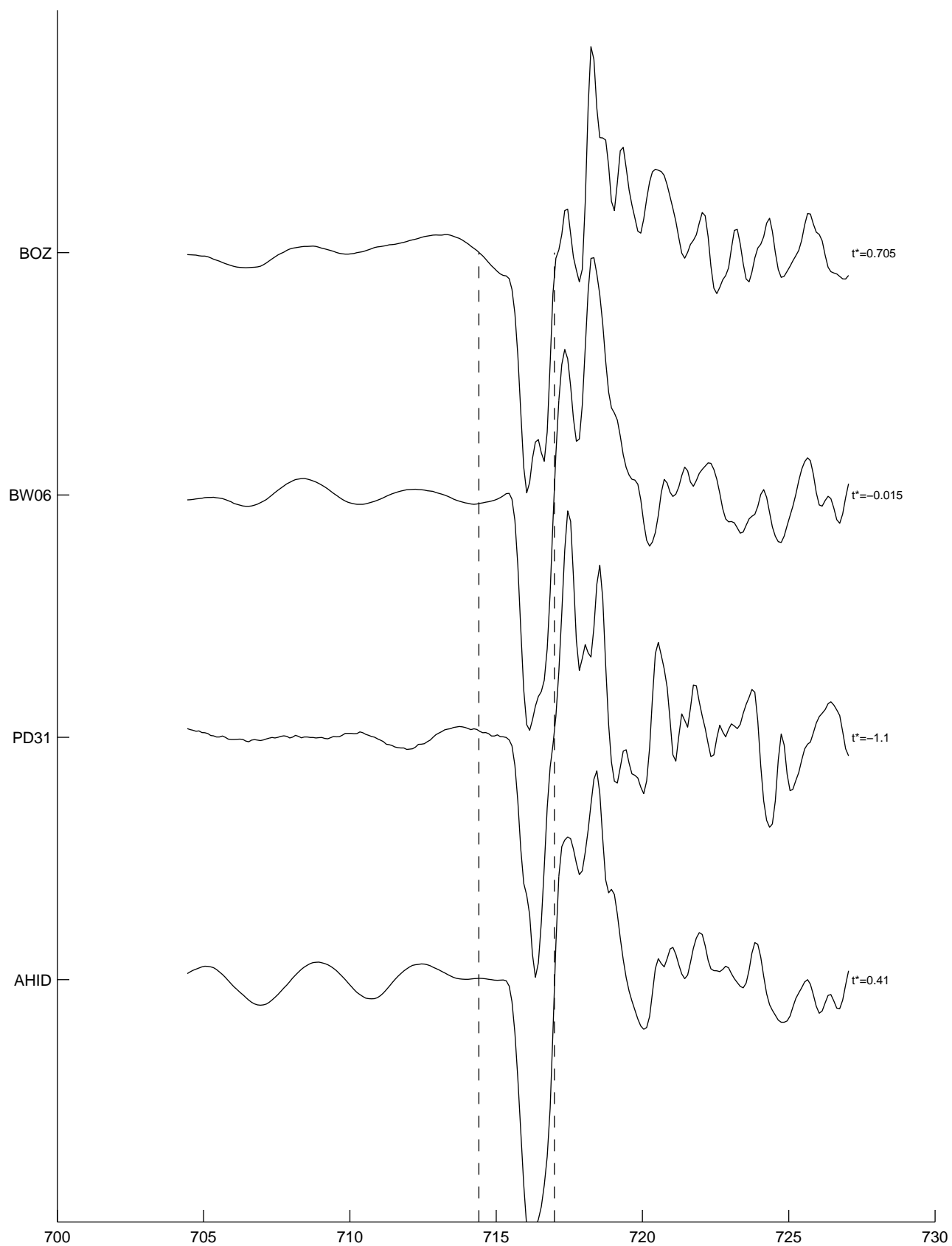
$t^*$  values



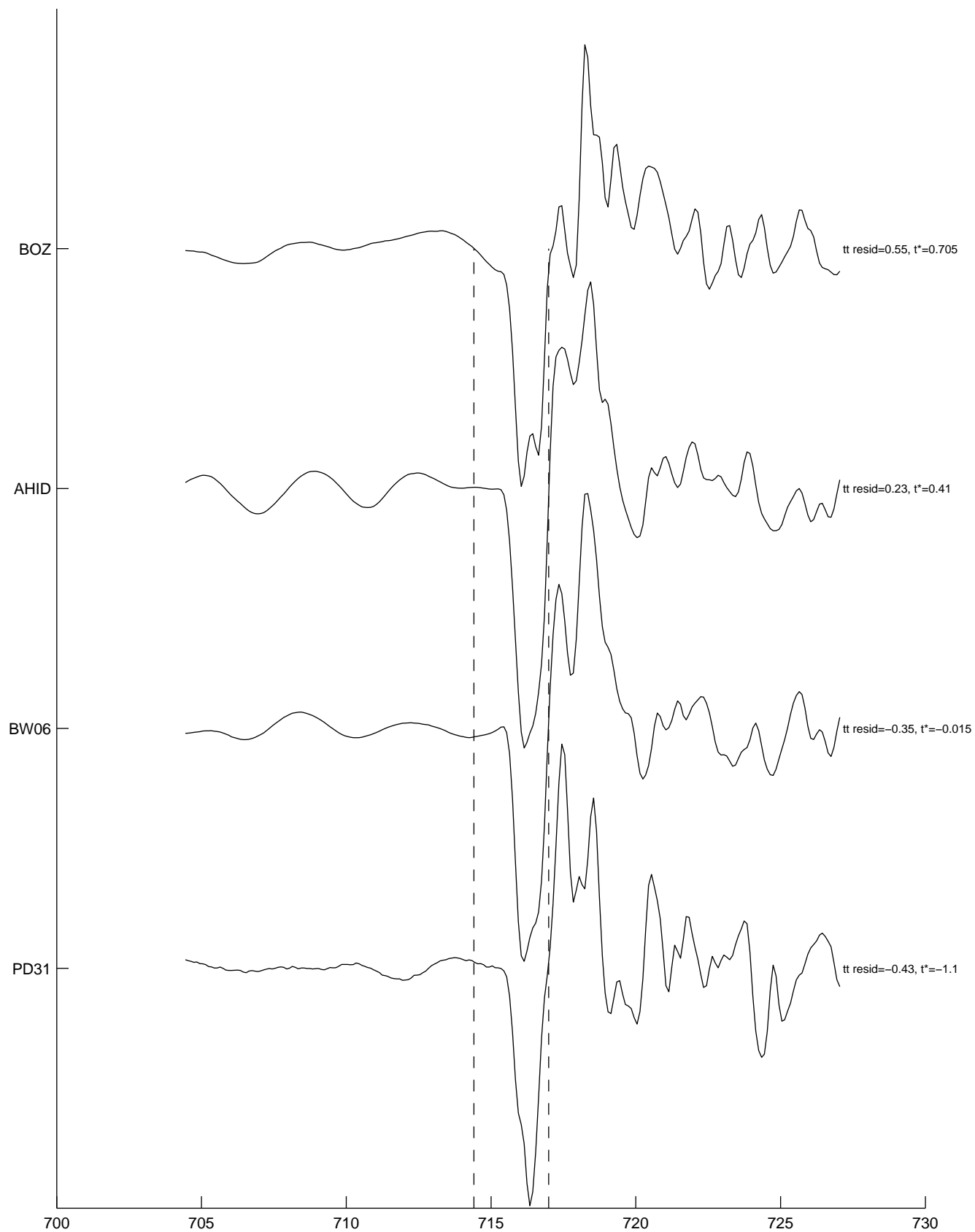
# Event\_2001\_255\_08\_48\_37



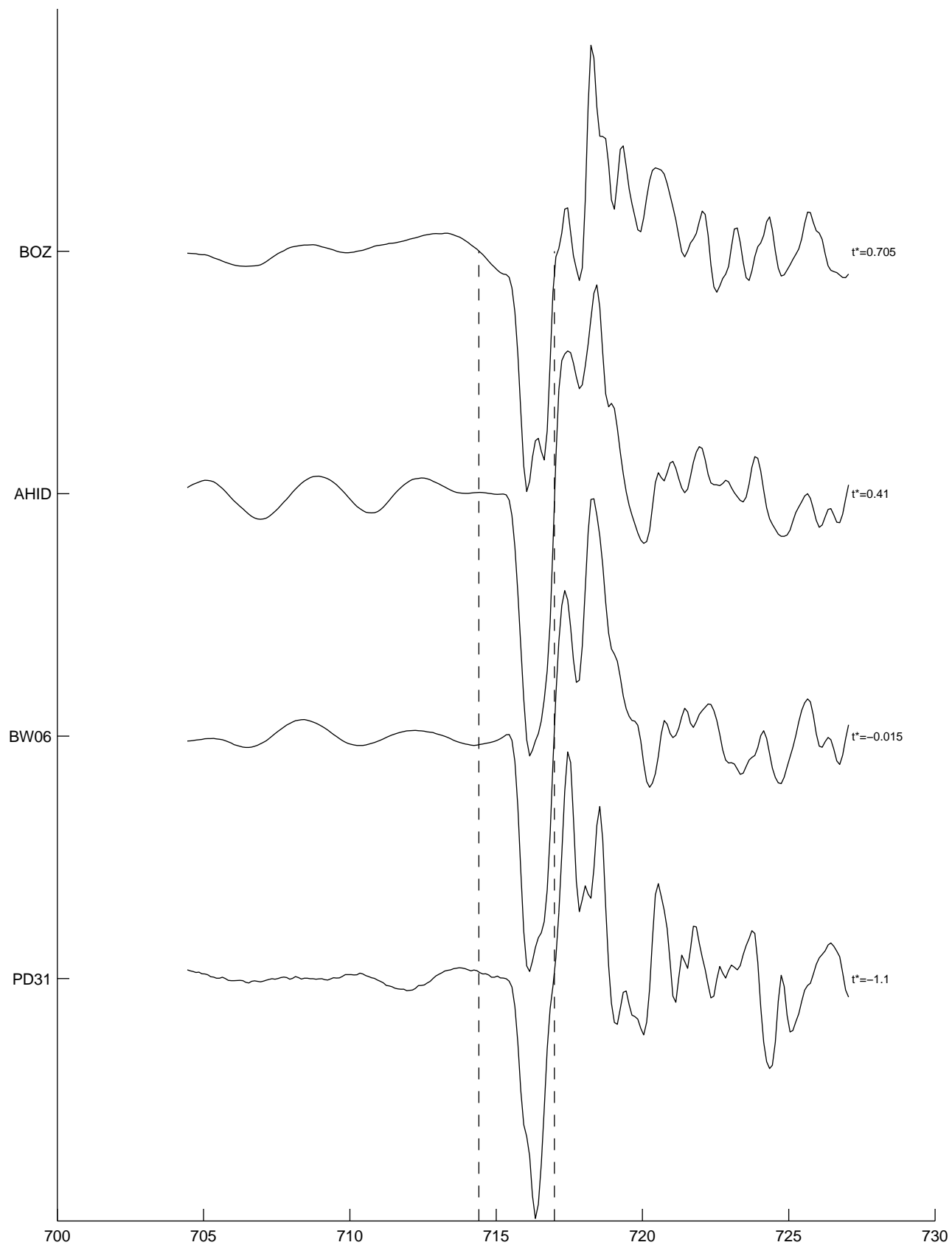
Sorted by Delta:Event\_2001\_255\_08\_48\_37



Sorted by travel time: Event\_2001\_255\_08\_48\_37



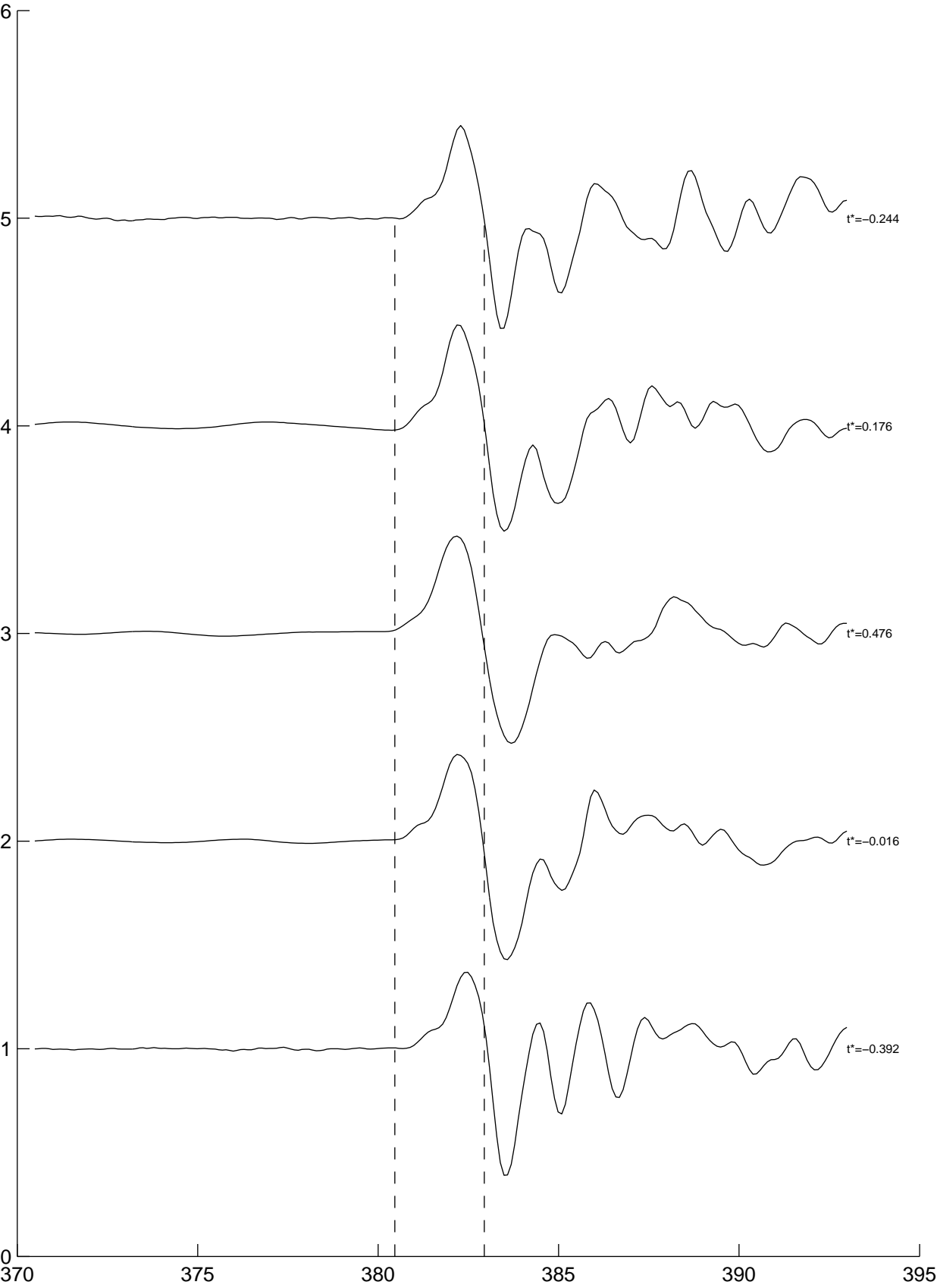
Sorted by  $t^*$ :Event\_2001\_255\_08\_48\_37



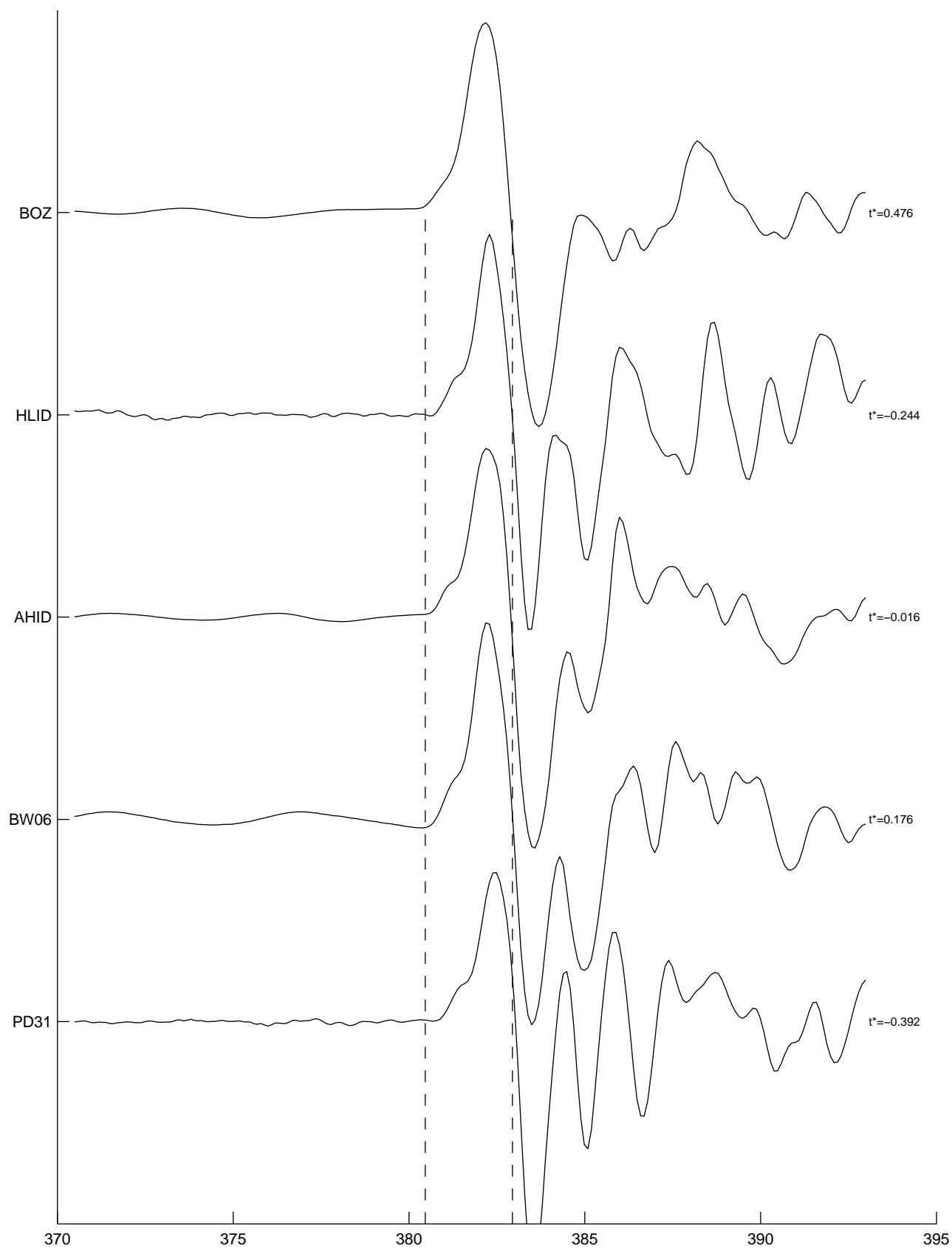




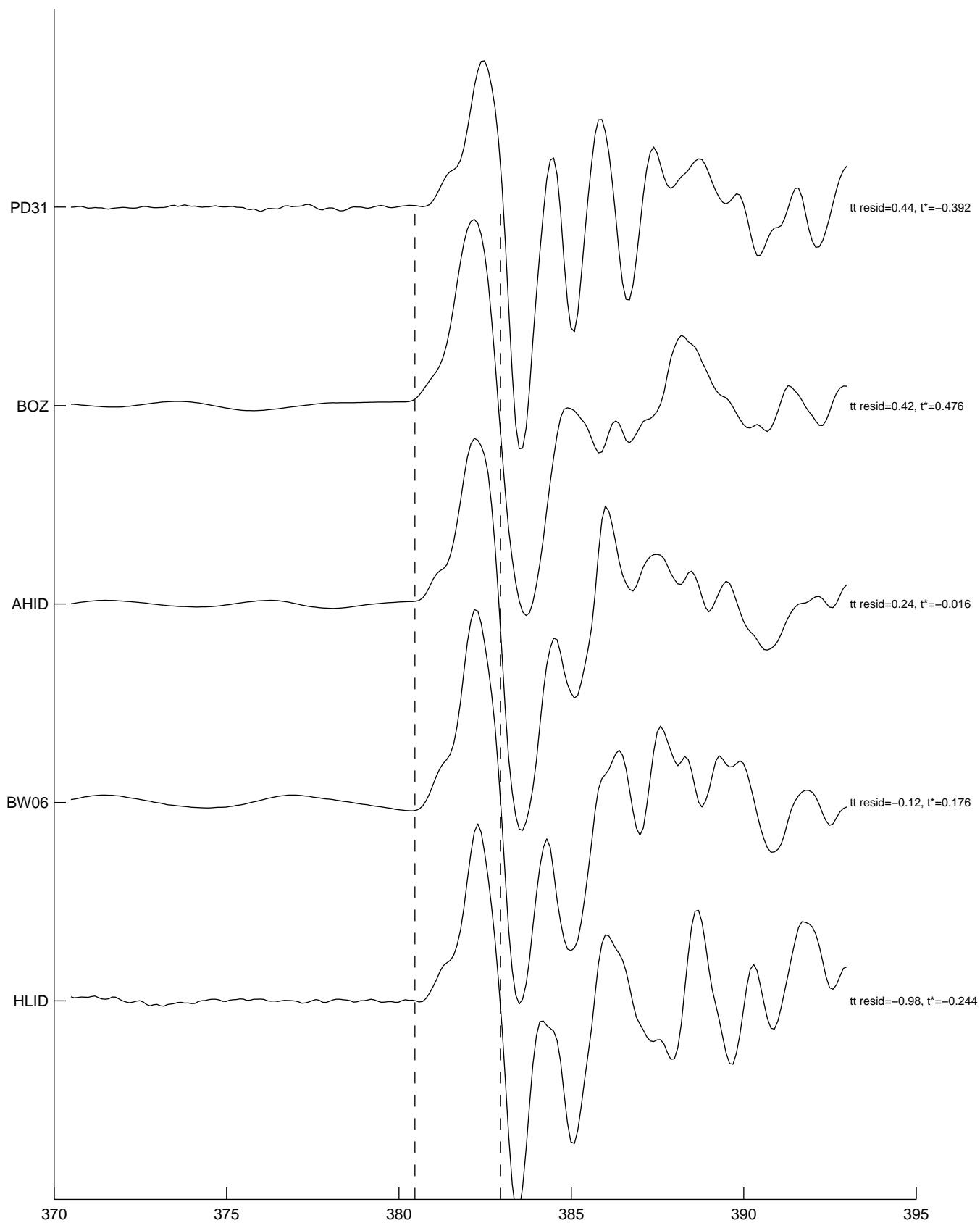
Event\_2001\_332\_14\_32\_32



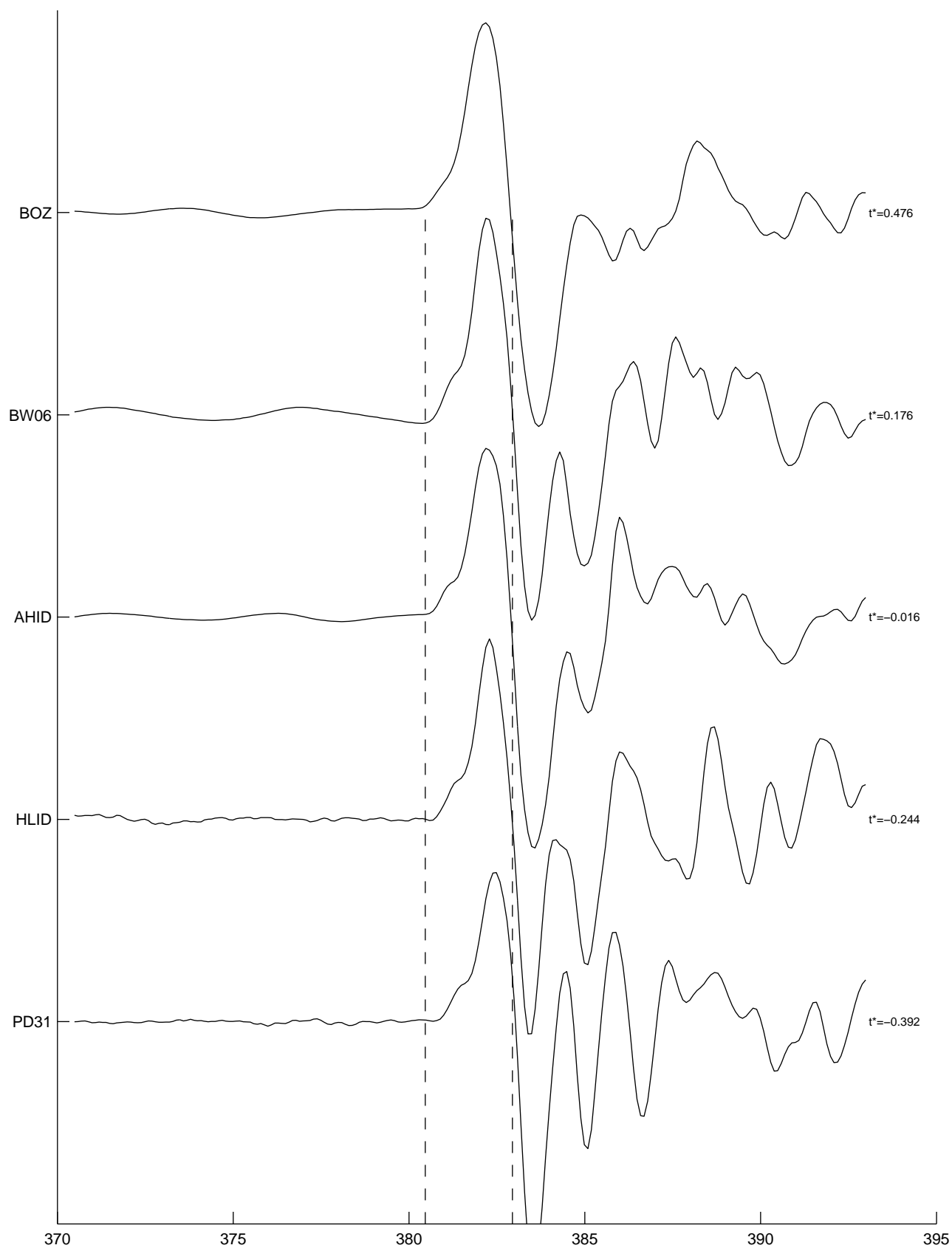
# Sorted by Delta:Event\_2001\_332\_14\_32\_32

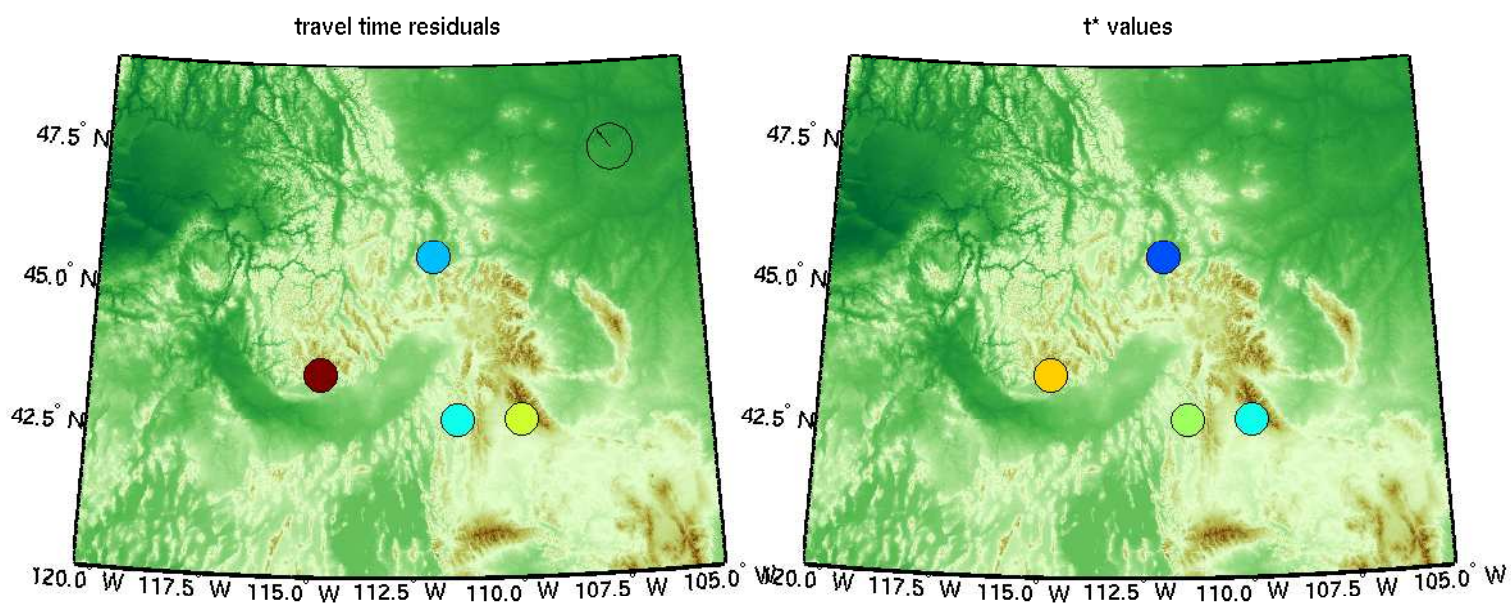
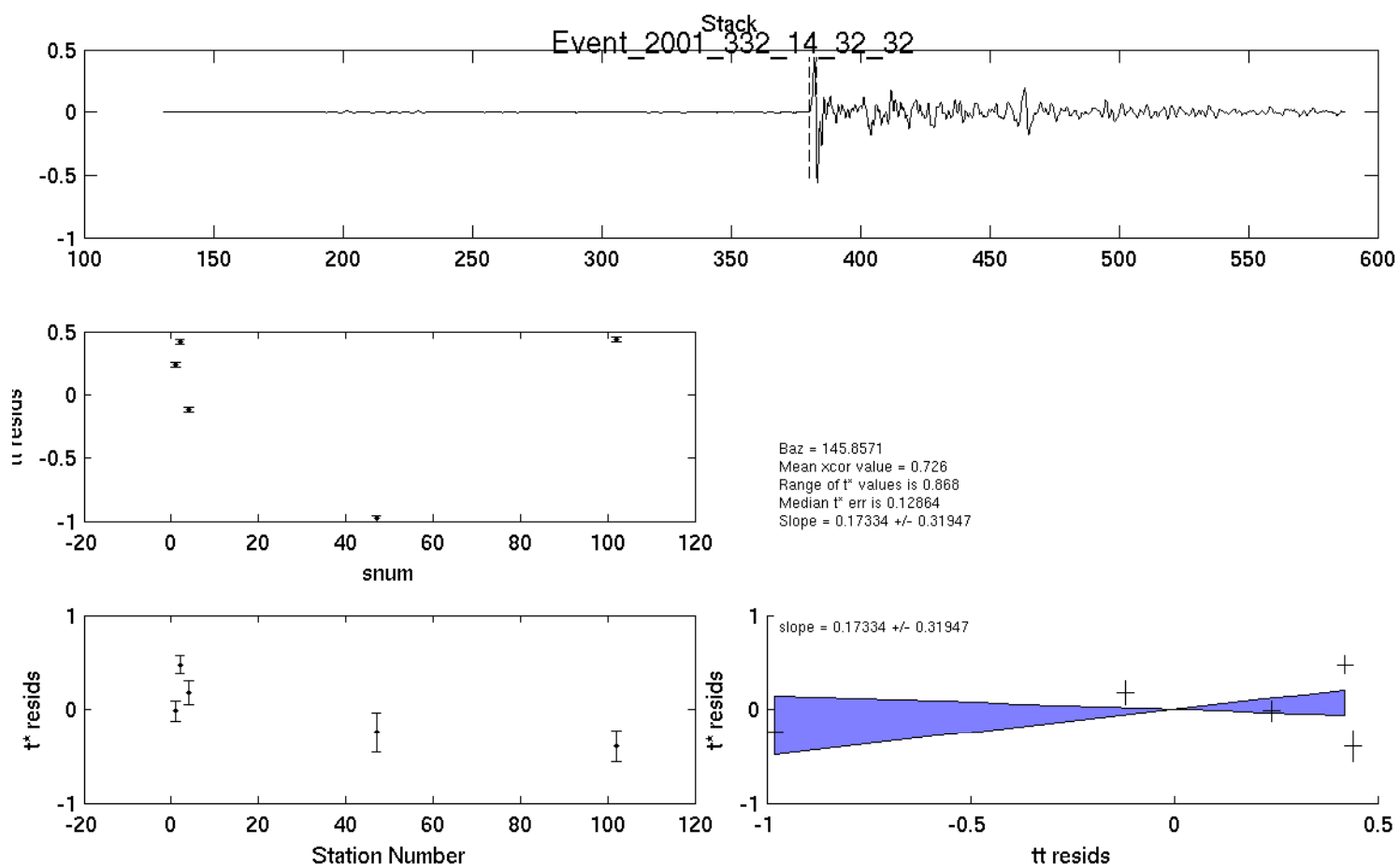


# Sorted by travel time: Event\_2001\_332\_14\_32\_32

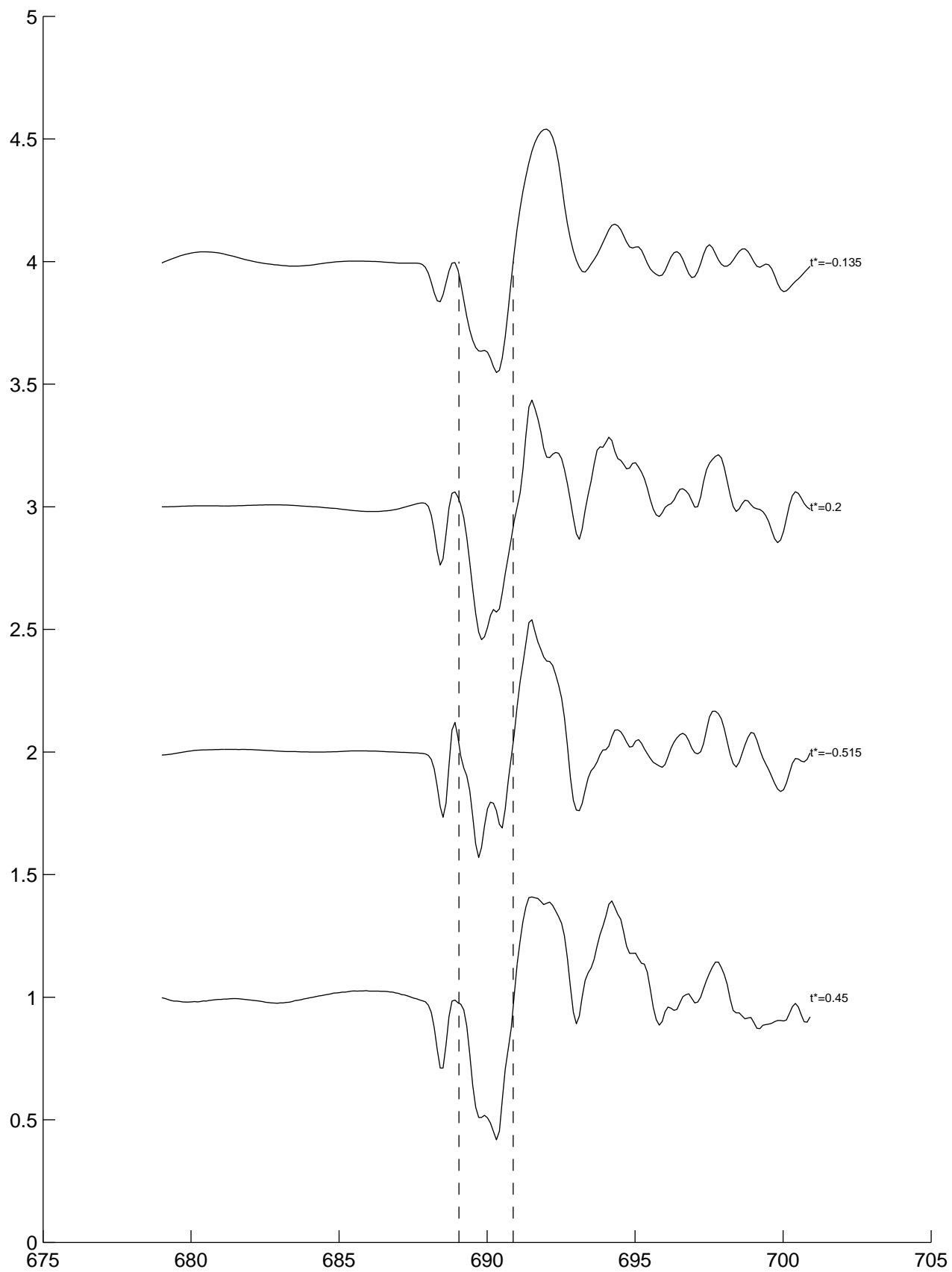


Sorted by  $t^*$ :Event\_2001\_332\_14\_32\_32

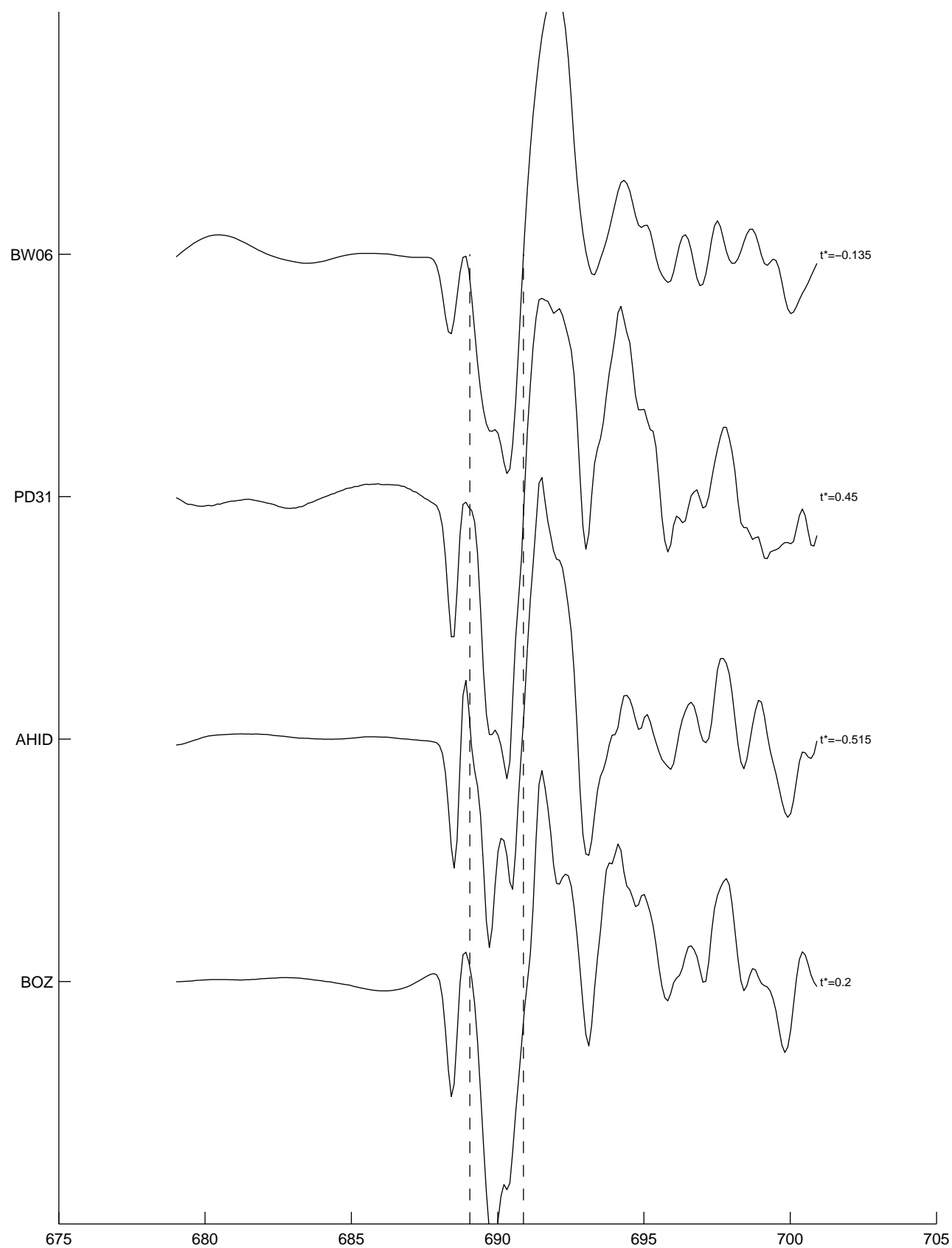




# Event\_2001\_336\_13\_01\_53

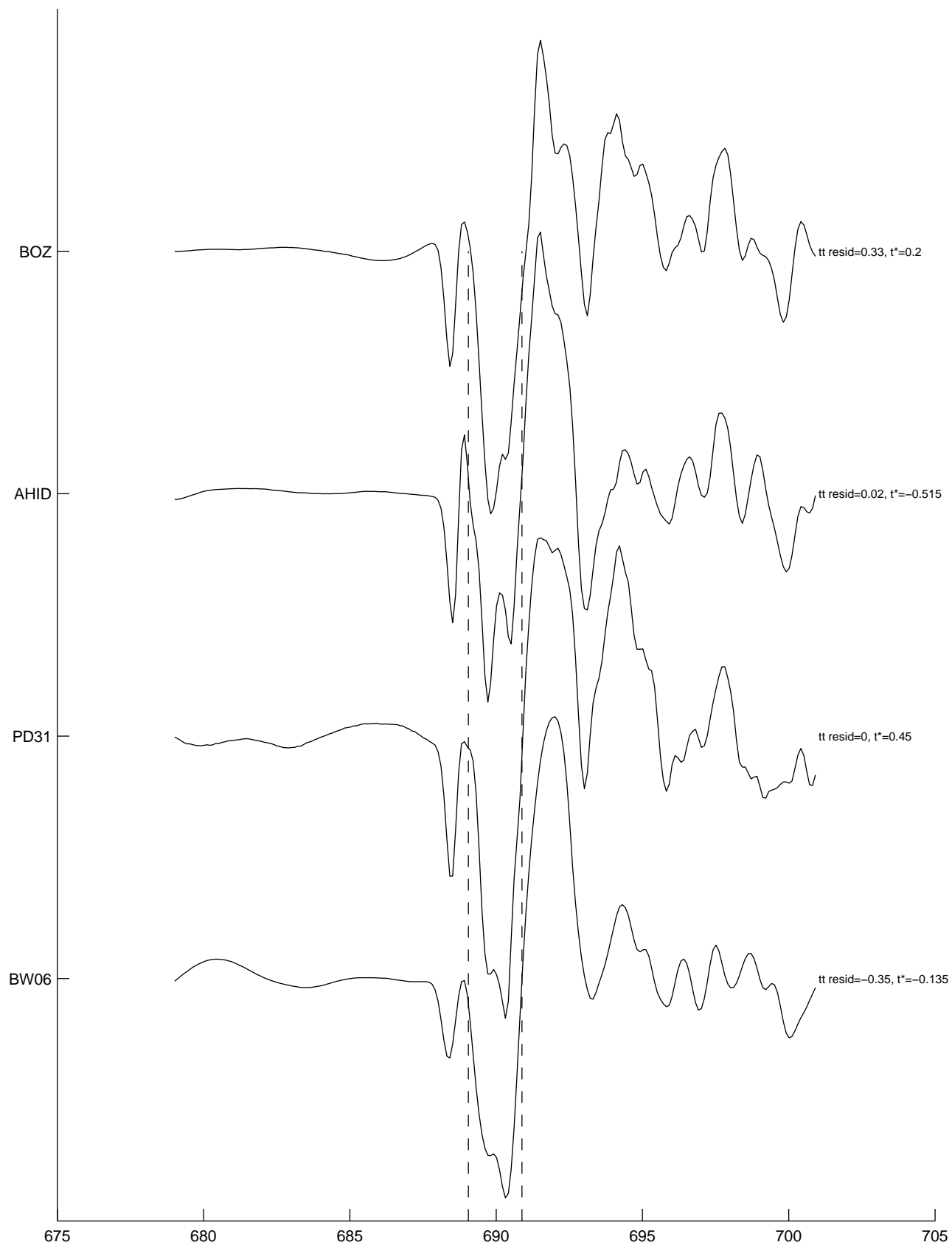


# Sorted by Delta:Event\_2001\_336\_13\_01\_53

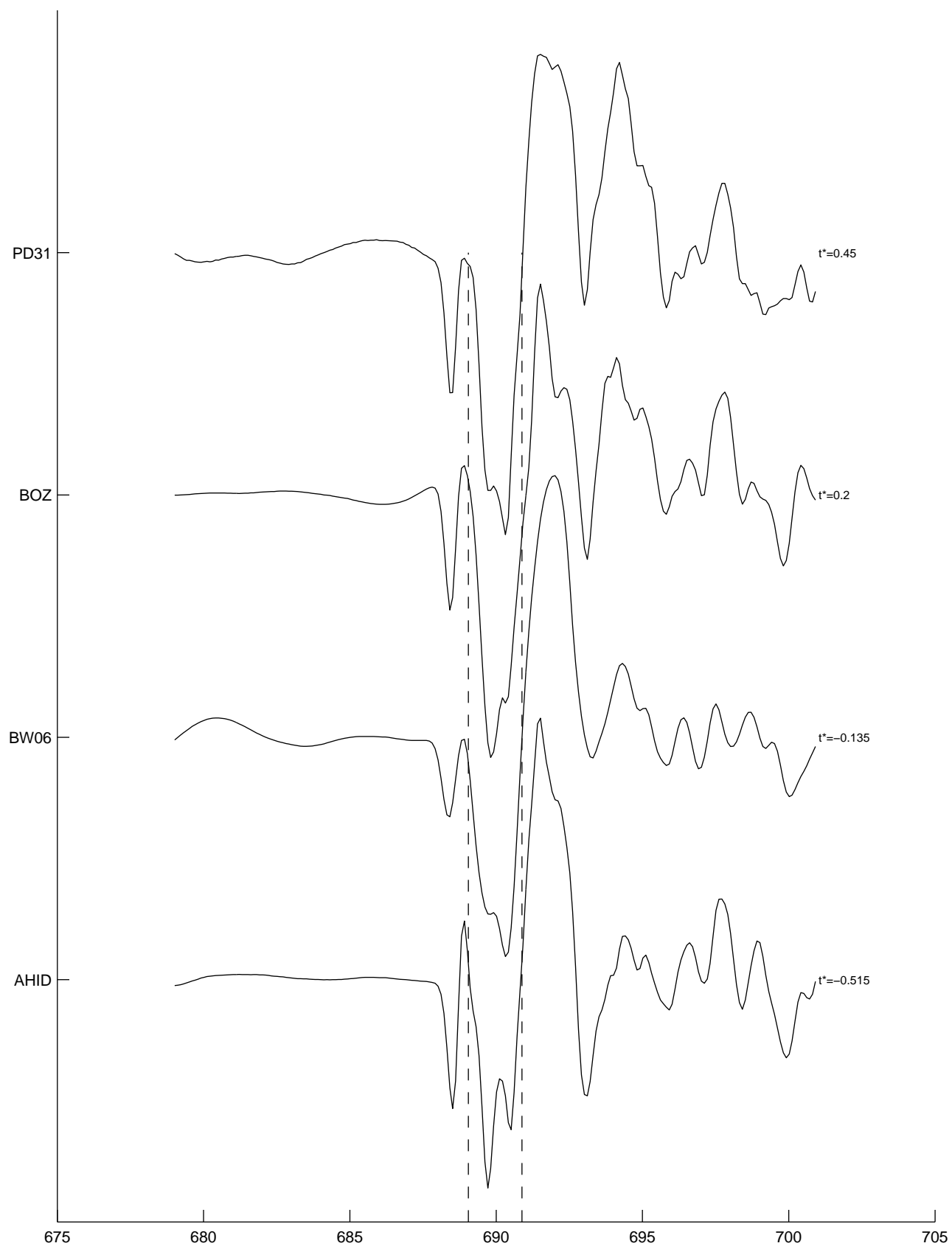


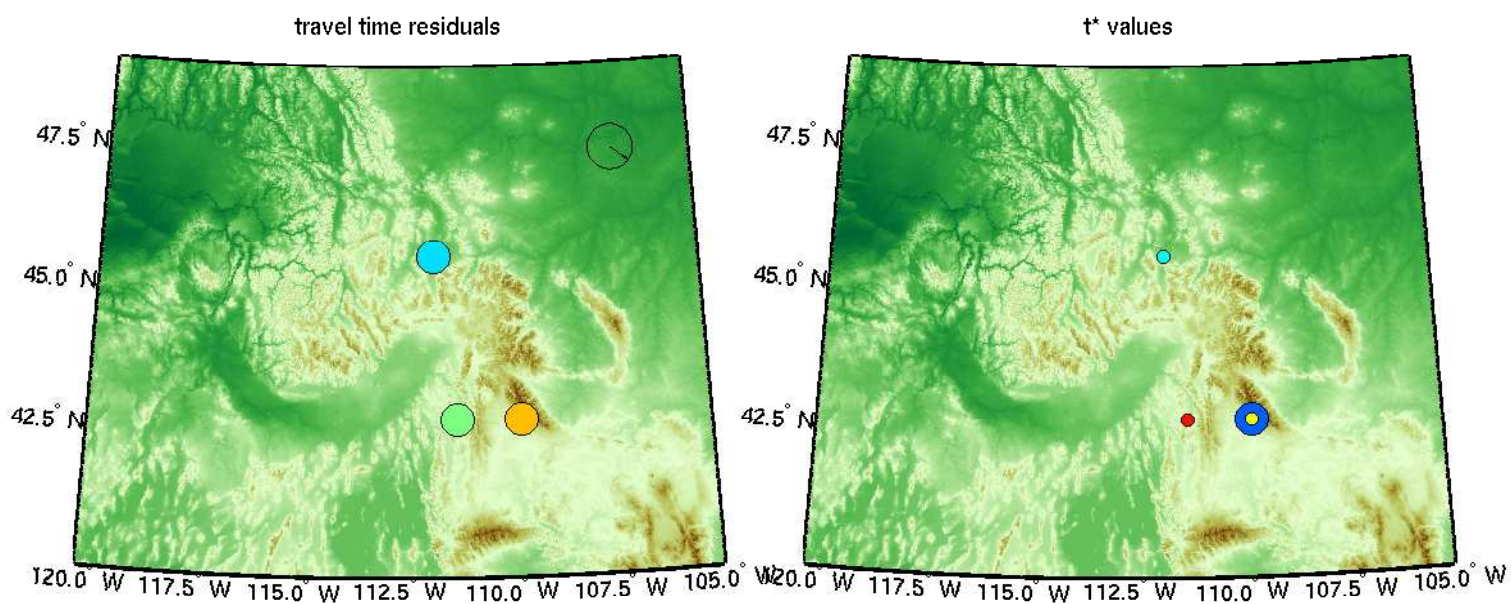
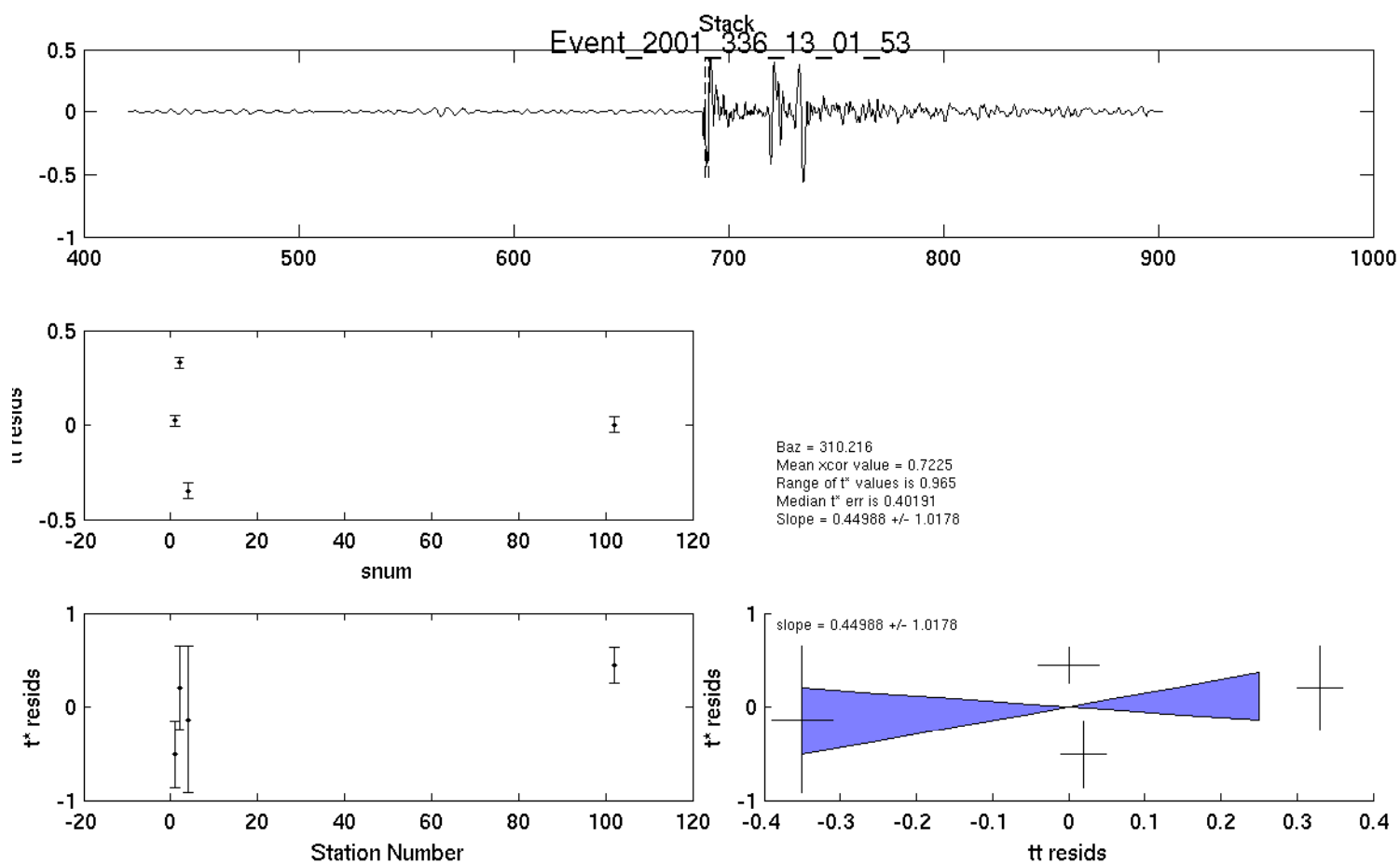


Sorted by travel time: Event\_2001\_336\_13\_01\_53

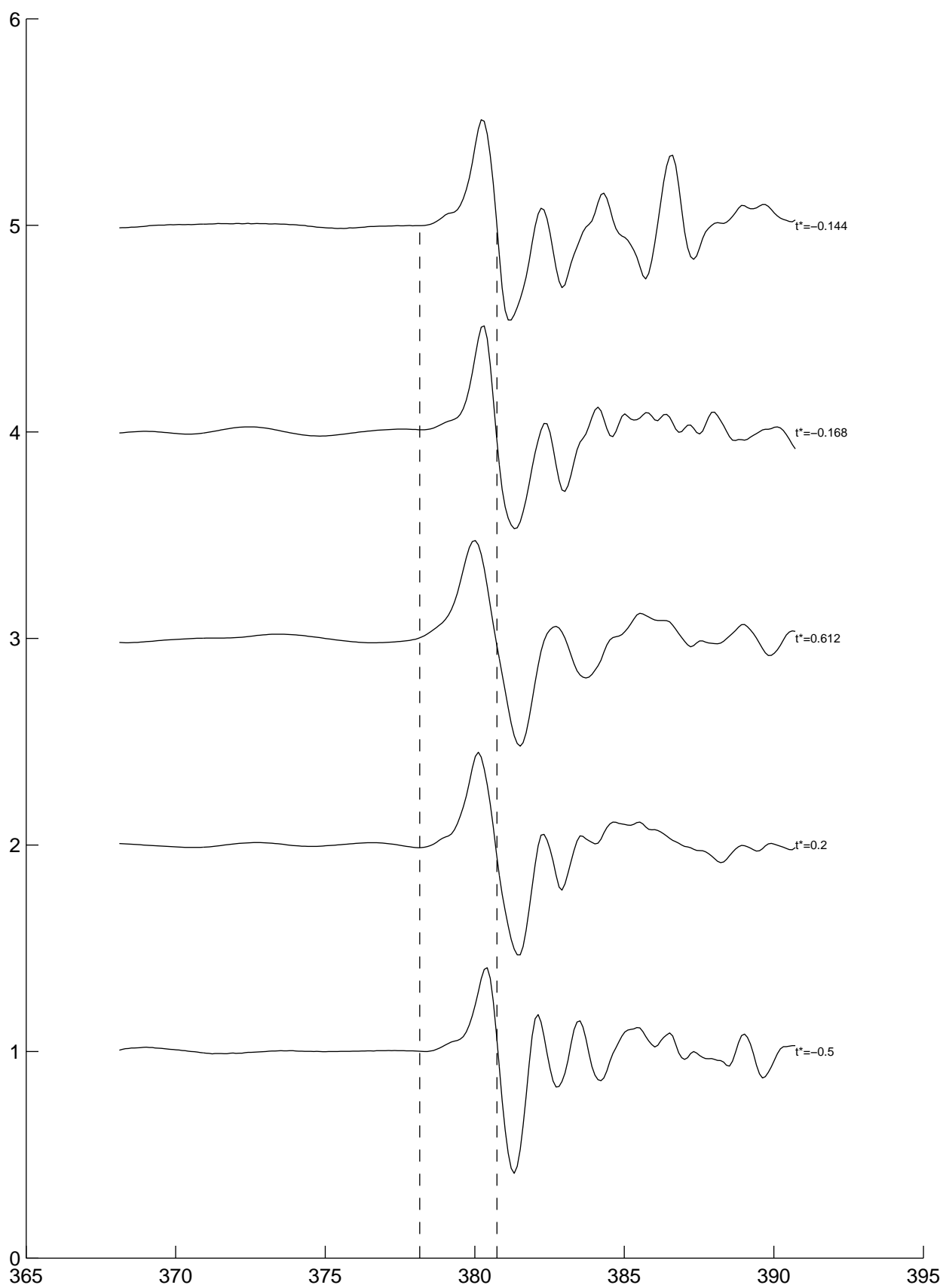


Sorted by  $t^*$ :Event\_2001\_336\_13\_01\_53

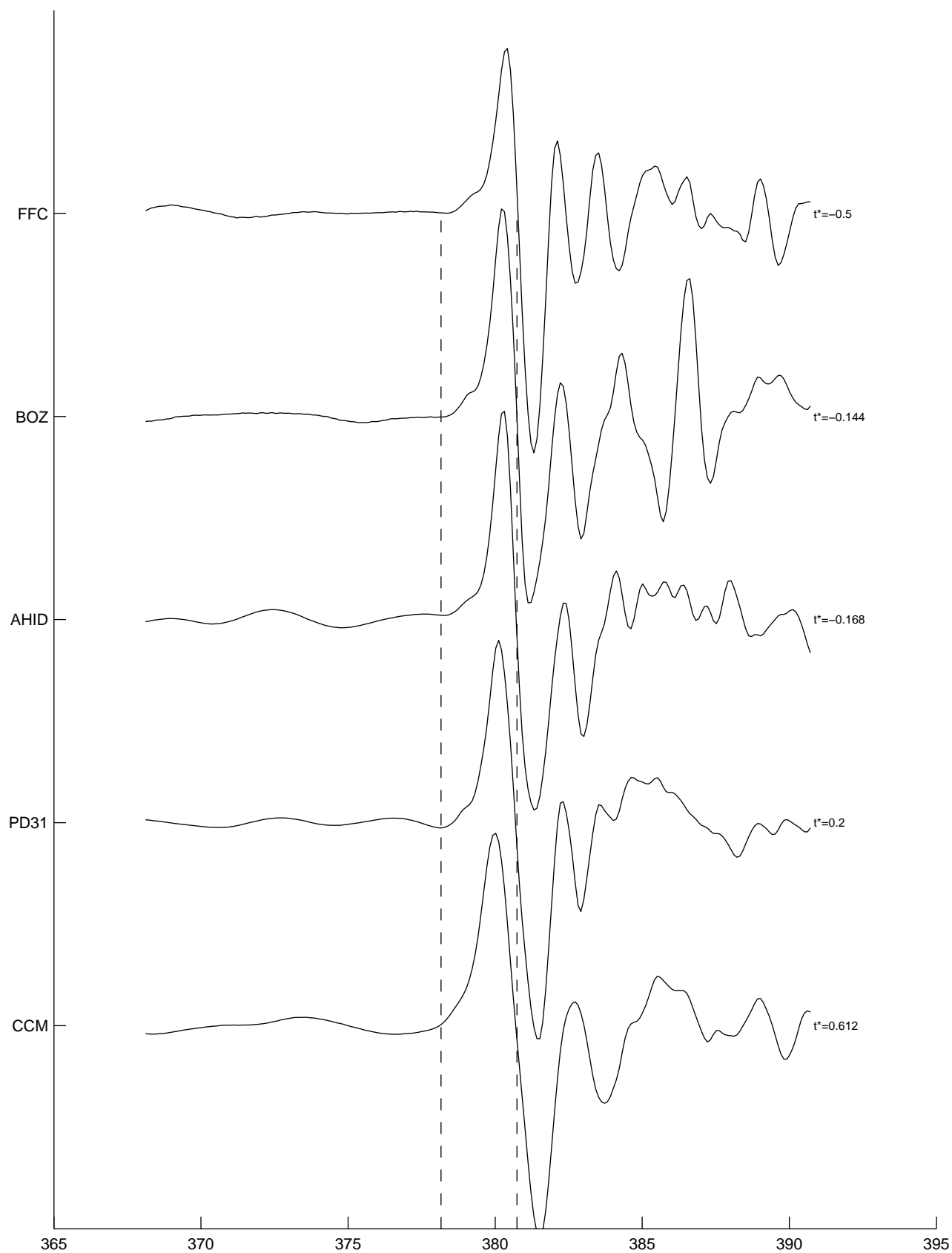




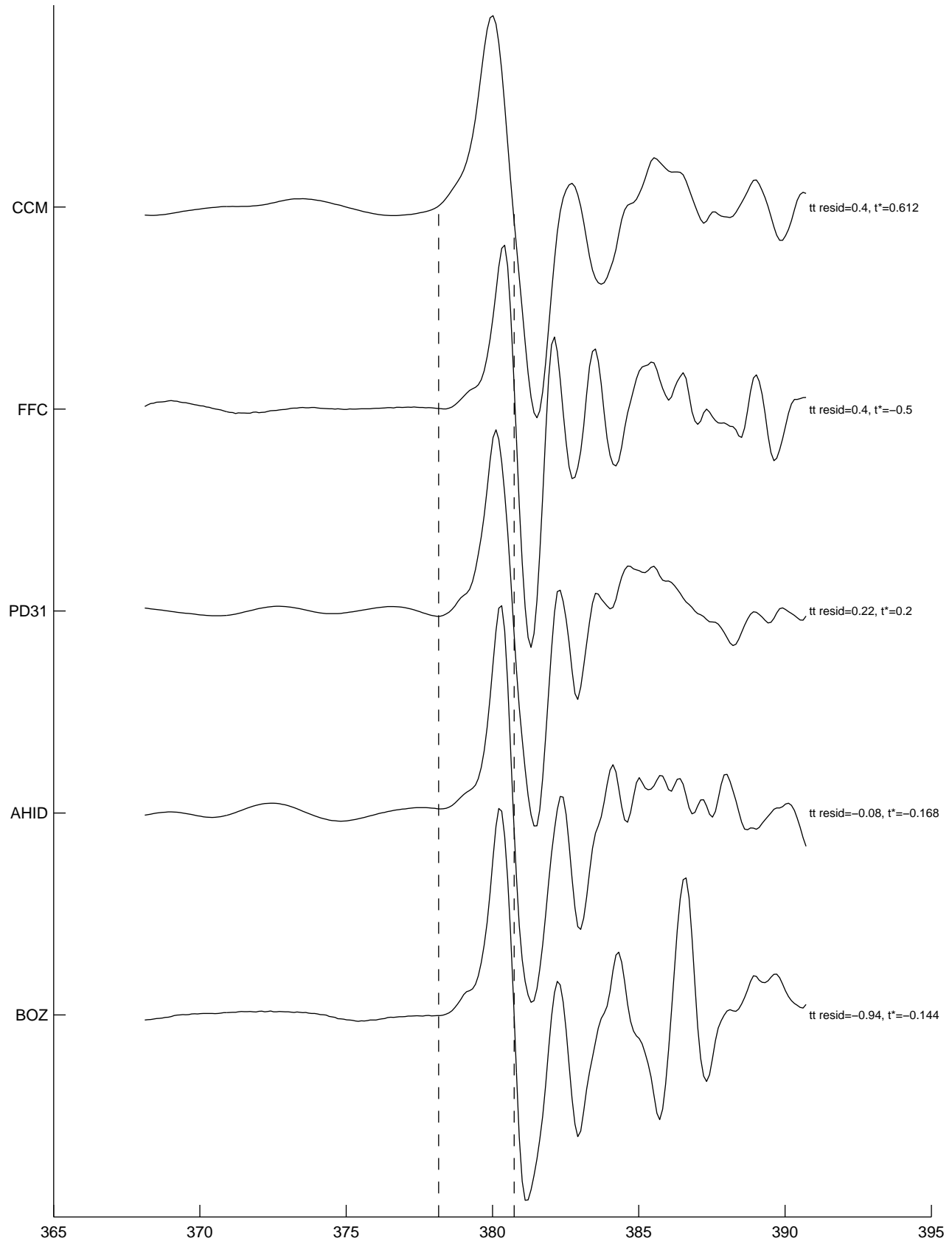
# Event\_2002\_016\_23\_09\_52



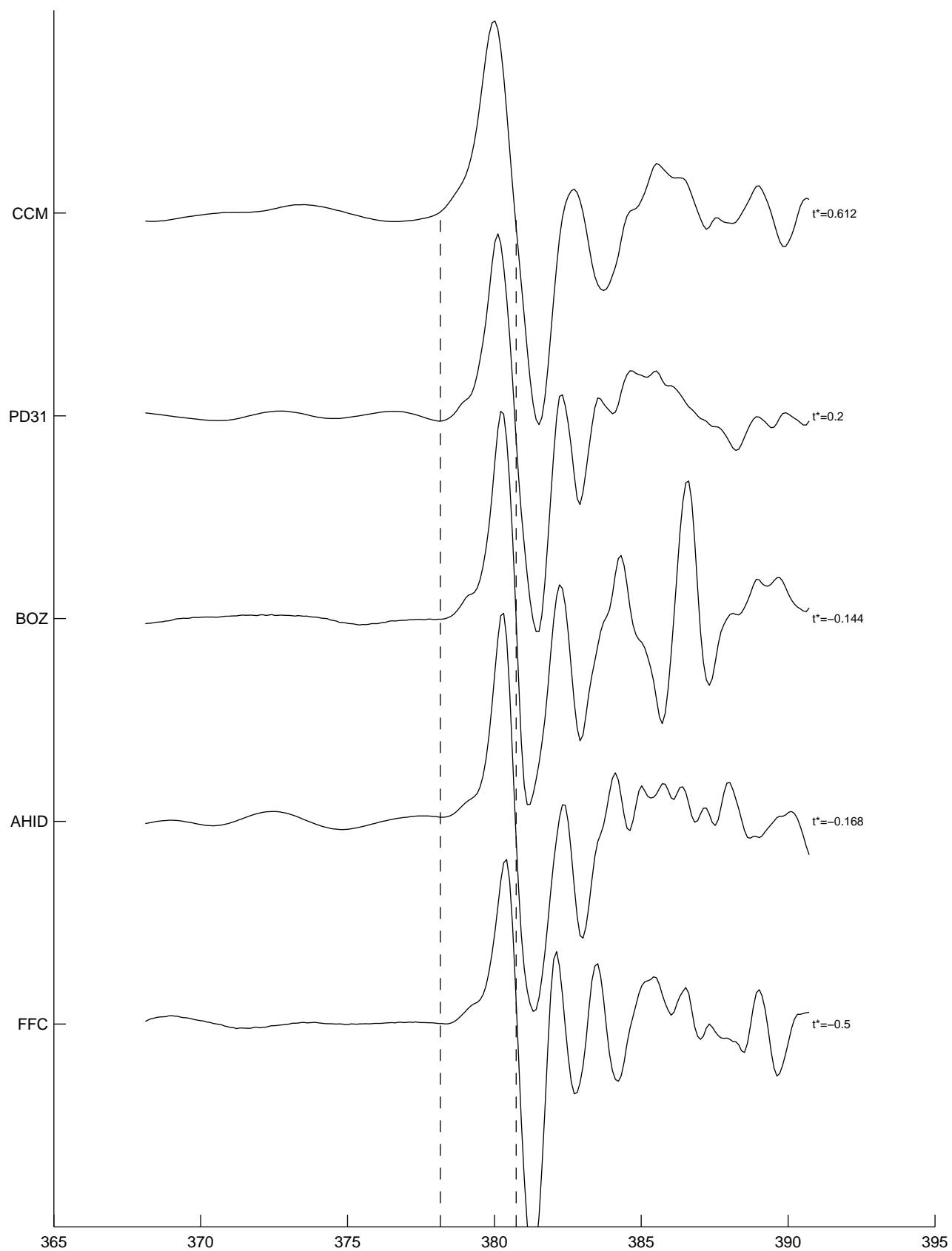
Sorted by Delta:Event\_2002\_016\_23\_09\_52



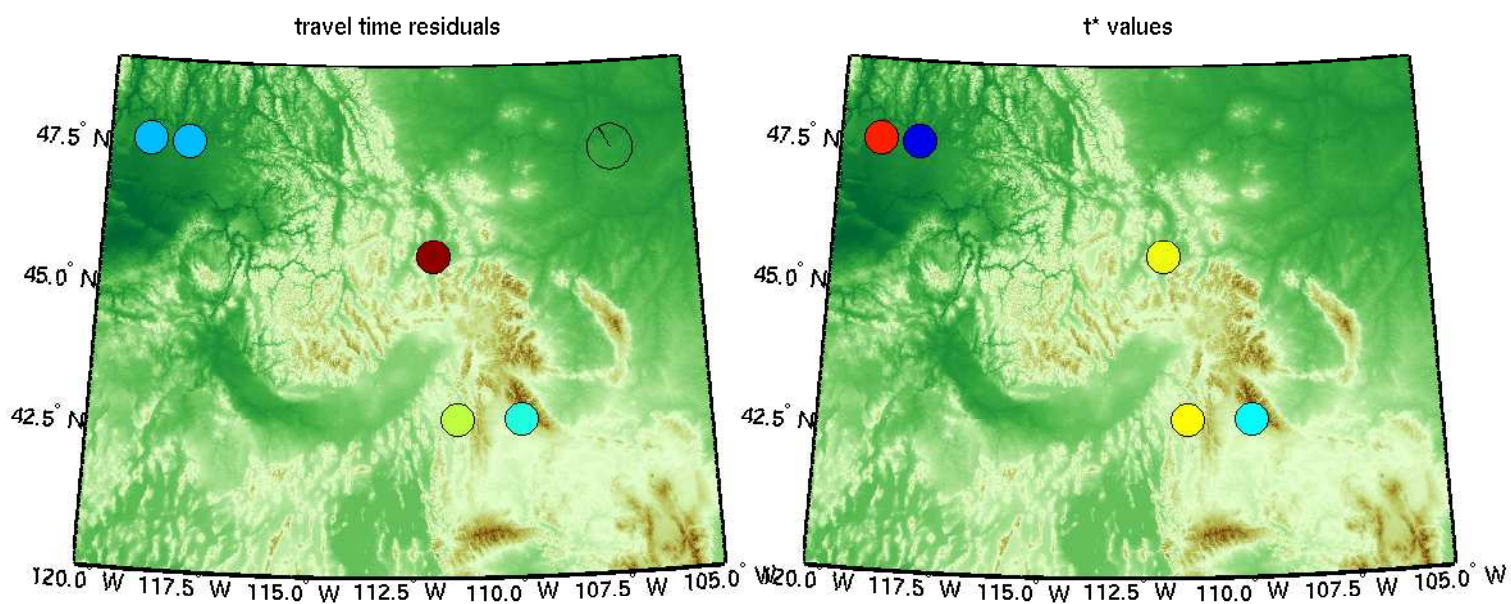
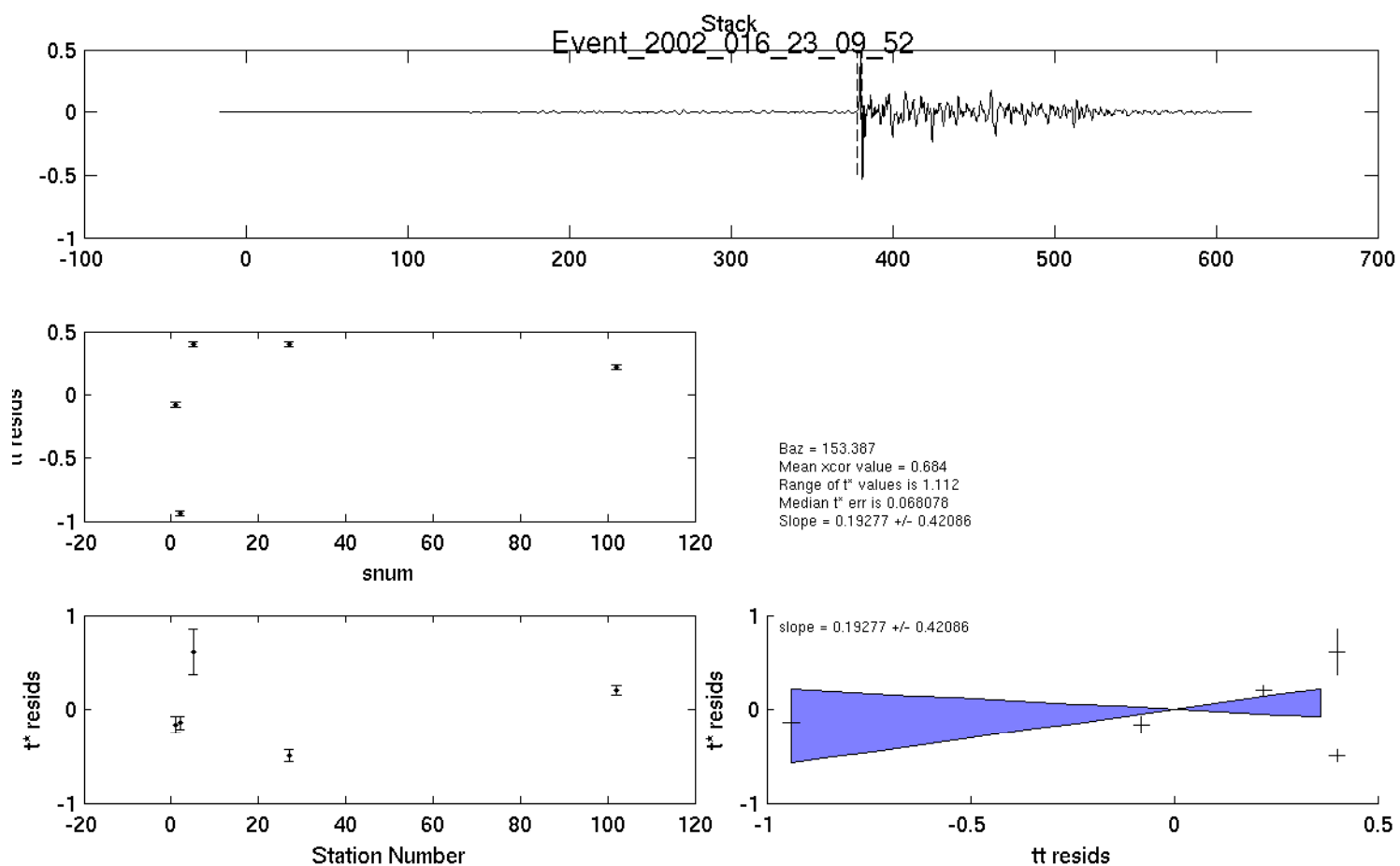
# Sorted by travel time: Event\_2002\_016\_23\_09\_52



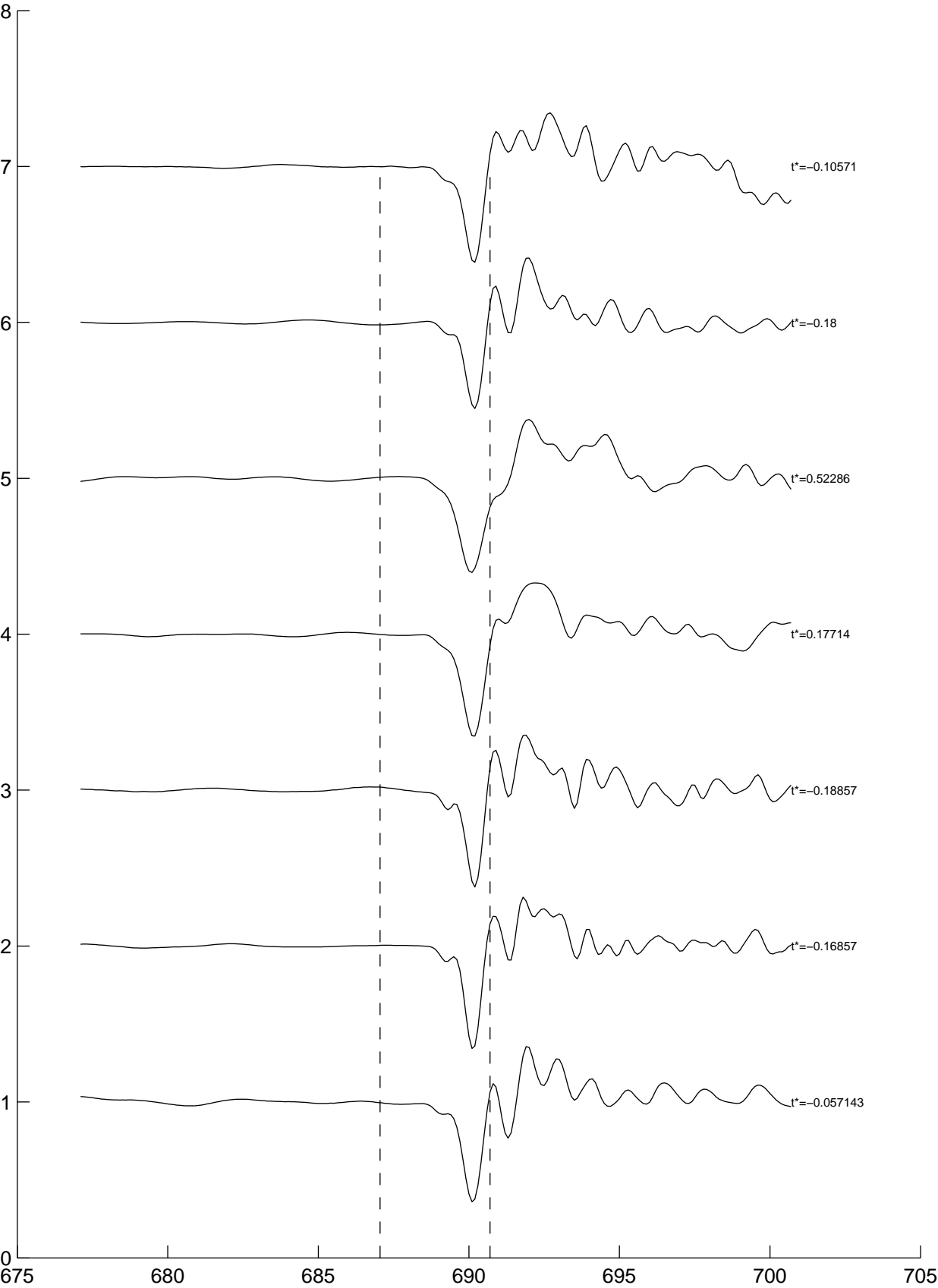
Sorted by  $t^*$ :Event\_2002\_016\_23\_09\_52



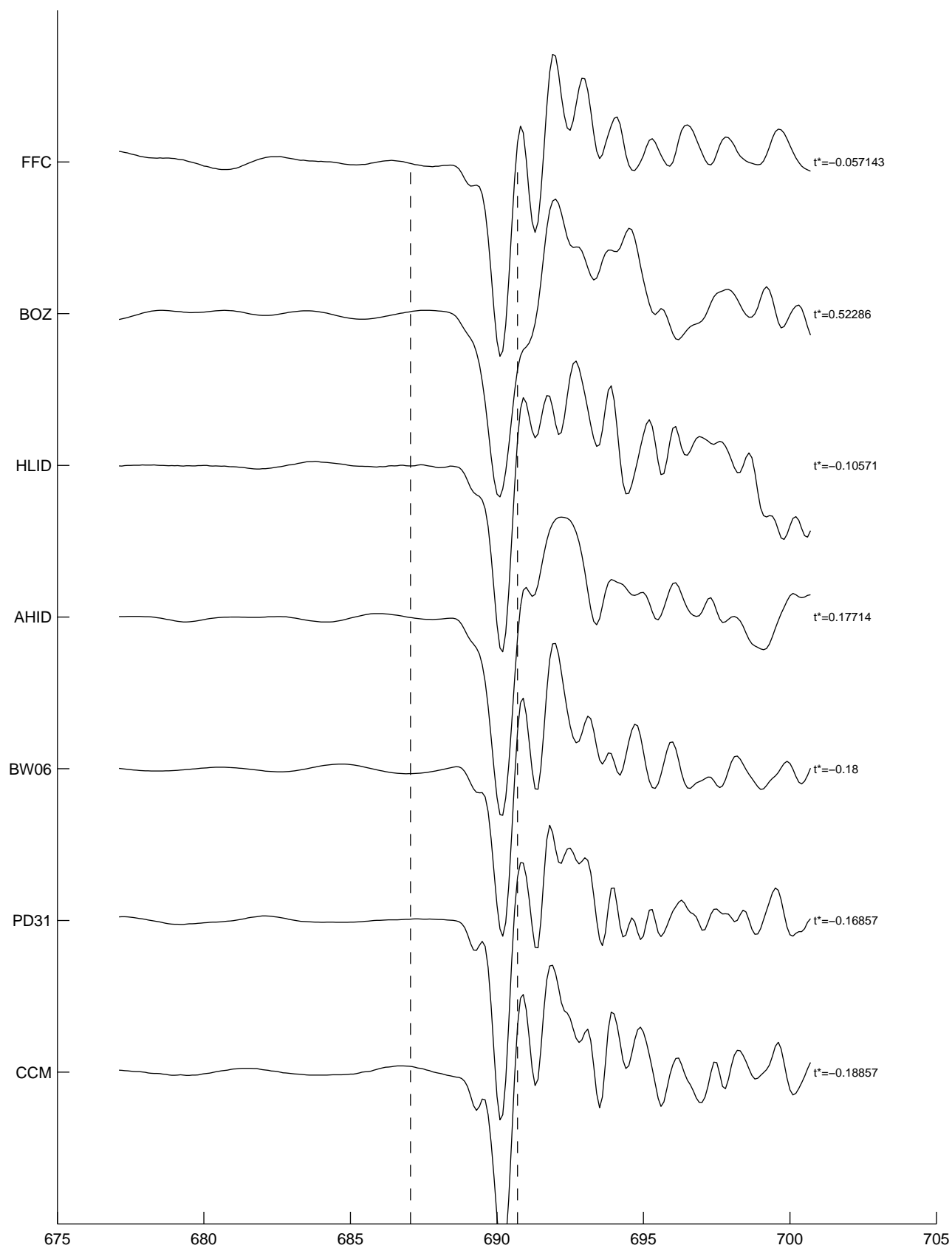




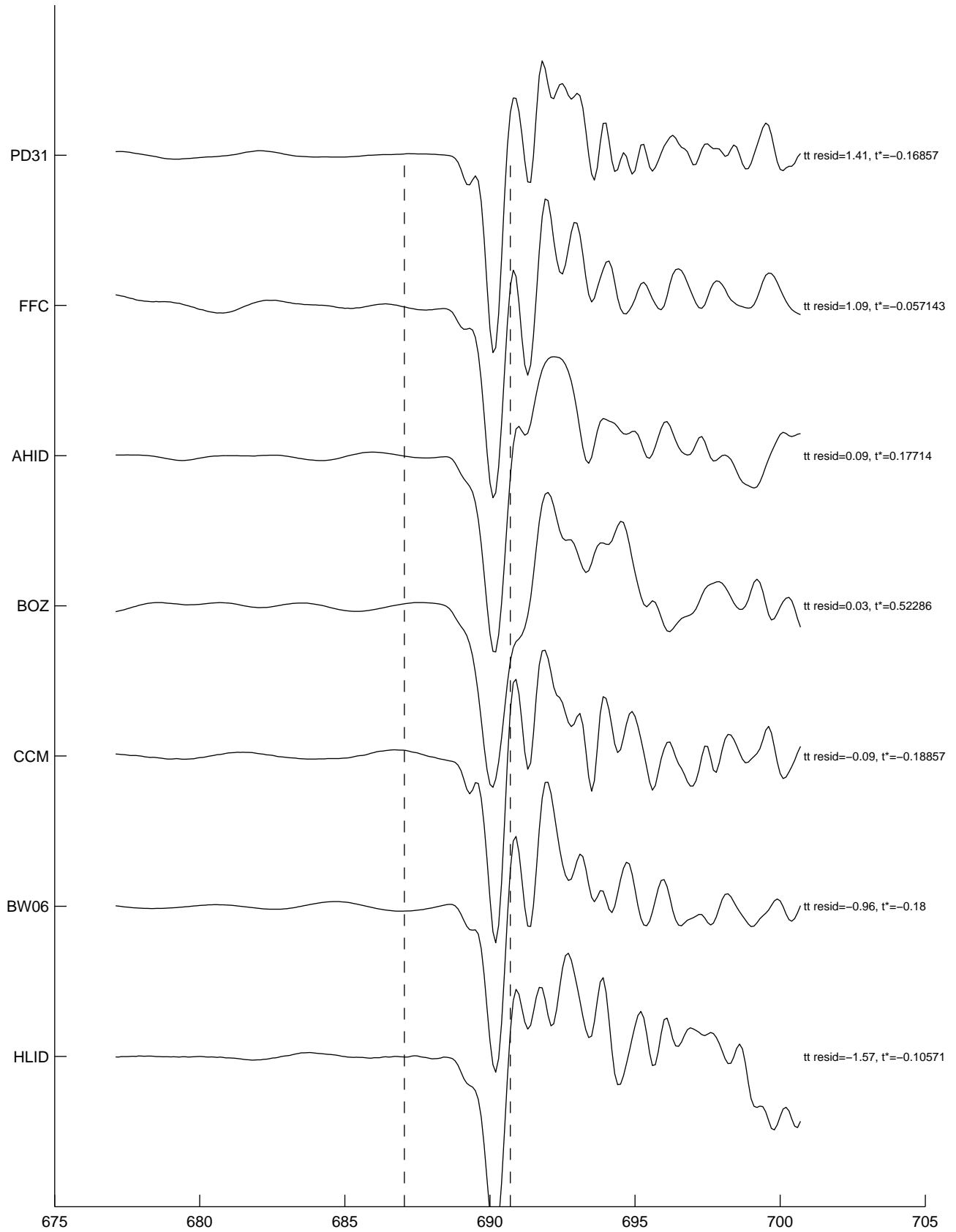
Event\_2002\_087\_04\_56\_22



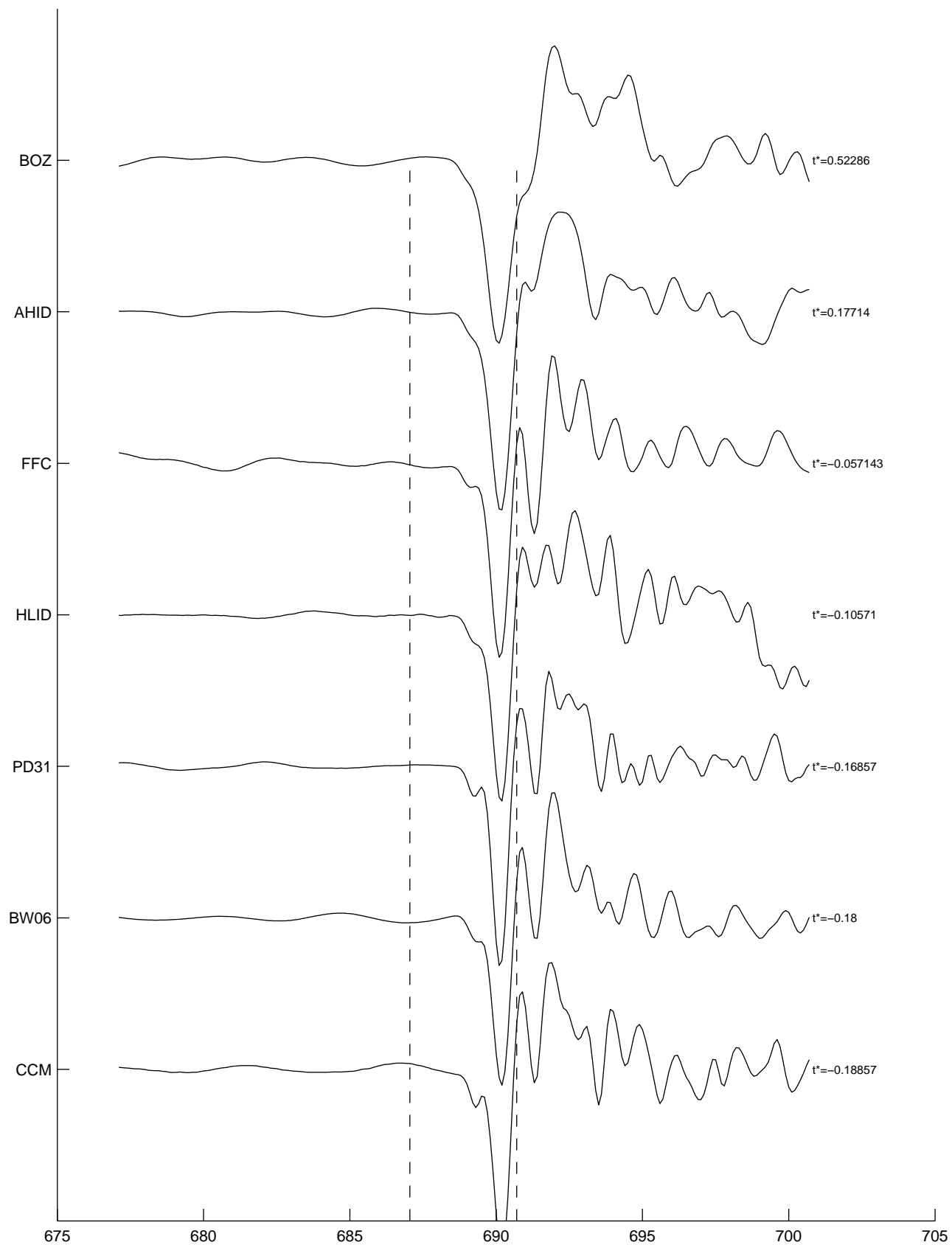
Sorted by Delta:Event\_2002\_087\_04\_56\_22



# Sorted by travel time: Event\_2002\_087\_04\_56\_22

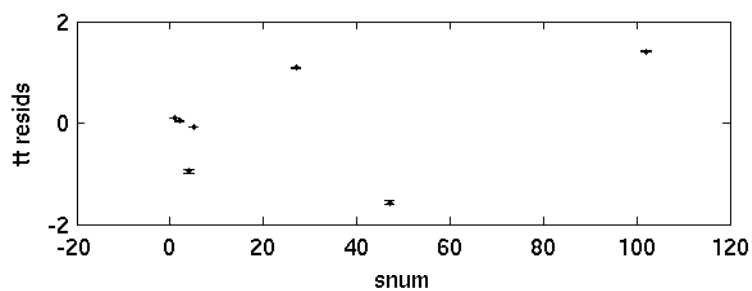
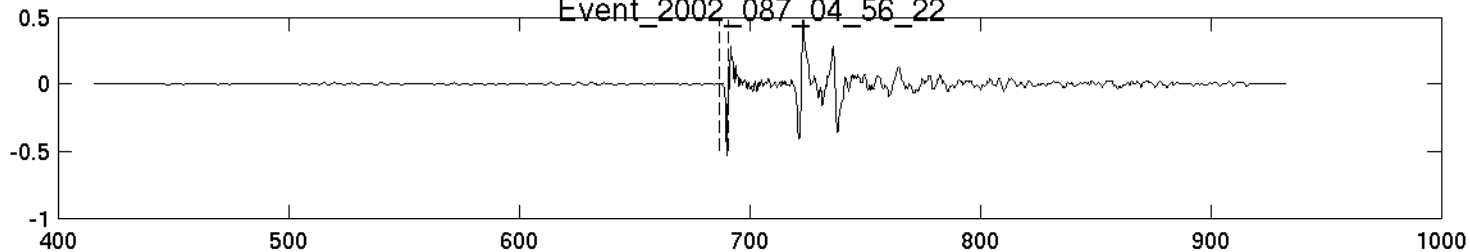


Sorted by t\*:Event\_2002\_087\_04\_56\_22

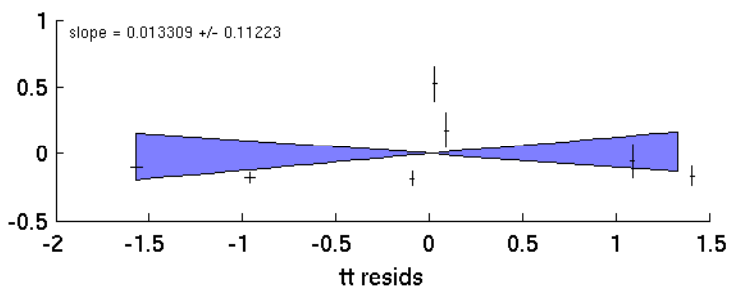
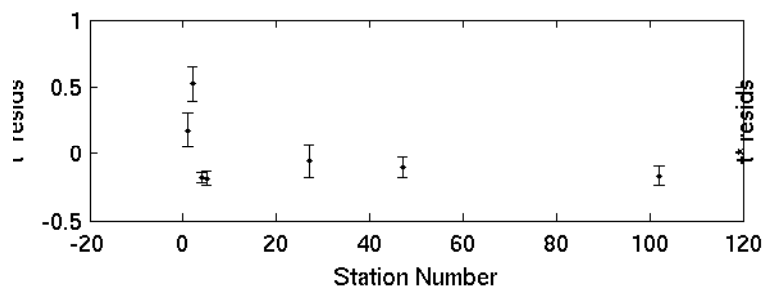


Event\_2002\_087\_04\_56\_22

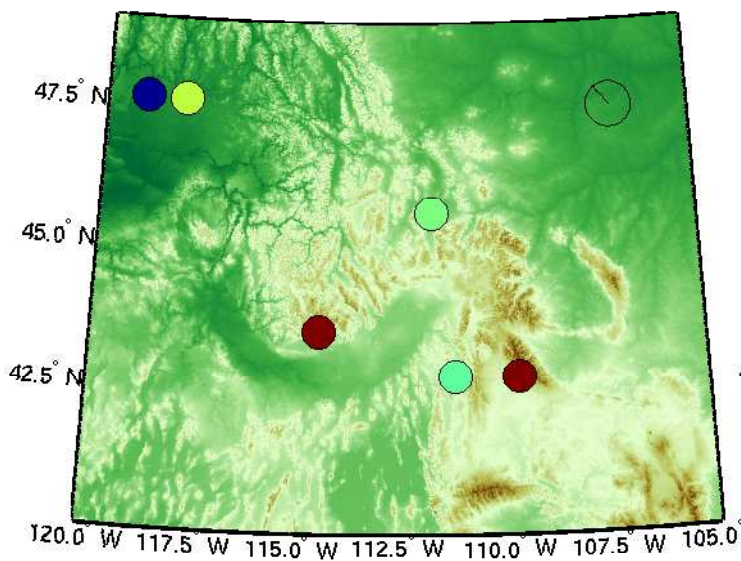
Stack



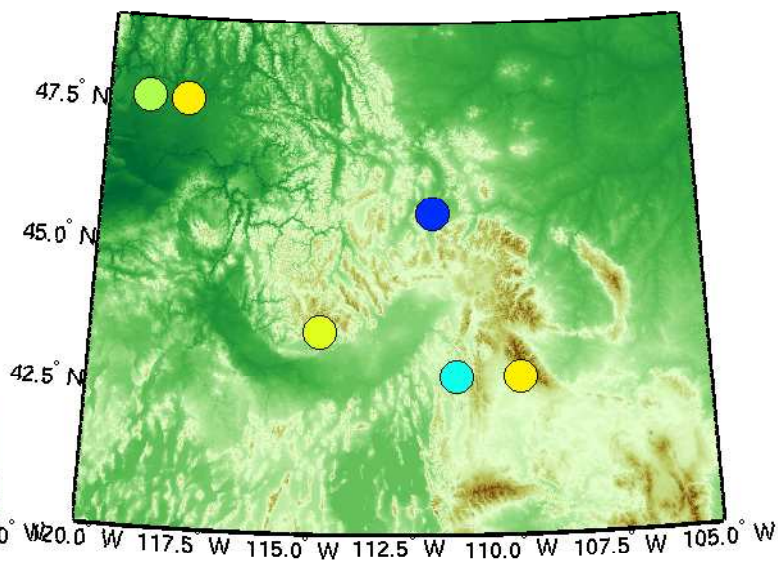
Baz = 142.6945  
Mean xcor value = 0.76286  
Range of  $t^*$  values is 0.71143  
Median  $t^*$  err is 0.074877  
Slope = 0.013309 +/- 0.11223



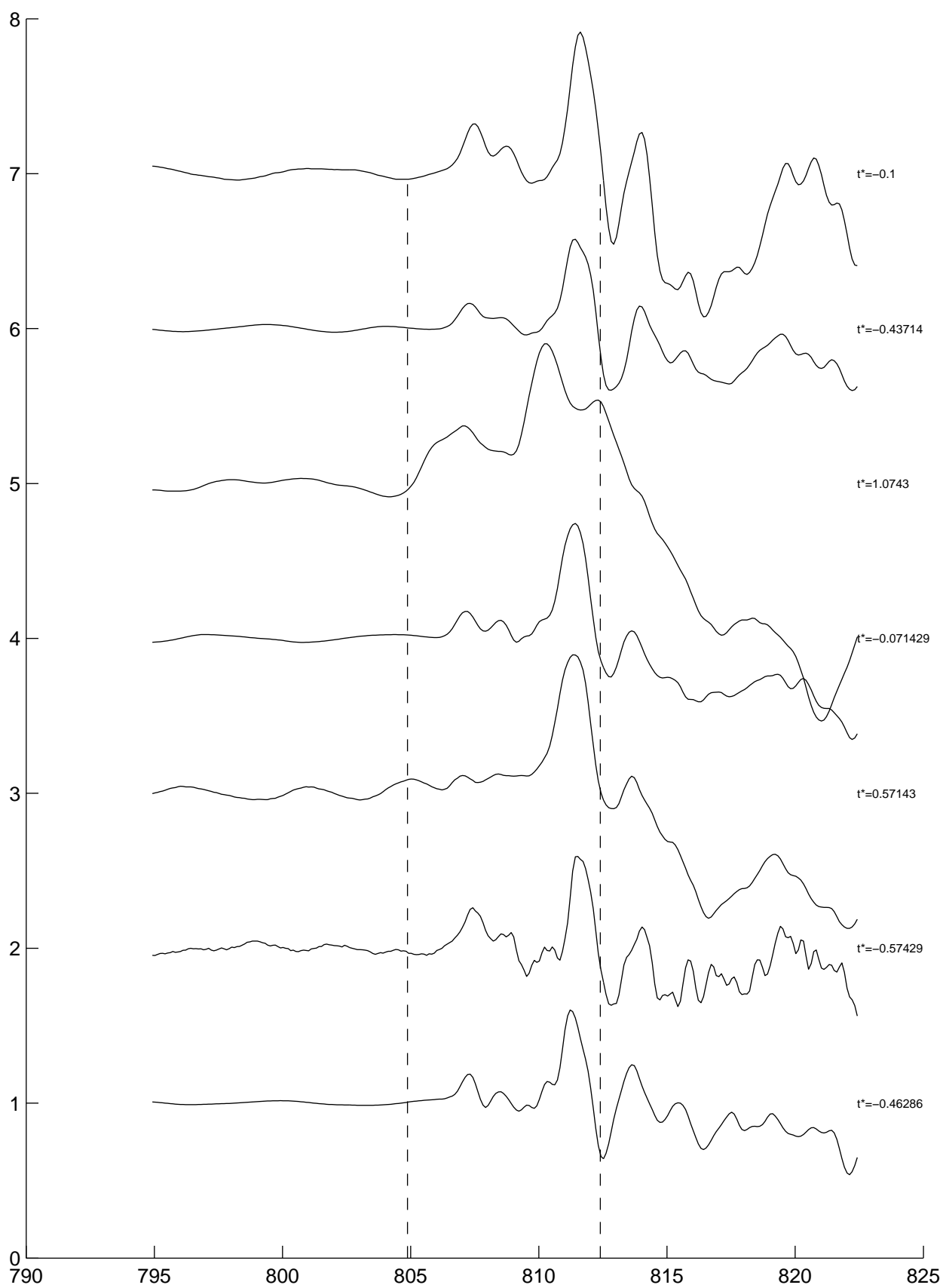
travel time residuals



$t^*$  values

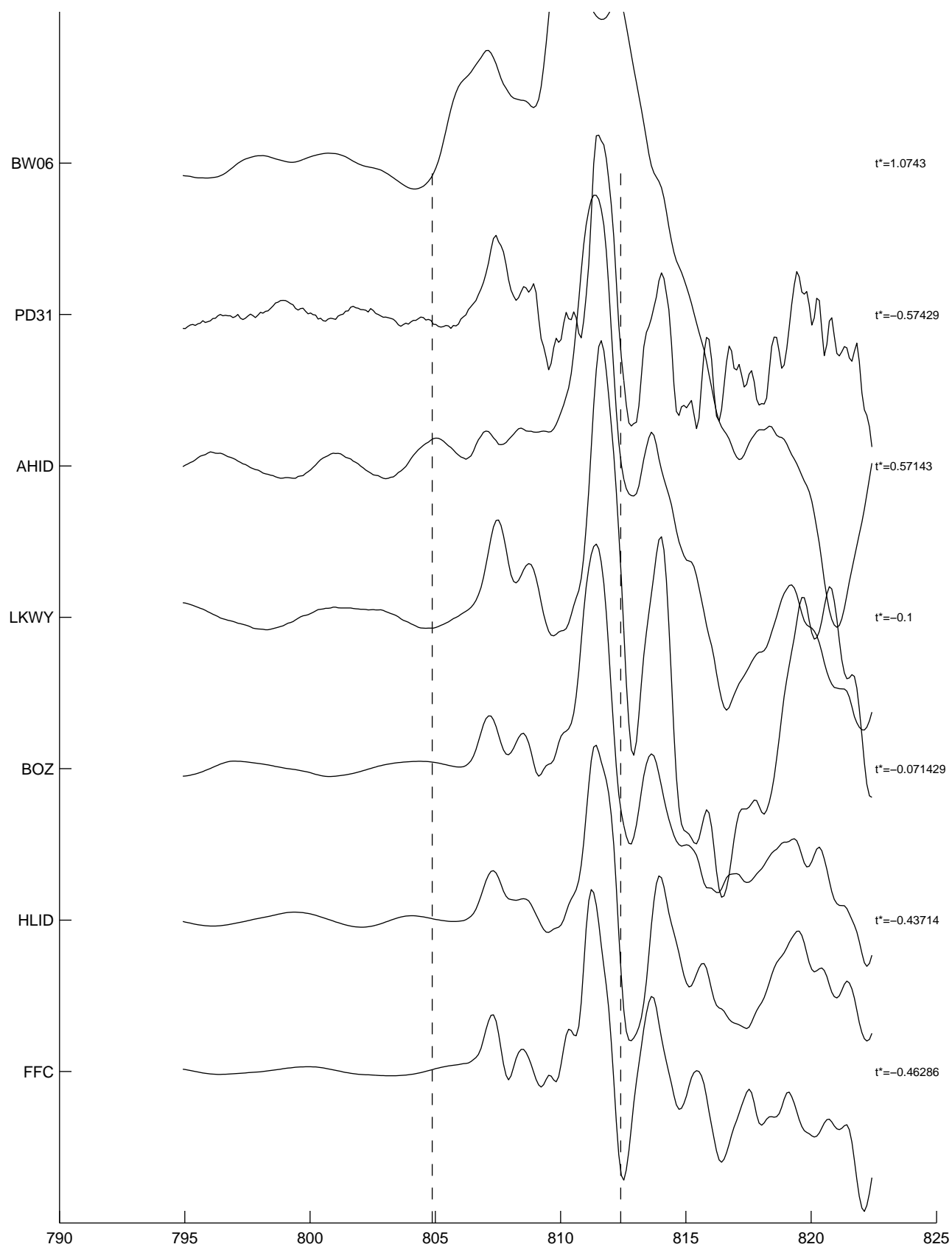


# Event\_2002\_090\_06\_52\_50

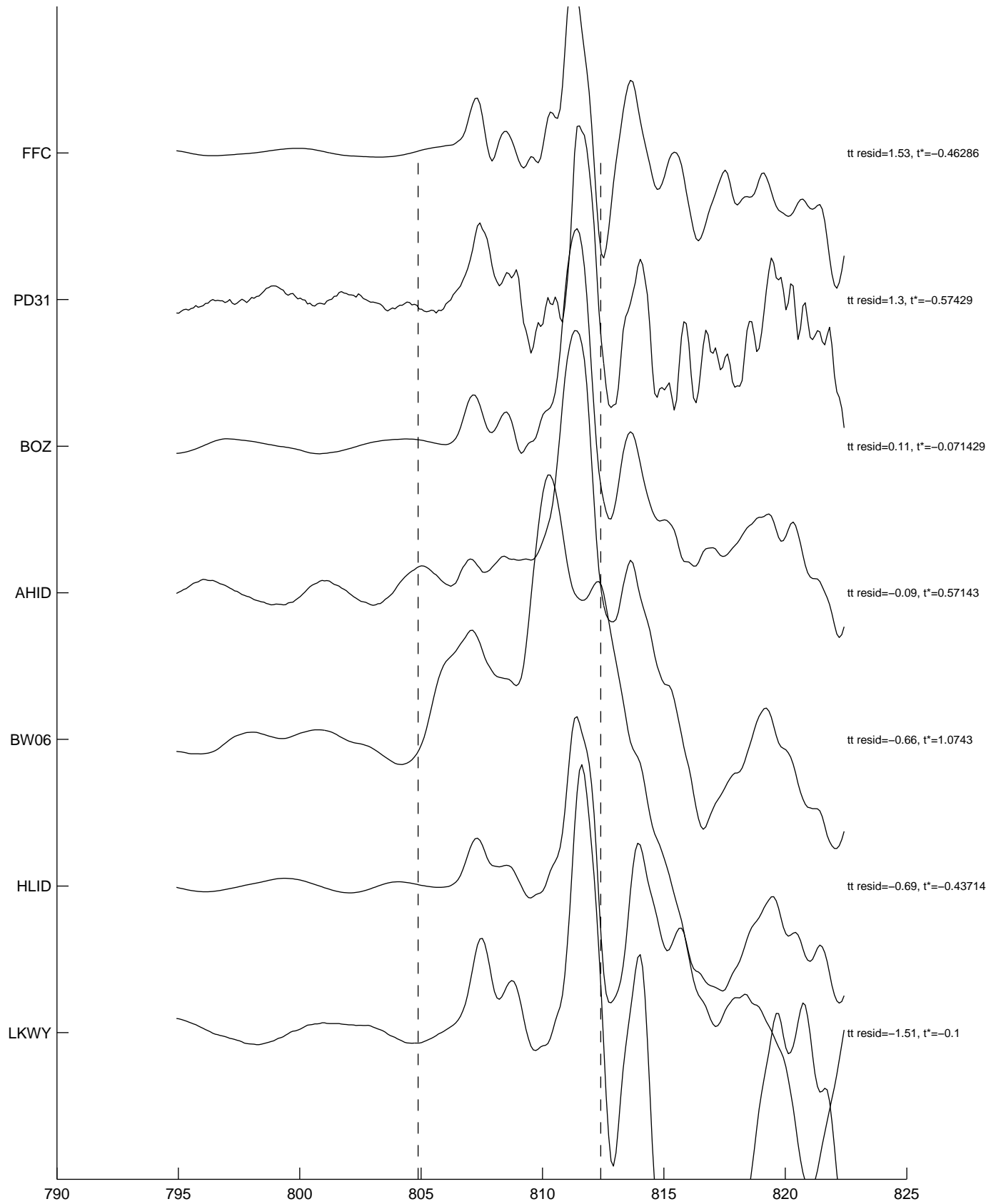




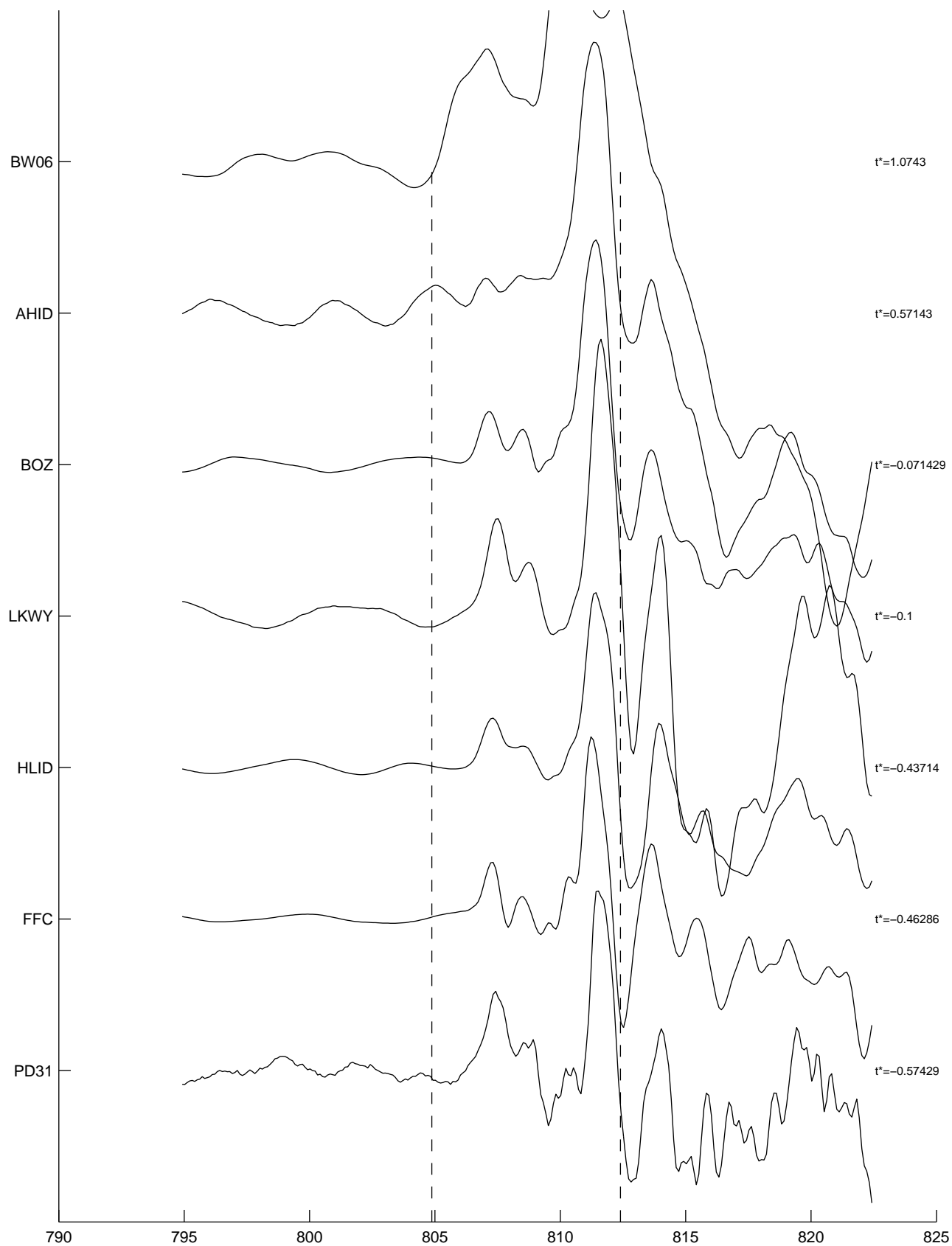
Sorted by Delta:Event\_2002\_090\_06\_52\_50



# Sorted by travel time:Event\_2002\_090\_06\_52\_50

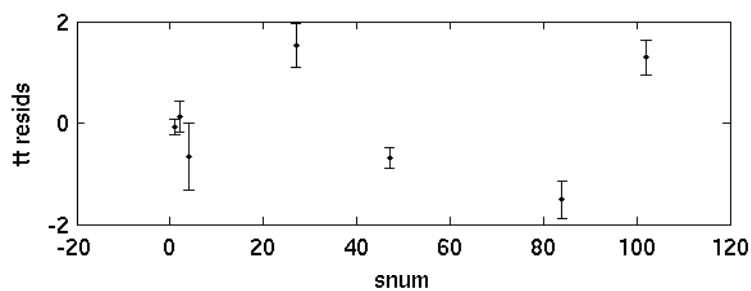
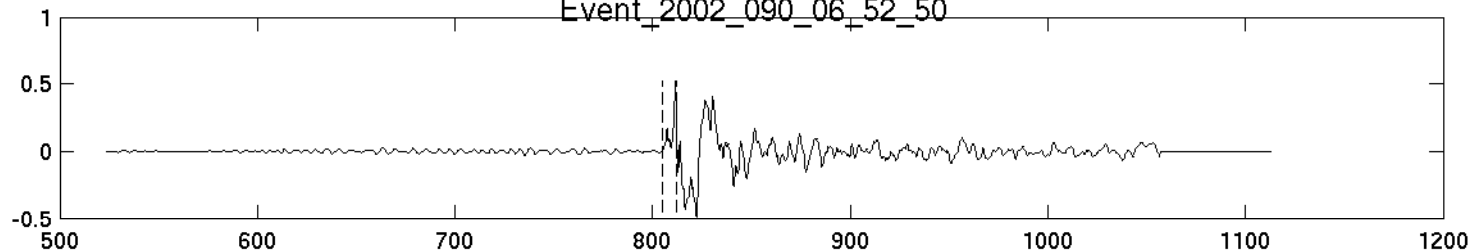


Sorted by  $t^*$ :Event\_2002\_090\_06\_52\_50

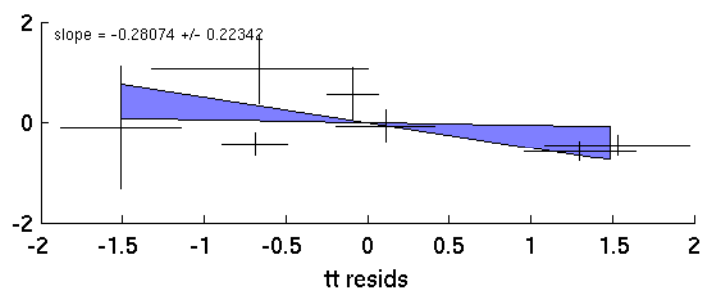
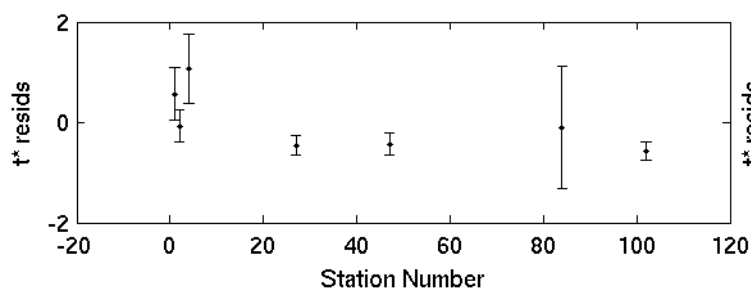


# Event\_2002\_090\_06\_52\_50

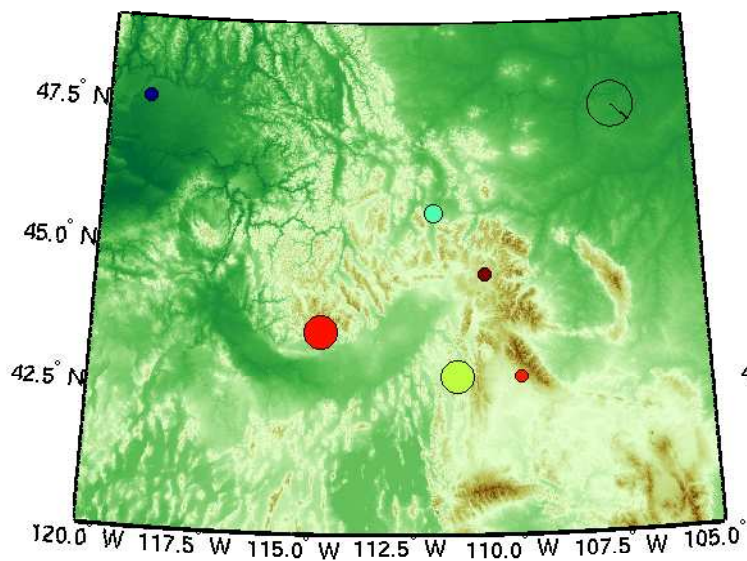
Stack



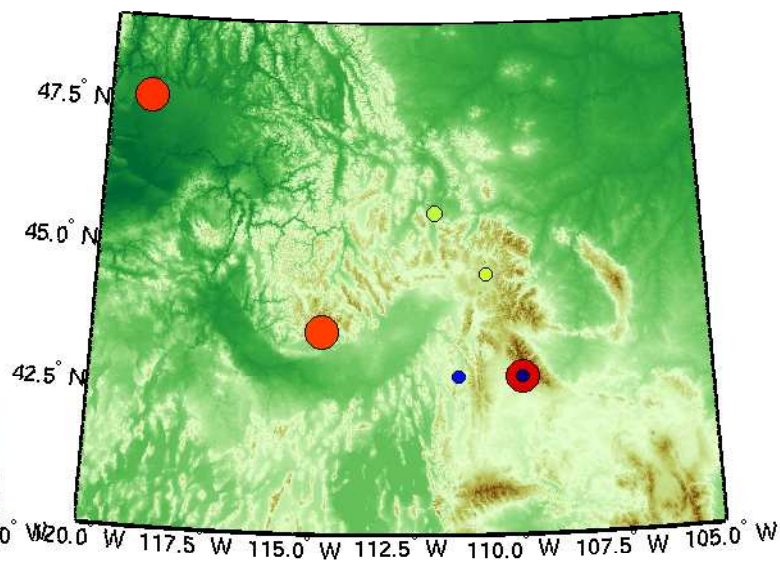
Baz = 313.7962  
 Mean xcor value = 0.77714  
 Range of  $t^*$  values is 1.6486  
 Median  $t^*$  err is 0.32073  
 Slope = -0.28074 +/- 0.22342



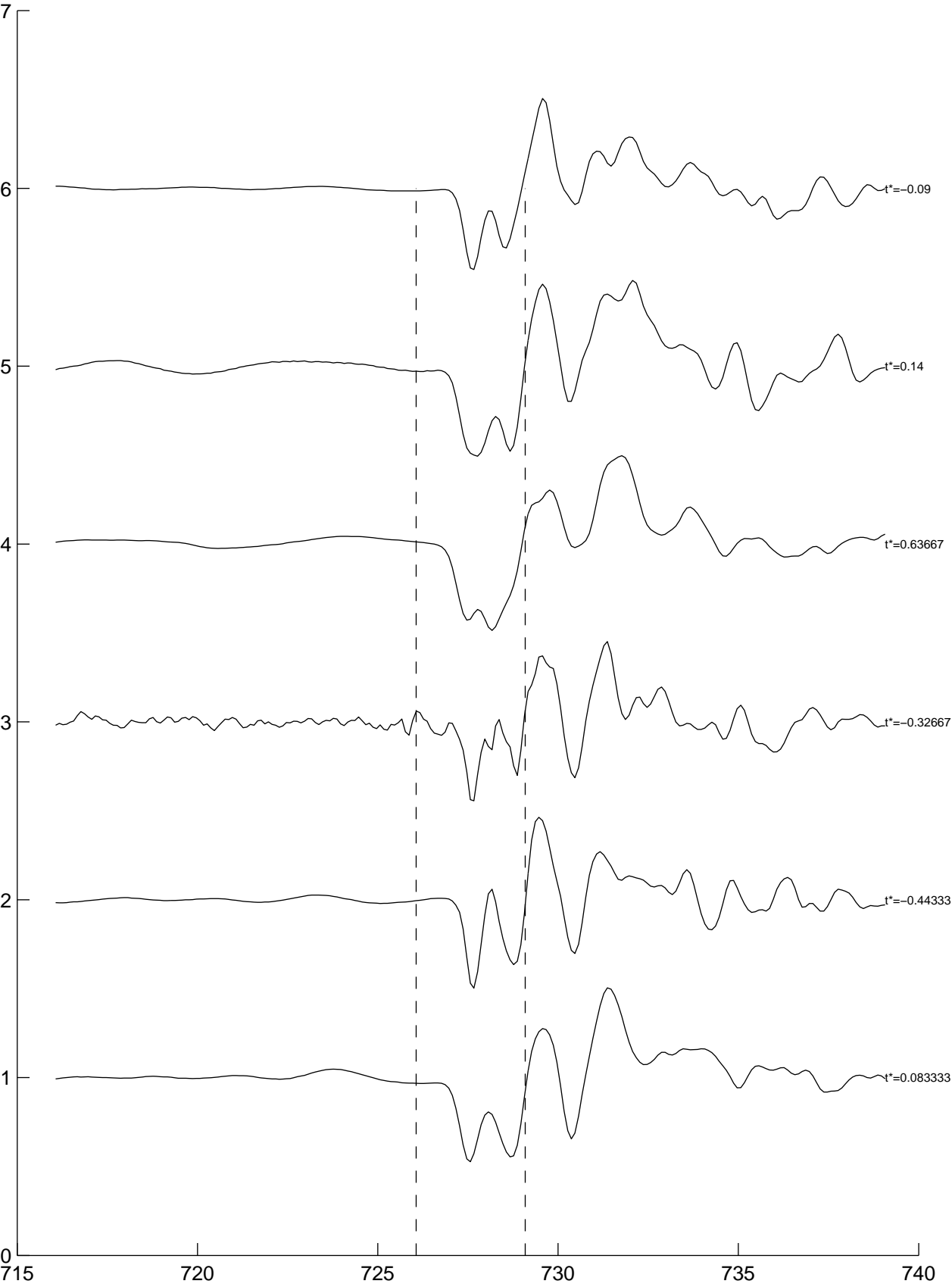
travel time residuals



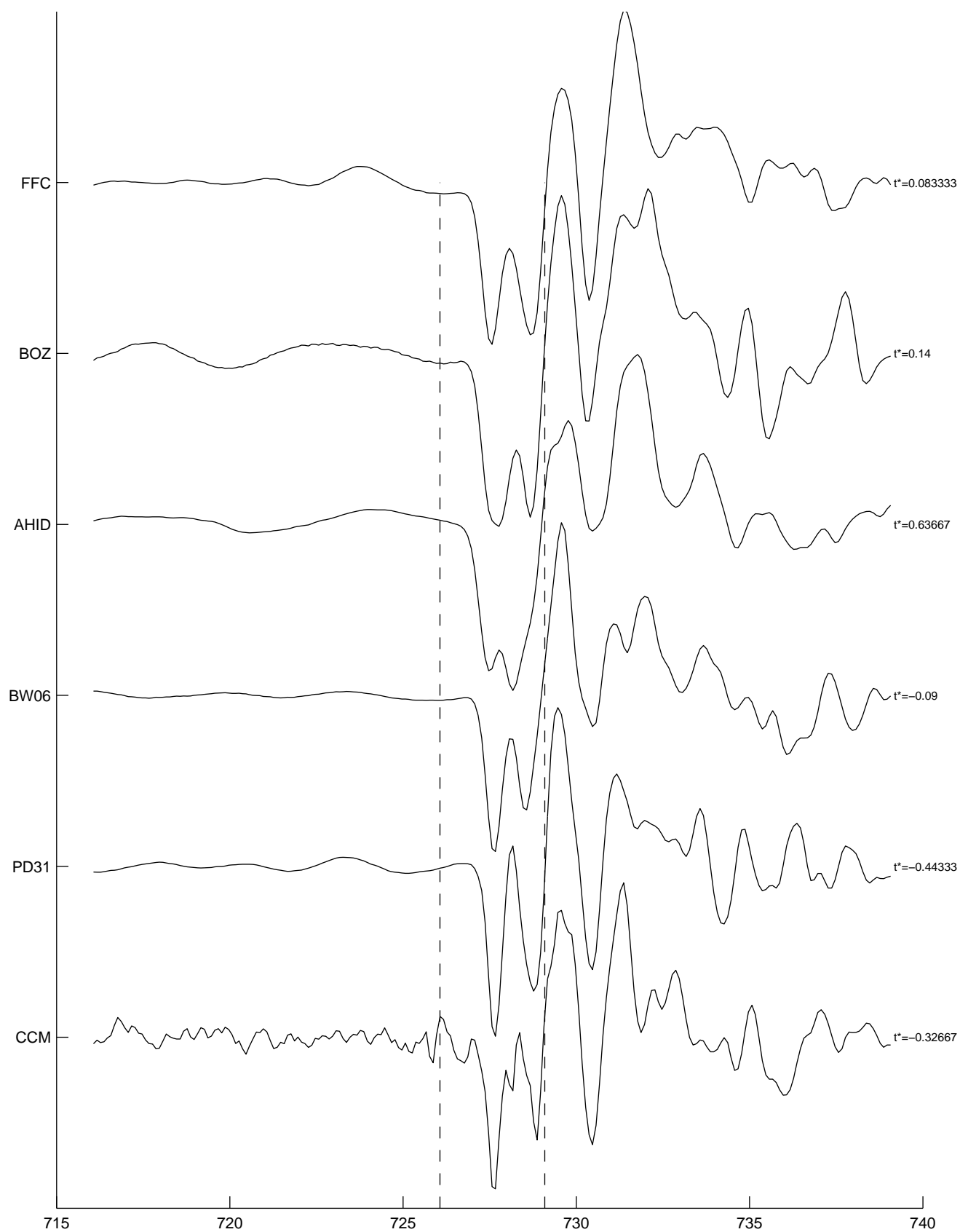
$t^*$  values



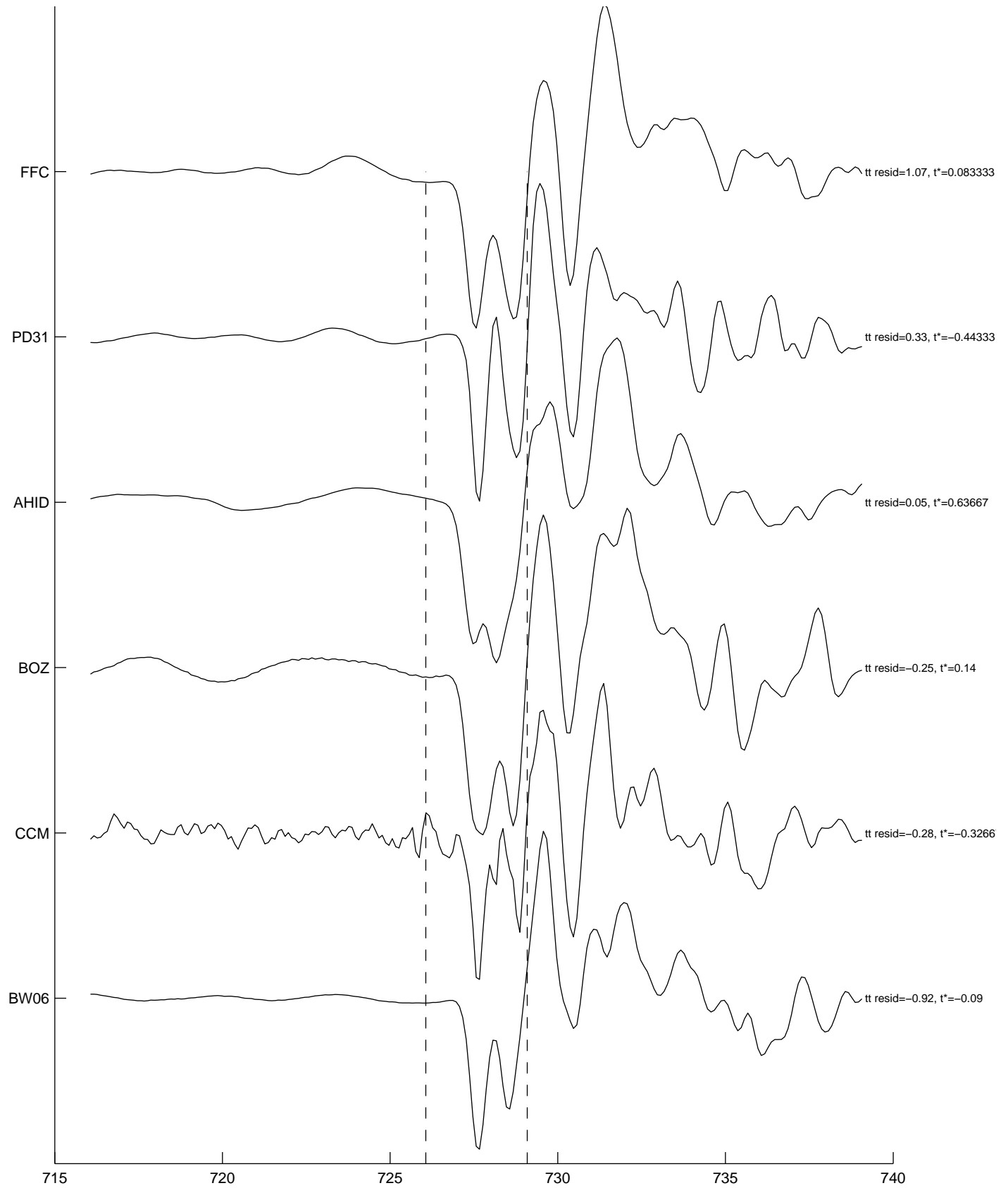
Event\_2002\_091\_19\_59\_32



# Sorted by Delta:Event\_2002\_091\_19\_59\_32

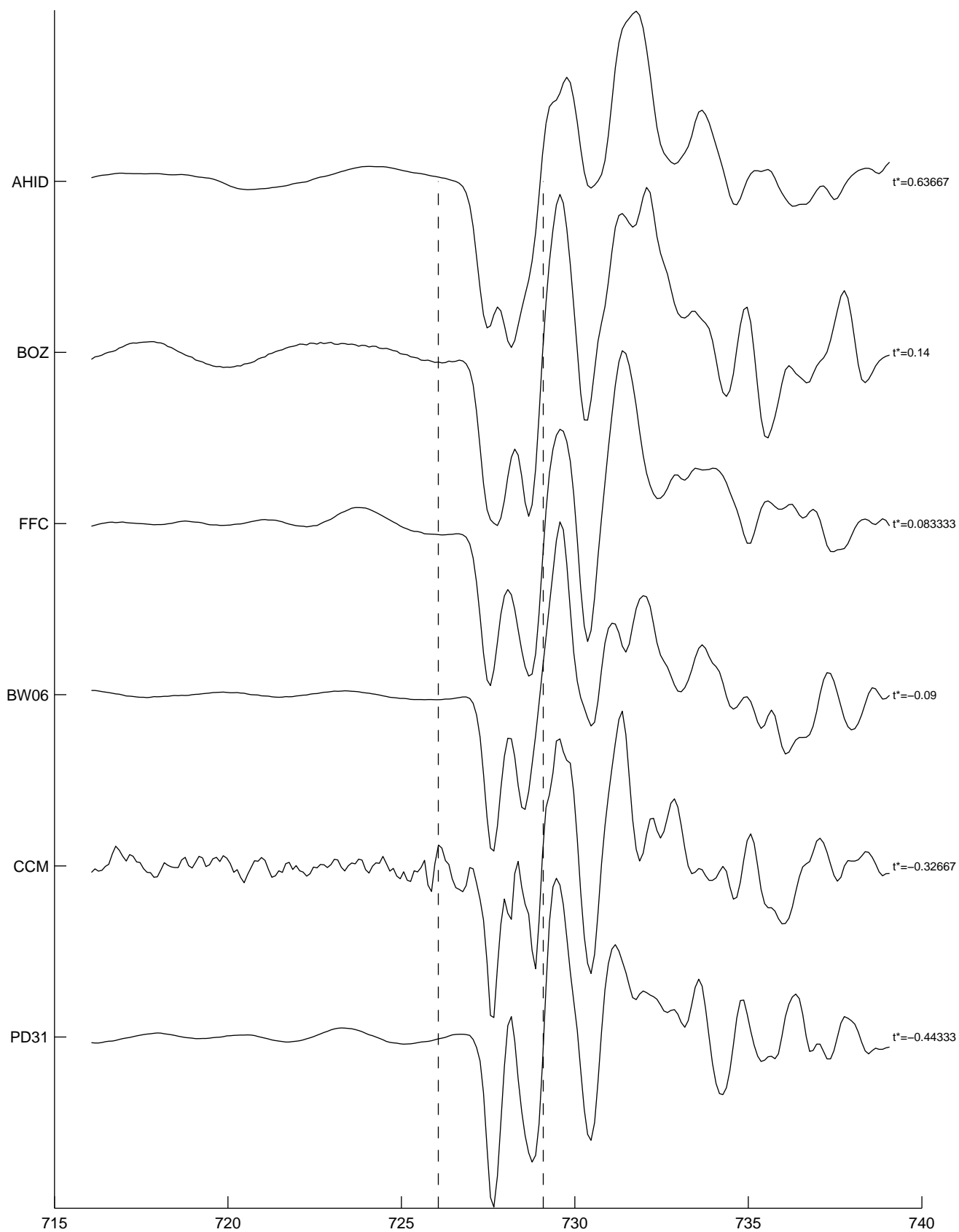


# Sorted by travel time:Event\_2002\_091\_19\_59\_32

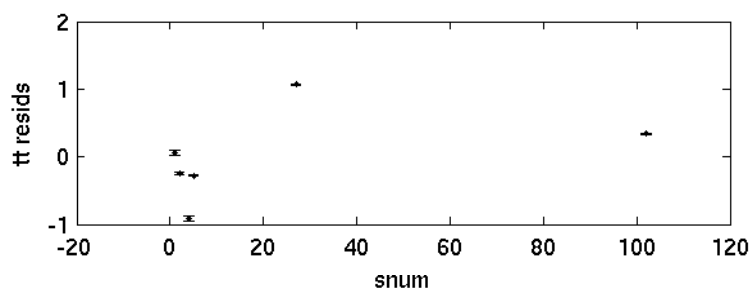
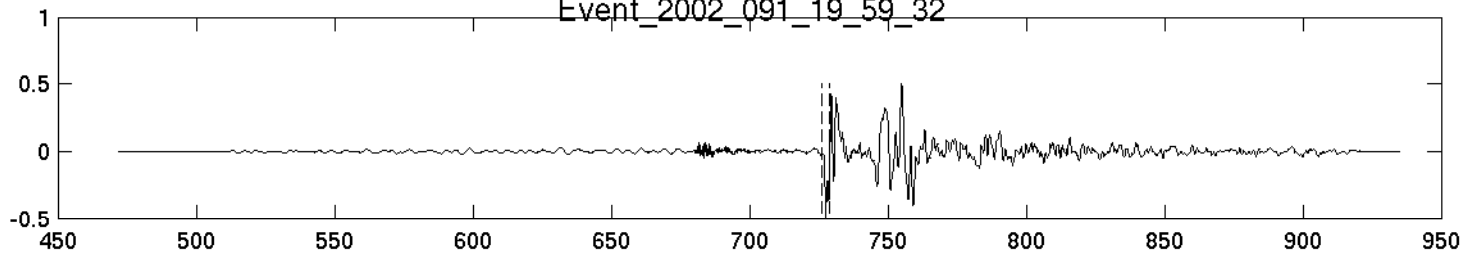




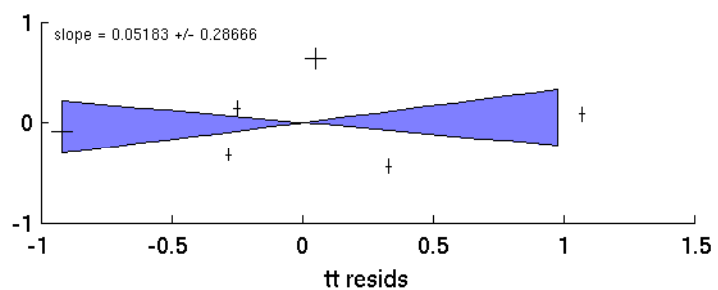
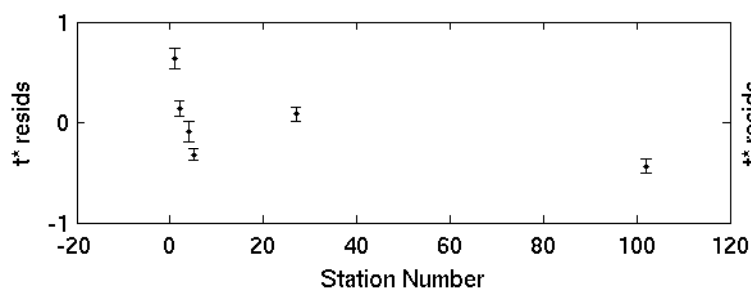
Sorted by  $t^*$ :Event\_2002\_091\_19\_59\_32



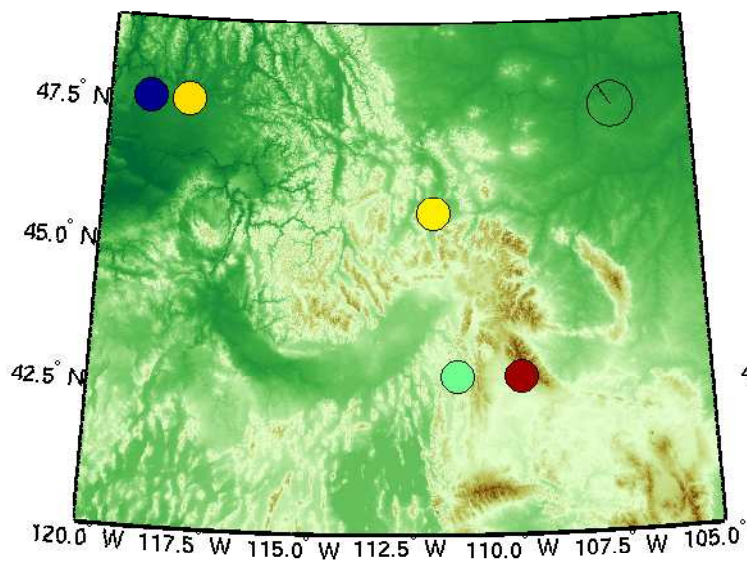
# Stack Event\_2002\_091\_19\_59\_32



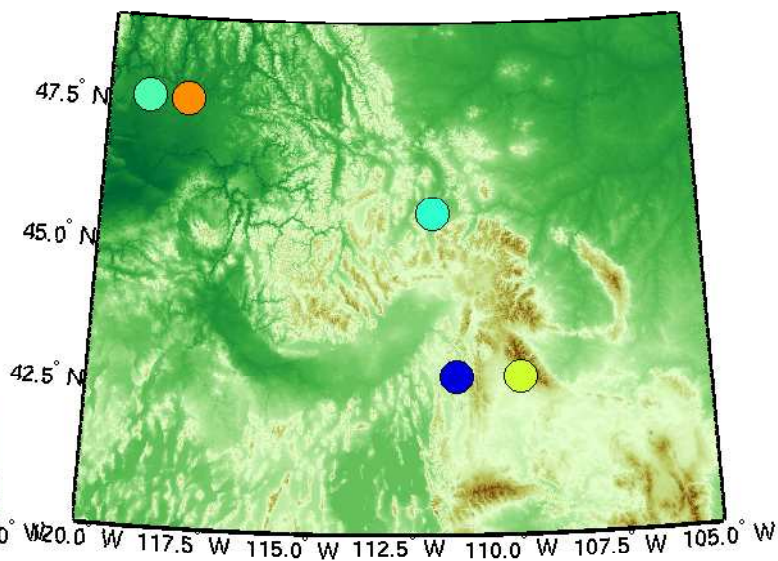
Baz = 148.8415  
Mean xcor value = 0.67667  
Range of t\* values is 1.08  
Median t\* err is 0.076924  
Slope = 0.05183 +/- 0.28666



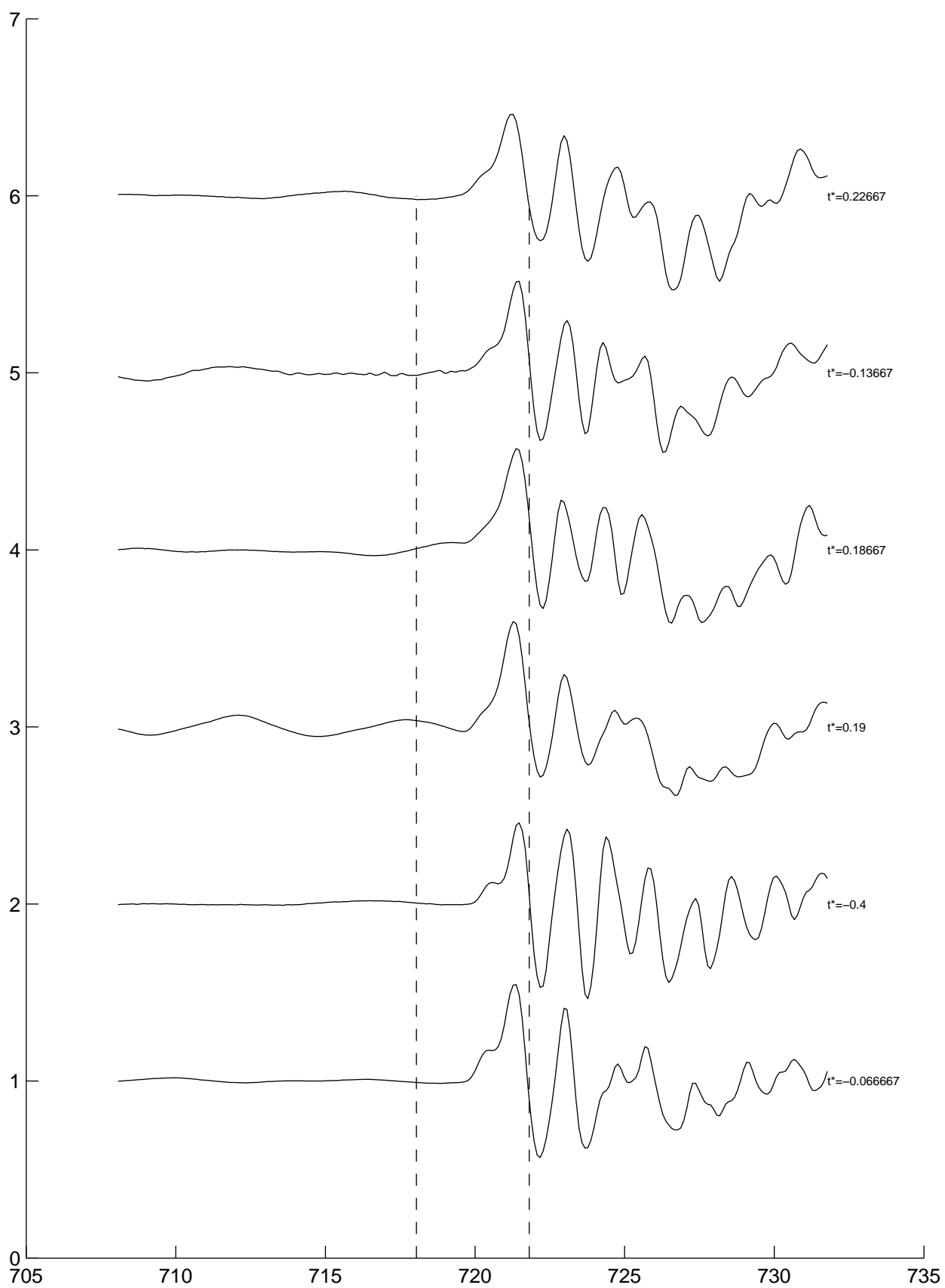
travel time residuals



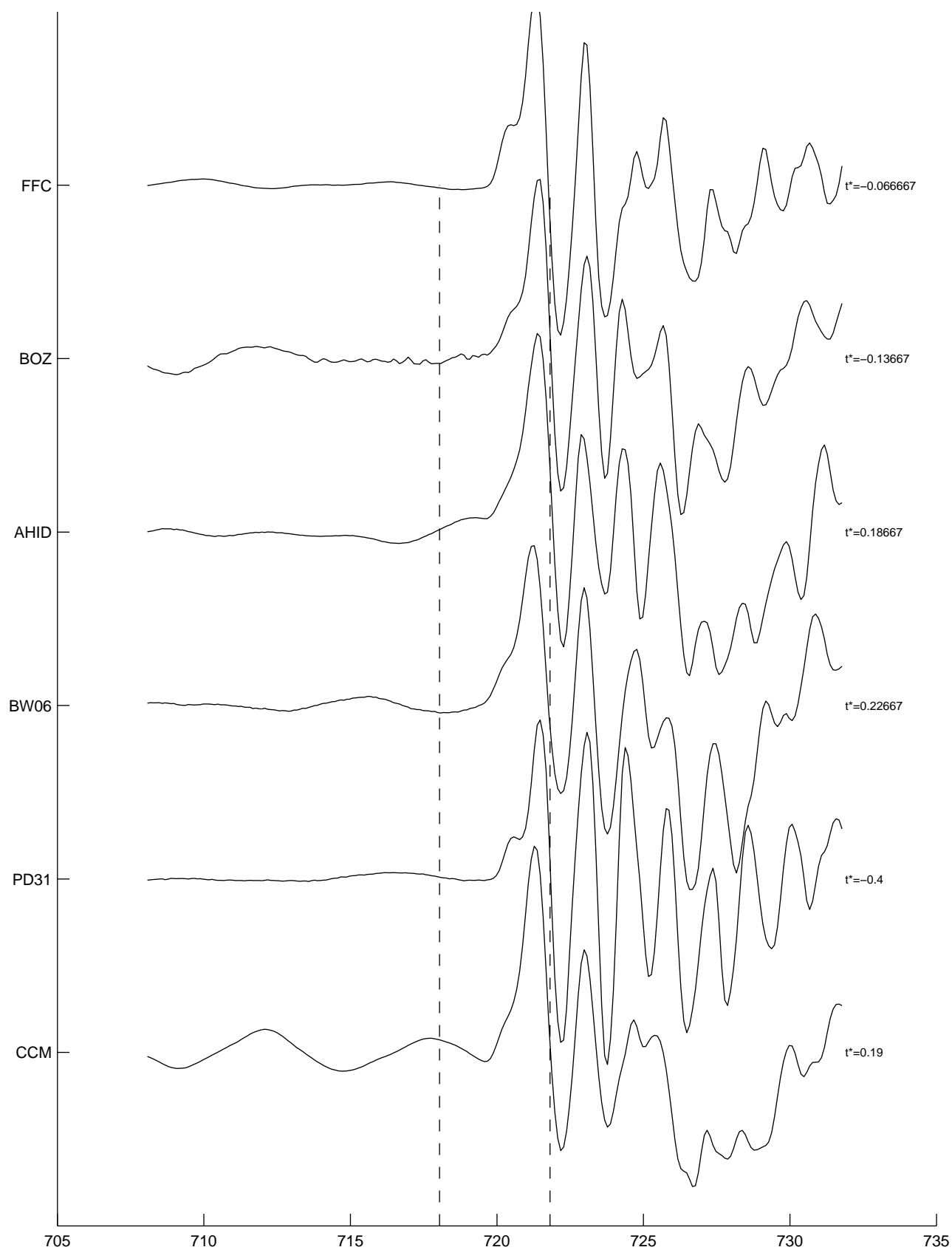
t\* values



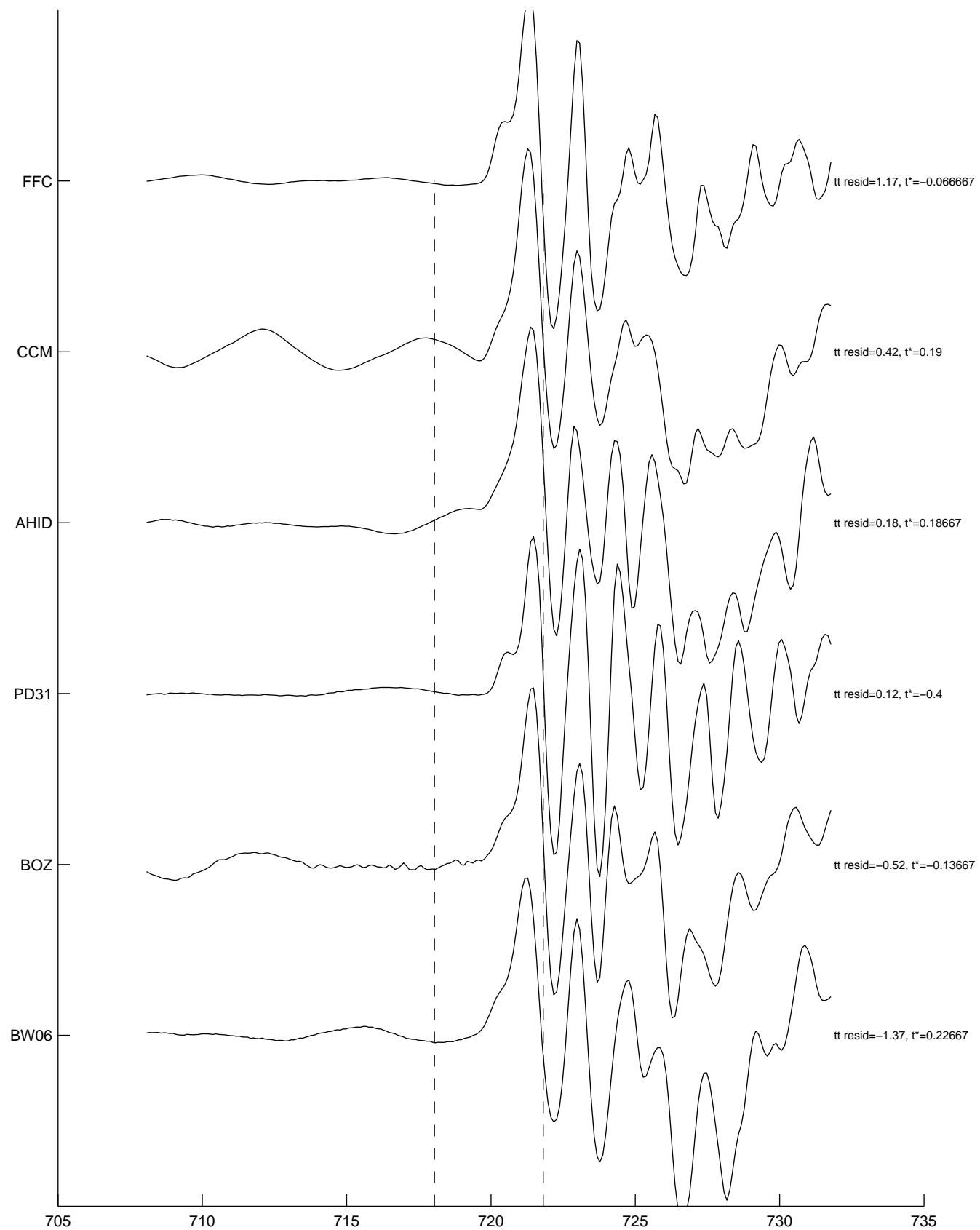
# Event\_2002\_108\_16\_08\_36



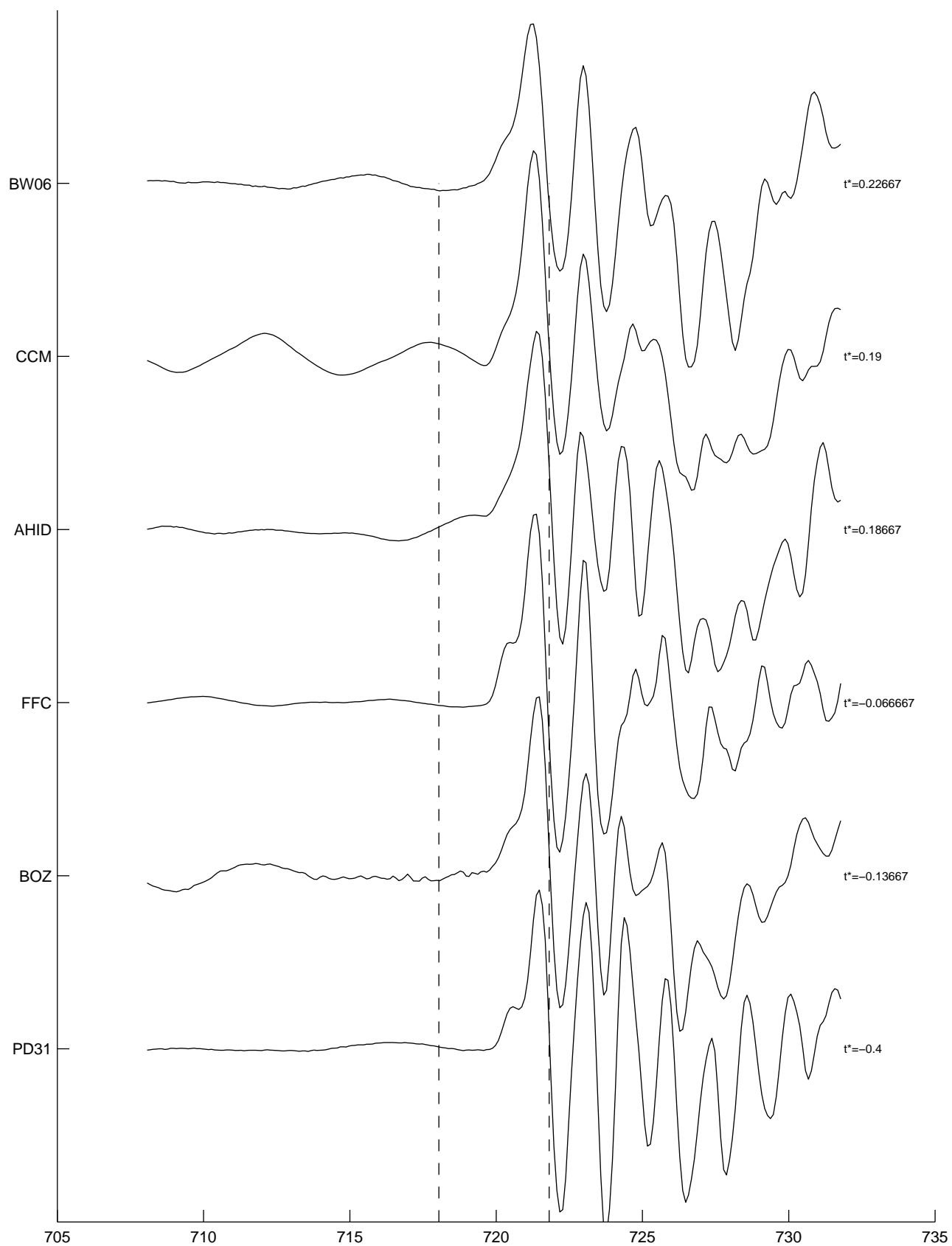
# Sorted by Delta:Event\_2002\_108\_16\_08\_36



Sorted by travel time:Event\_2002\_108\_16\_08\_36

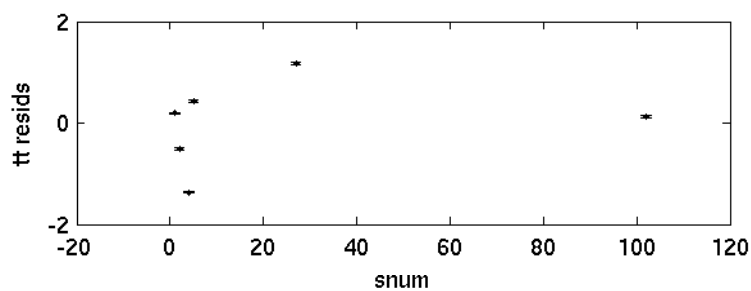
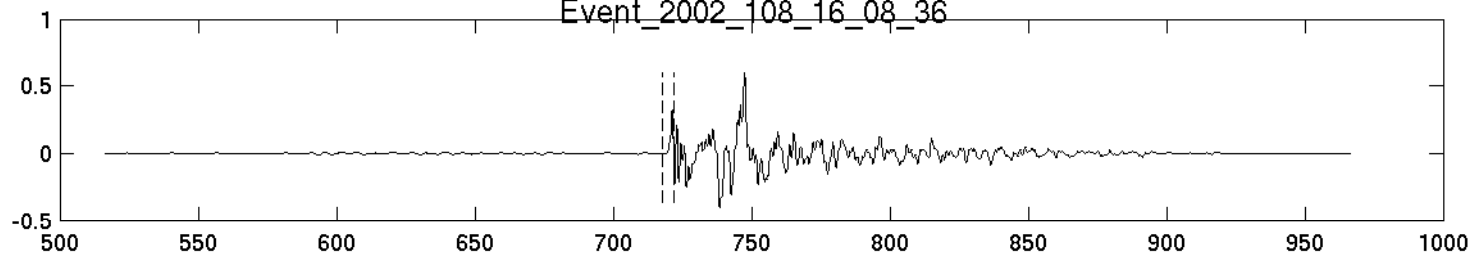


Sorted by  $t^*$ :Event\_2002\_108\_16\_08\_36

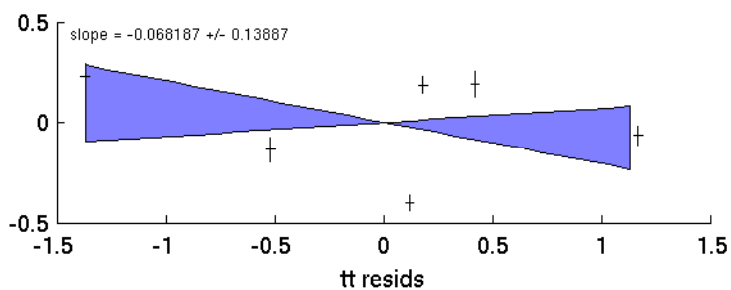
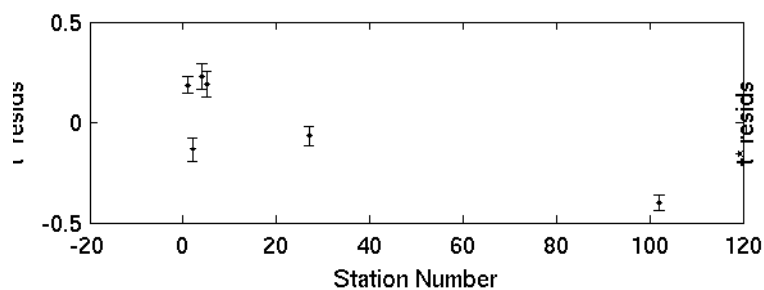


# Event\_2002\_108\_16\_08\_36

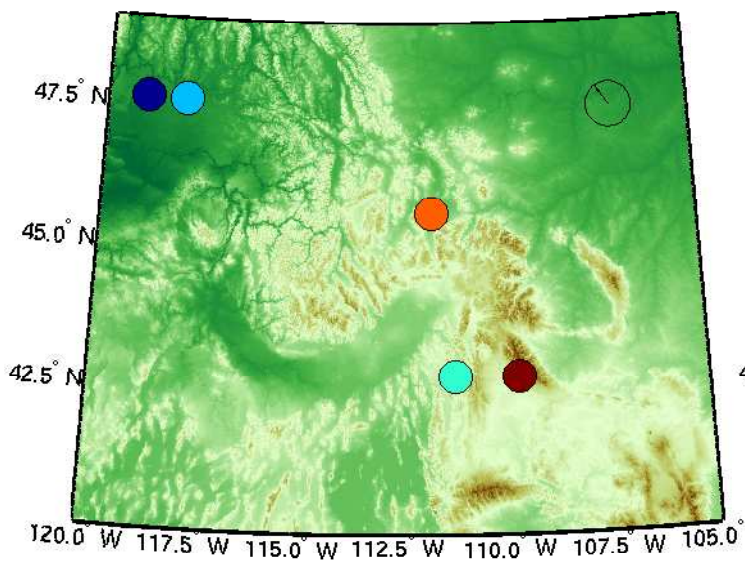
Stack



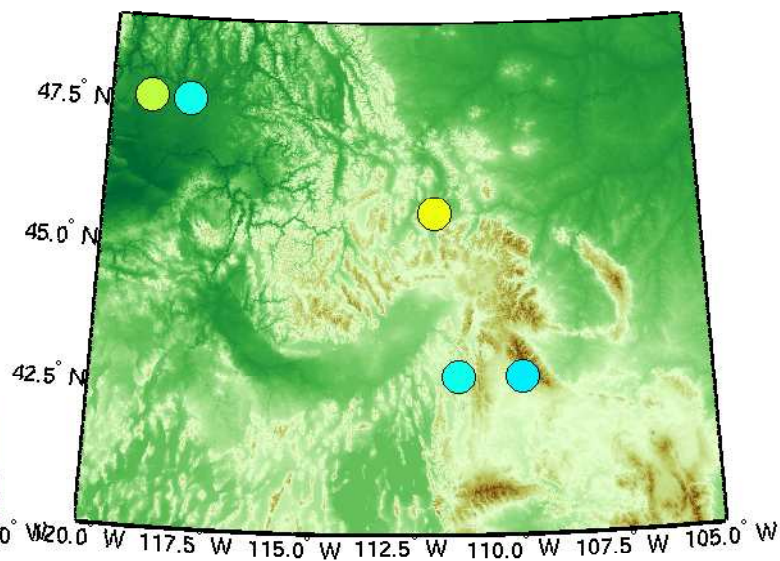
Baz = 147.2721  
Mean xcor value = 0.67167  
Range of t\* values is 0.62667  
Median t\* err is 0.053784  
Slope = -0.068187 +/- 0.13887



travel time residuals

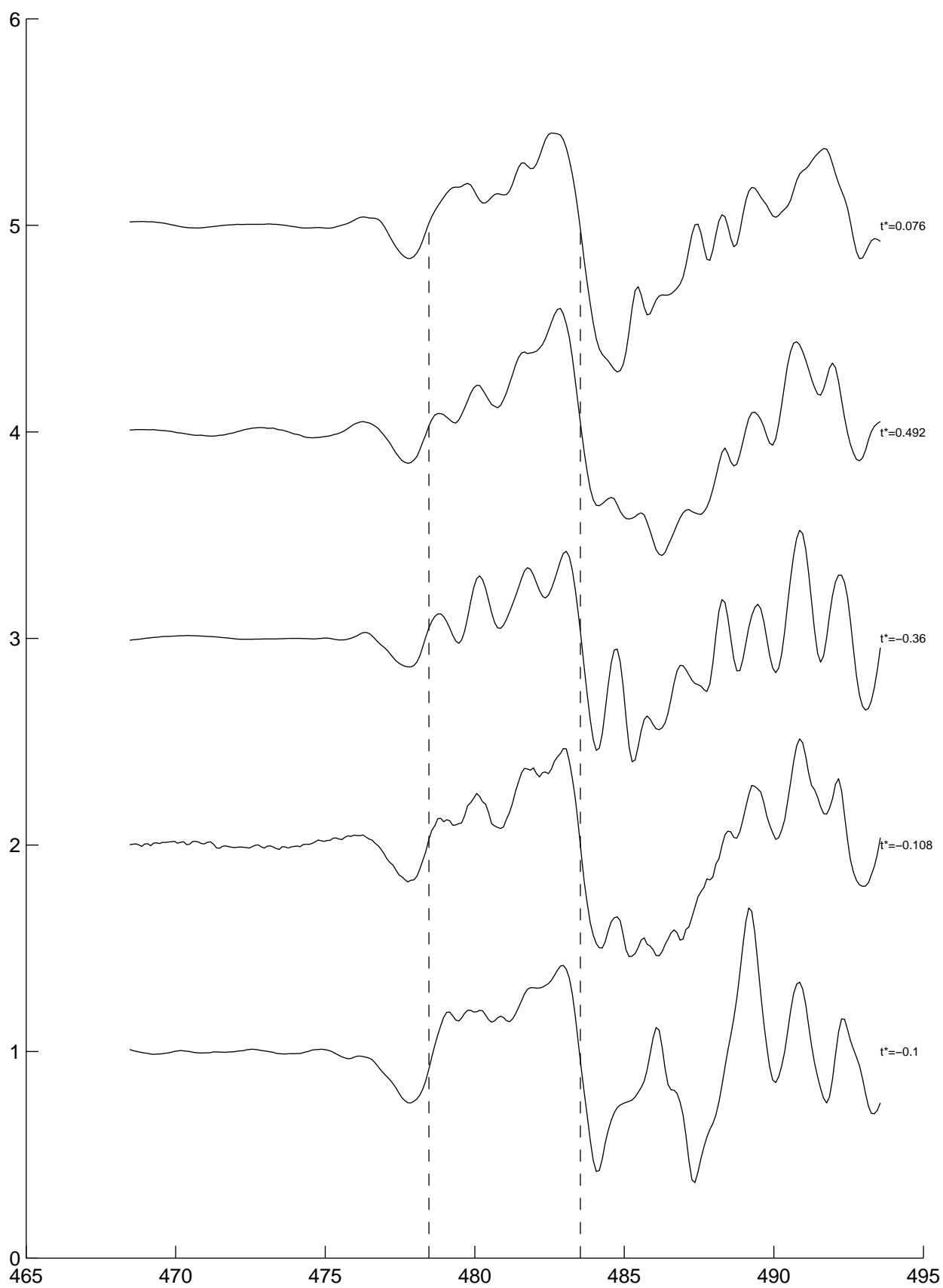


t\* values

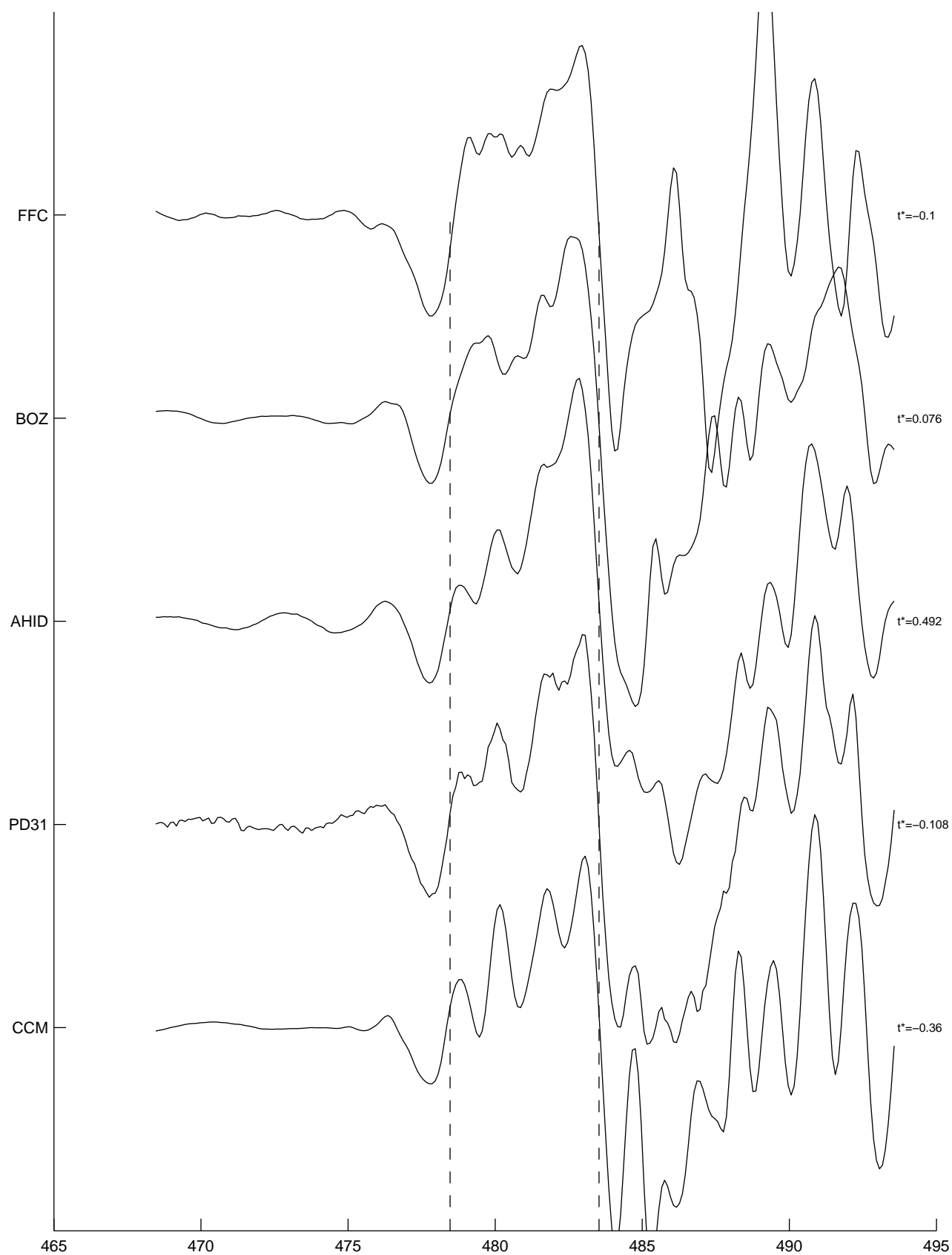




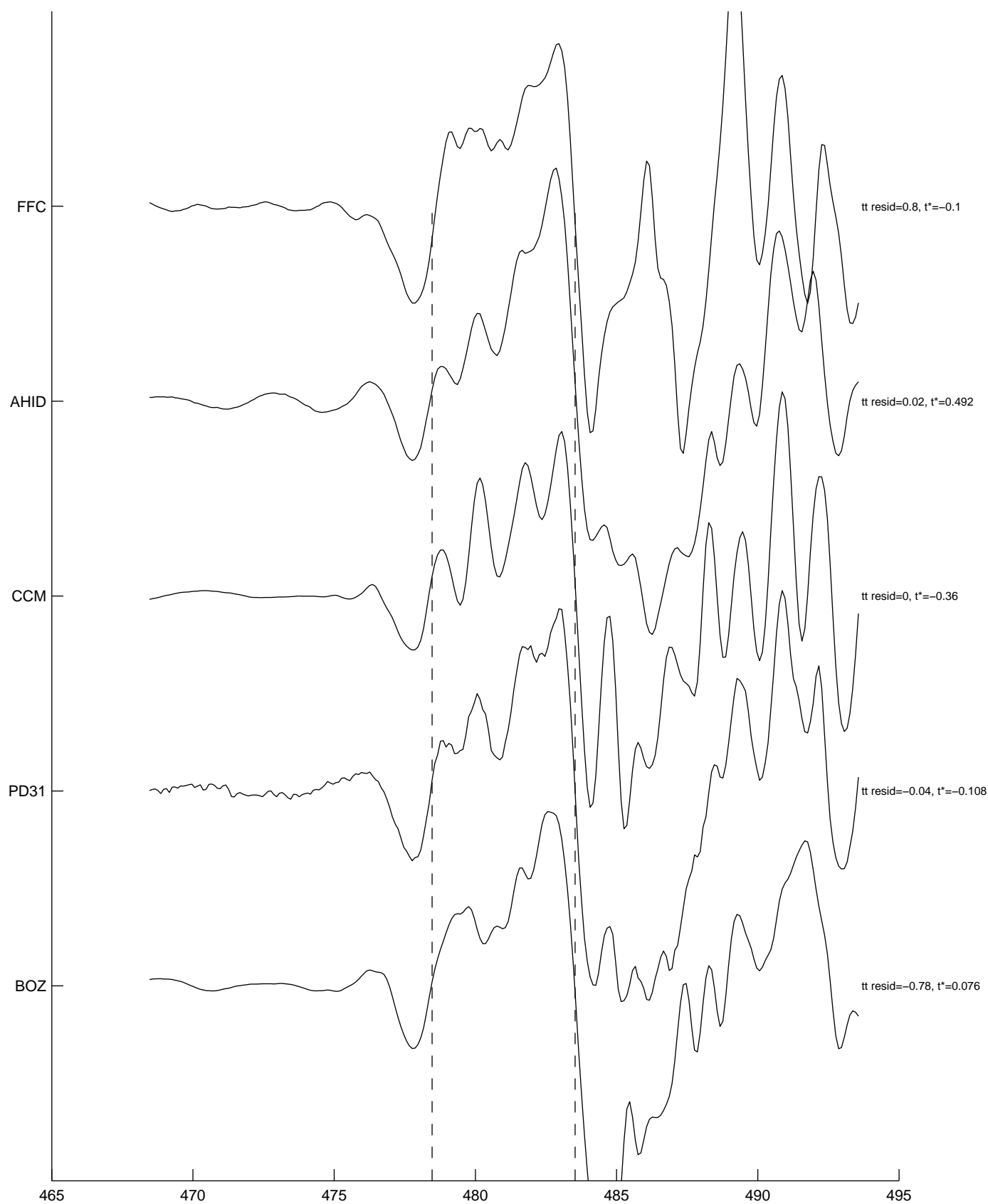
# Event\_2002\_212\_00\_16\_44



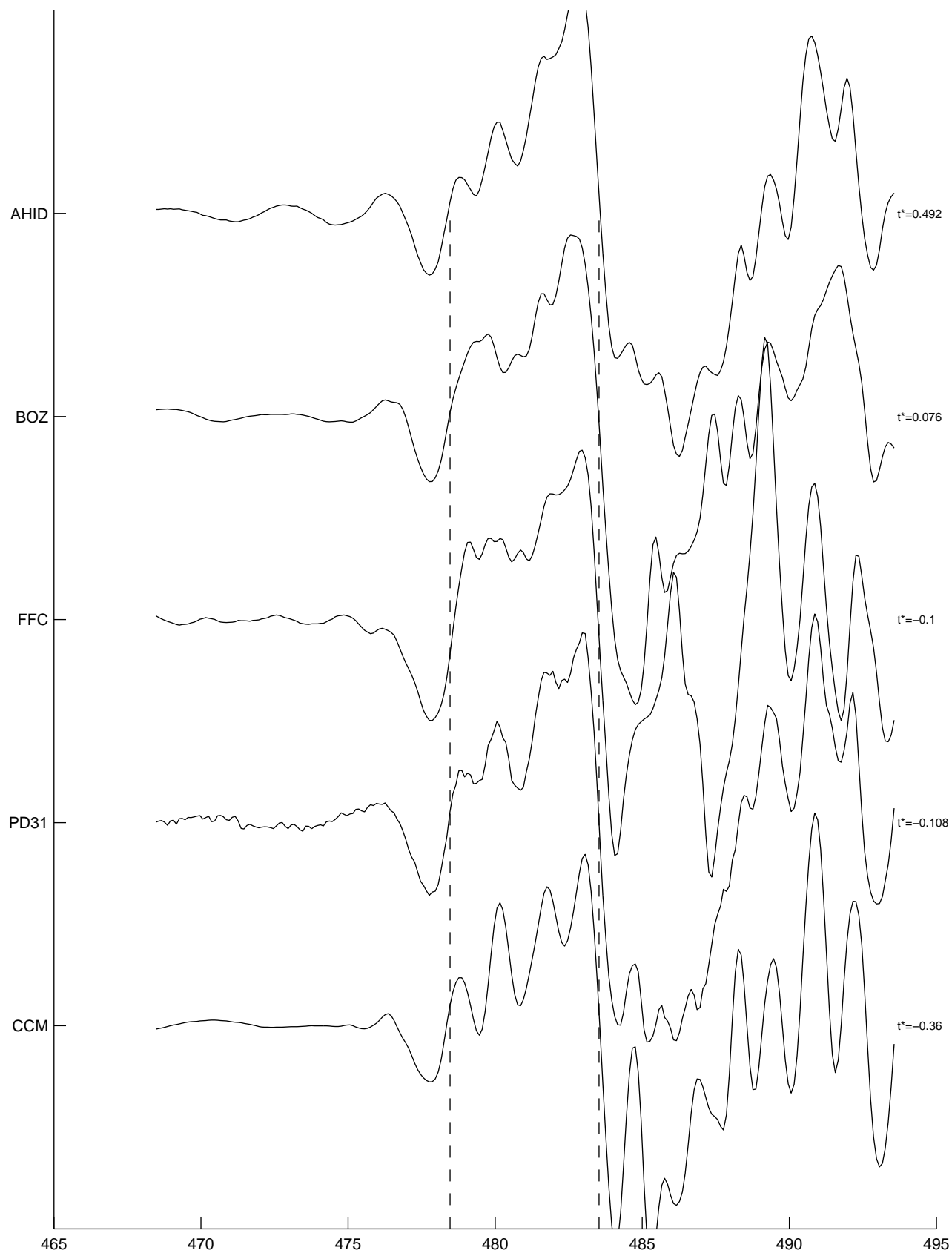
Sorted by Delta:Event\_2002\_212\_00\_16\_44



Sorted by travel time: Event\_2002\_212\_00\_16\_44

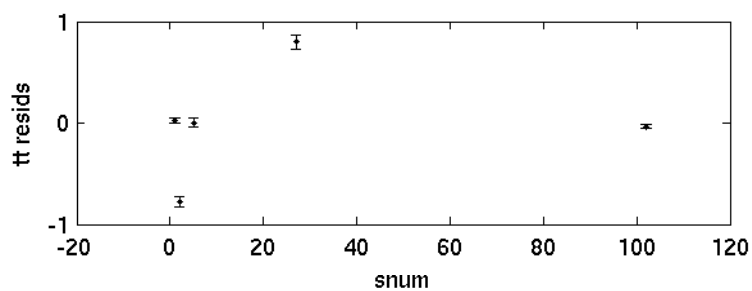
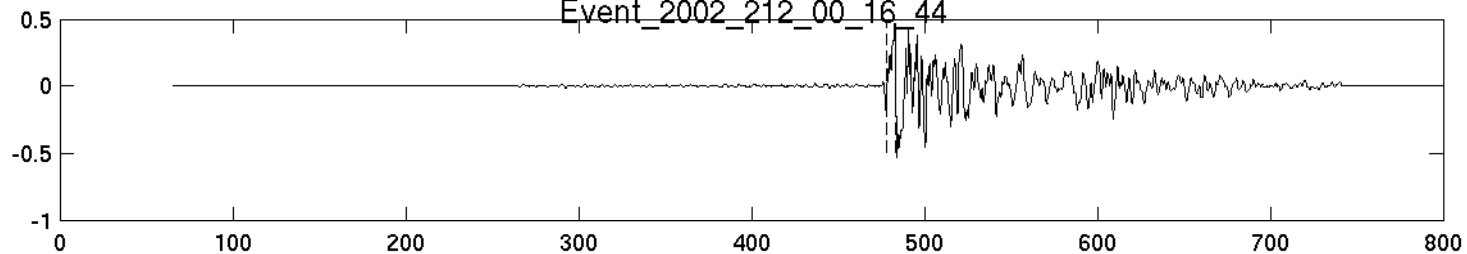


Sorted by  $t^*$ :Event\_2002\_212\_00\_16\_44

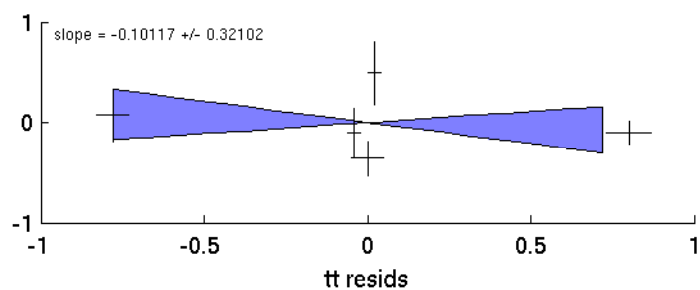
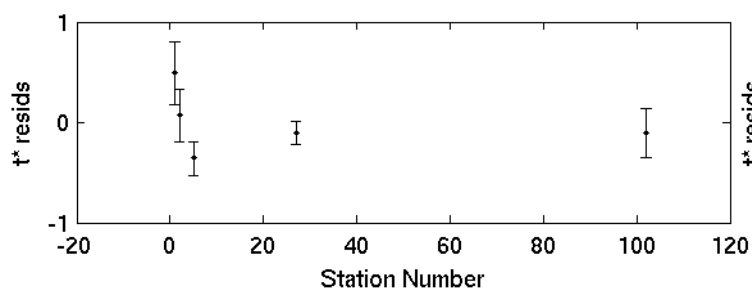


Event\_2002\_212\_00\_16\_44

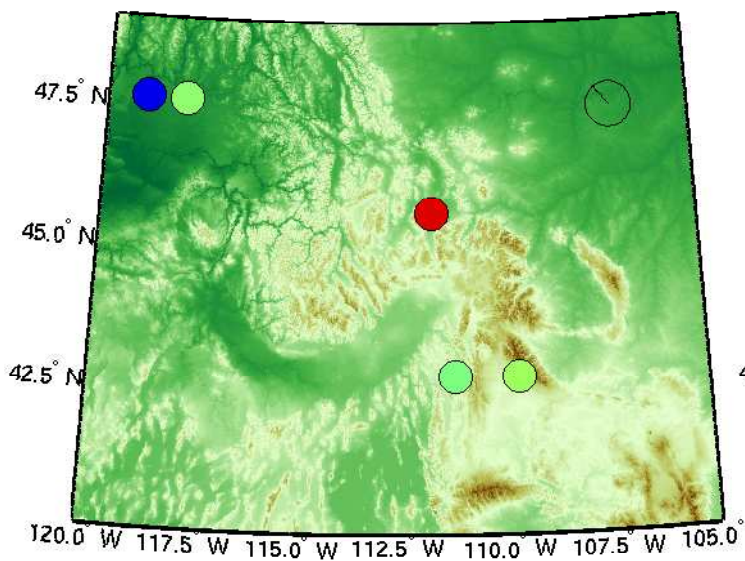
Stack



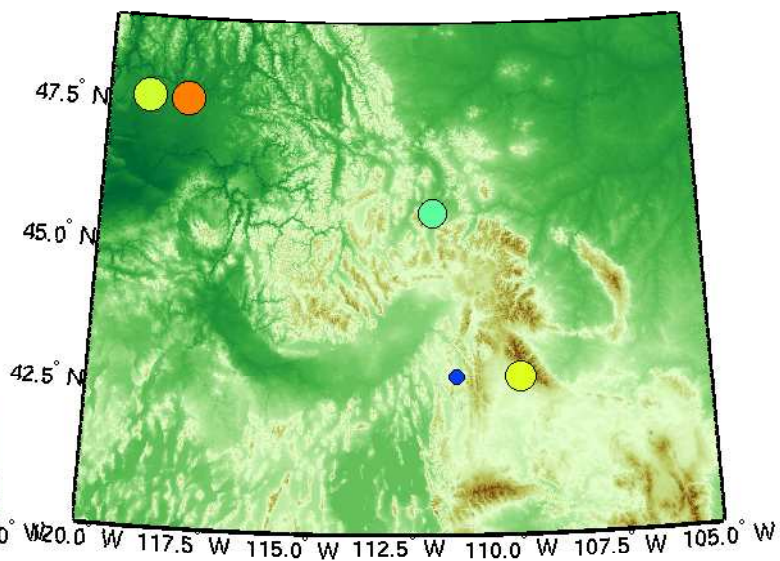
Baz = 142.4723  
Mean xcor value = 0.698  
Range of  $t^*$  values is 0.852  
Median  $t^*$  err is 0.24705  
Slope =  $-0.10117 \pm 0.32102$



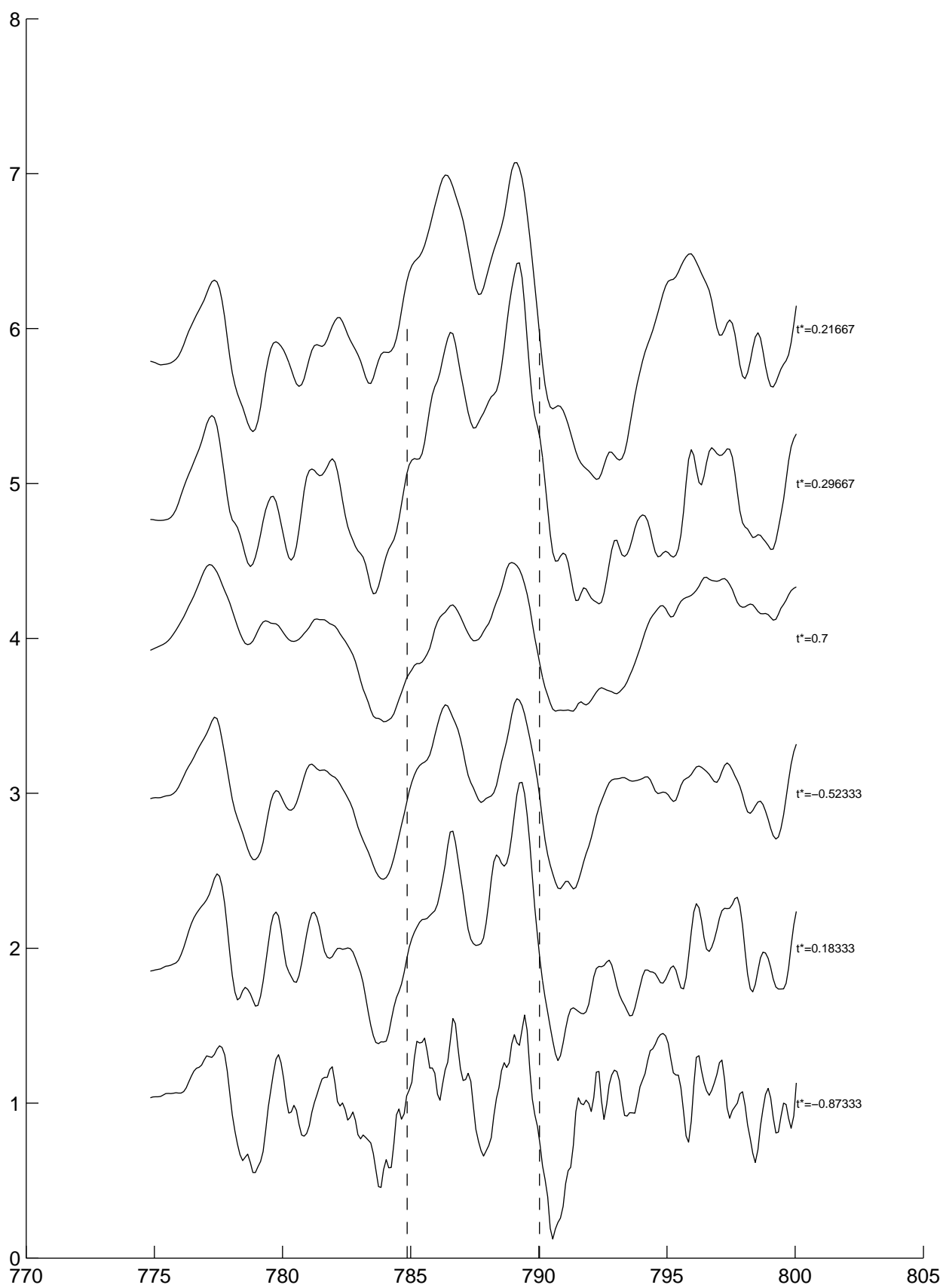
travel time residuals



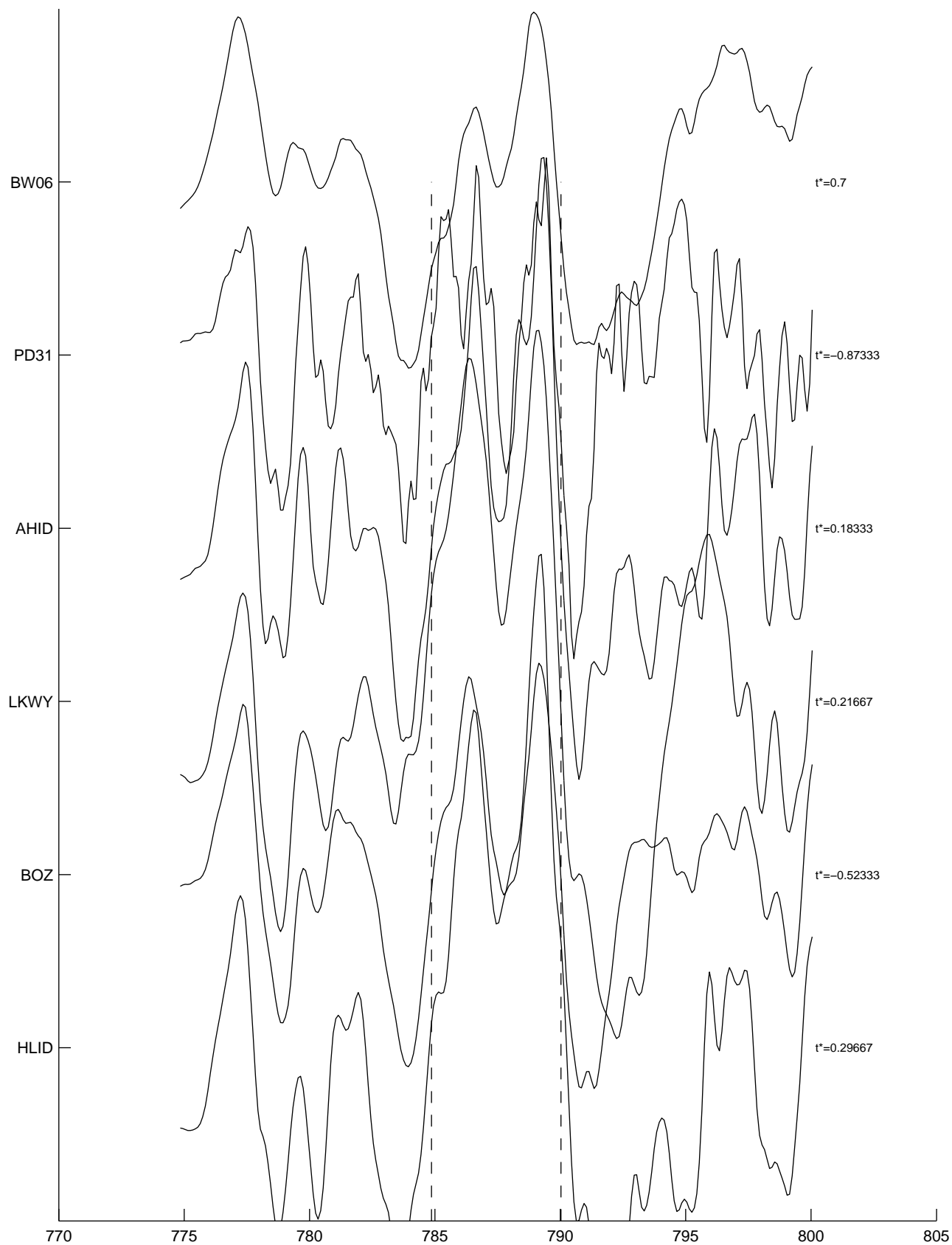
$t^*$  values



# Event\_2002\_226\_13\_57\_52

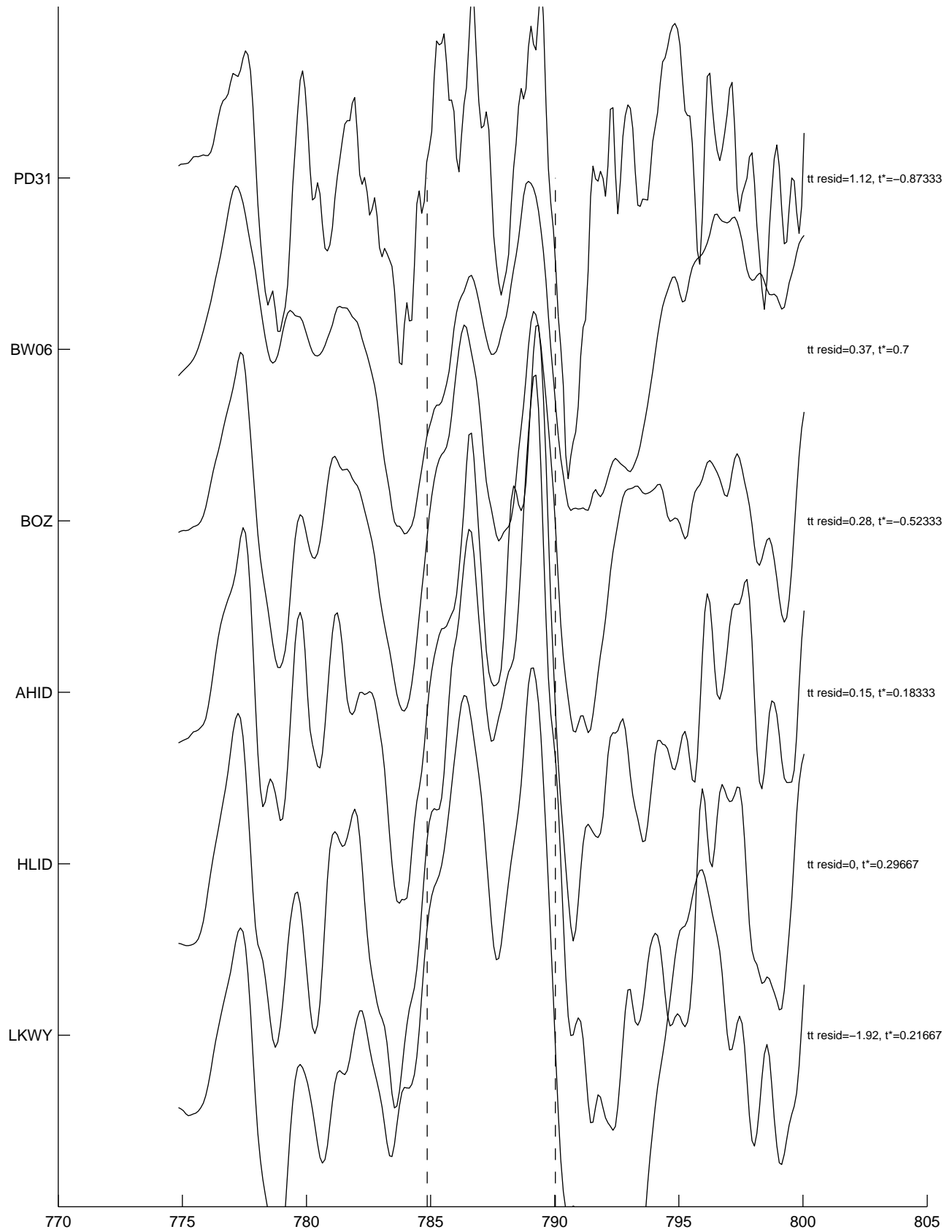


Sorted by Delta:Event\_2002\_226\_13\_57\_52

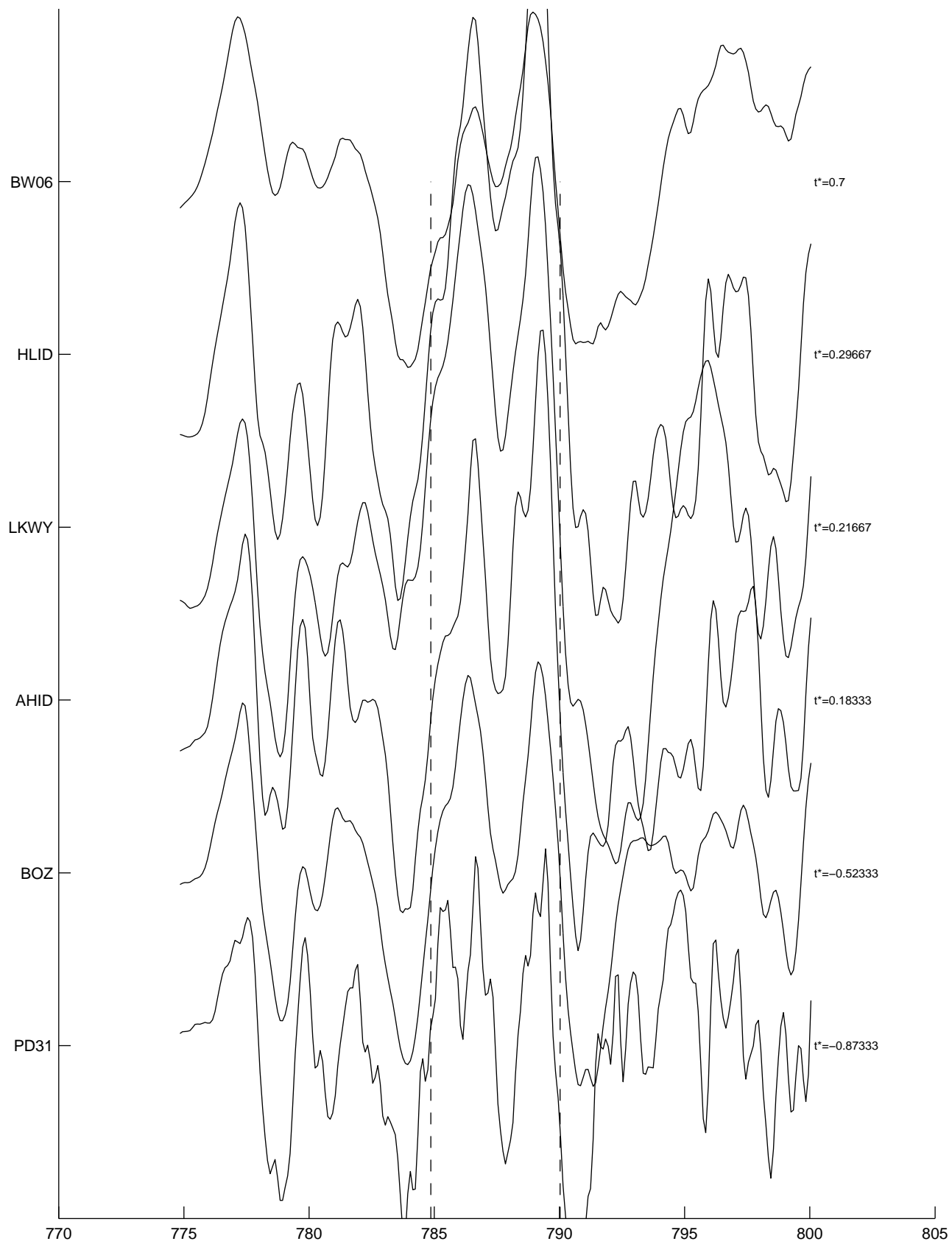




# Sorted by travel time:Event\_2002\_226\_13\_57\_52

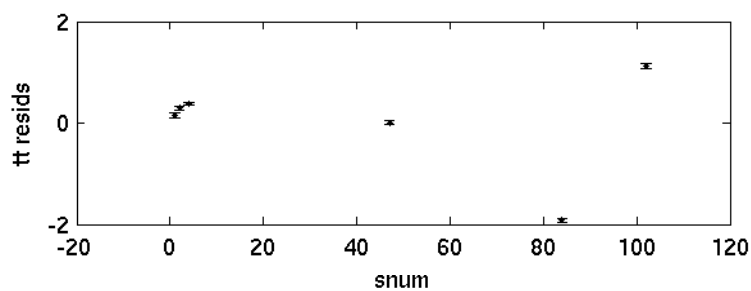
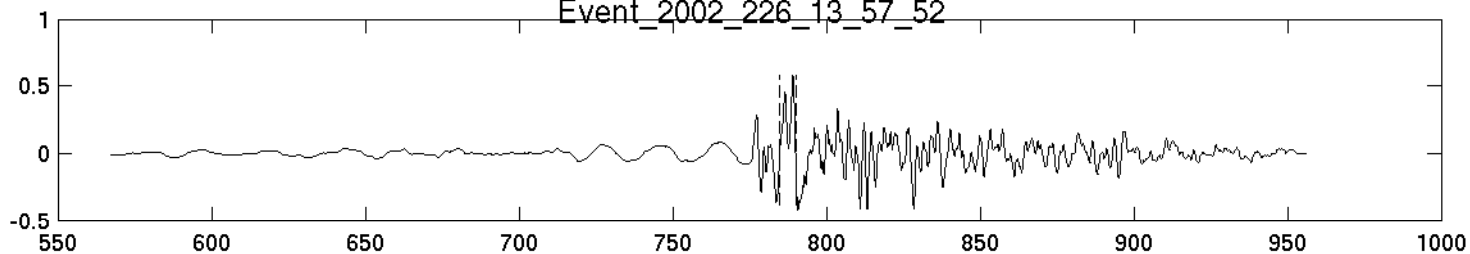


Sorted by t\*:Event\_2002\_226\_13\_57\_52

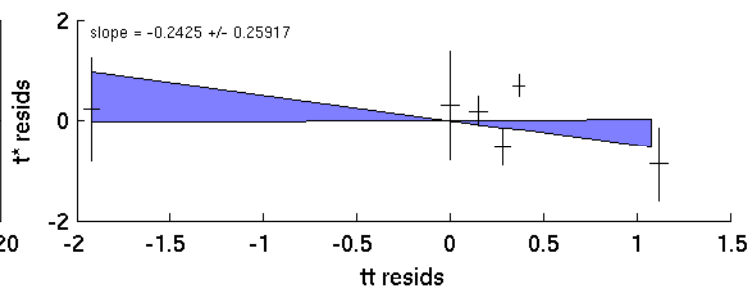
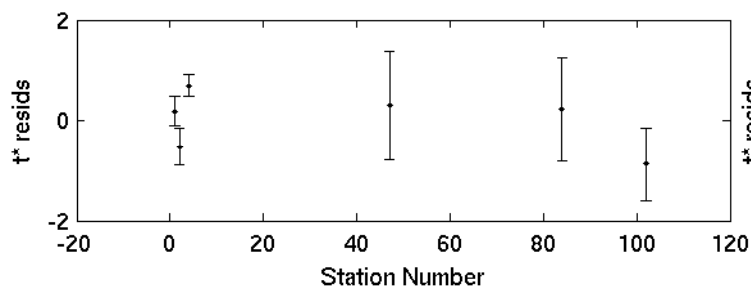


# Event\_2002\_226\_13\_57\_52

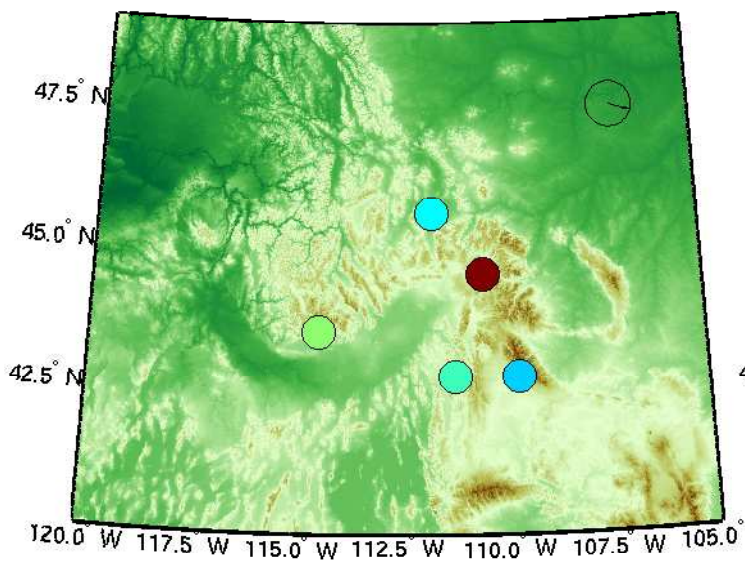
Stack



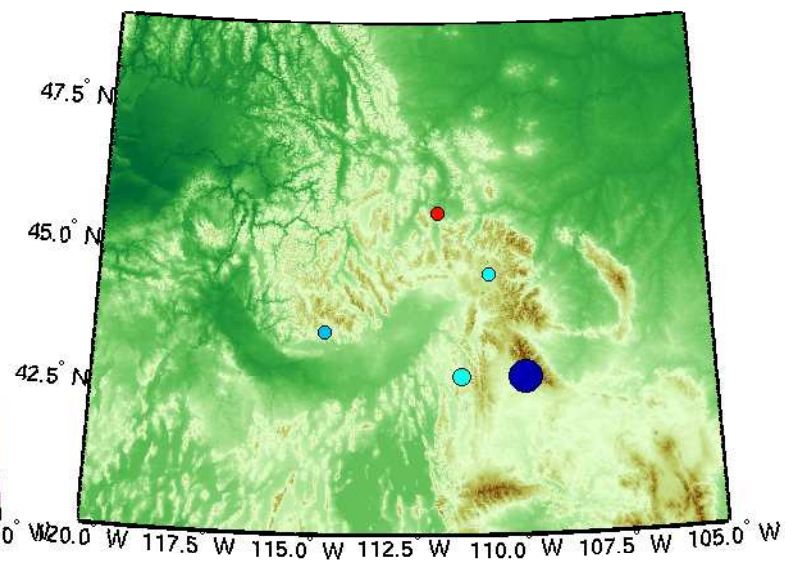
Baz = 288.8627  
Mean xcor value = 0.73333  
Range of t\* values is 1.5733  
Median t\* err is 0.55078  
Slope = -0.2425 +/- 0.25917



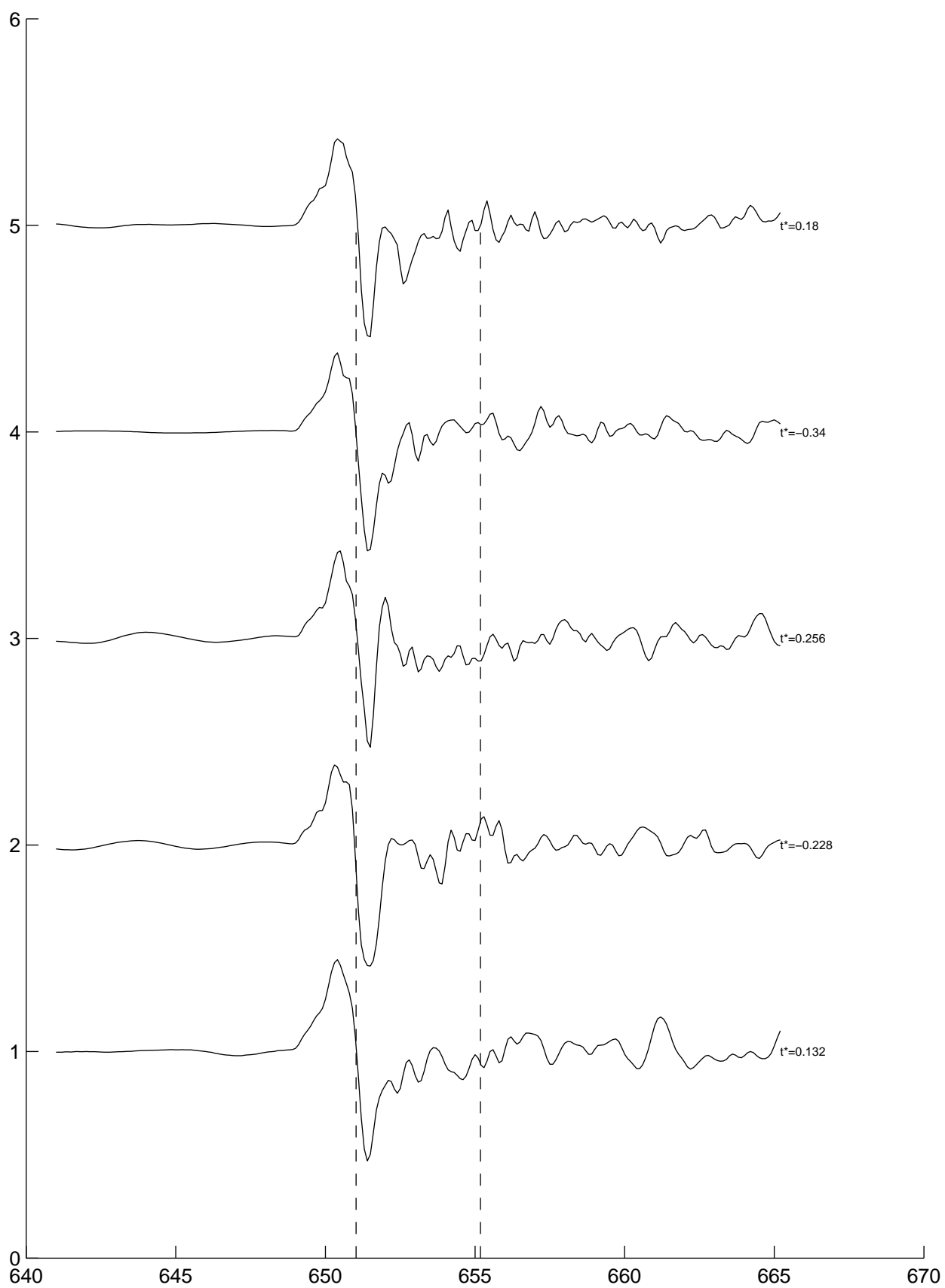
travel time residuals



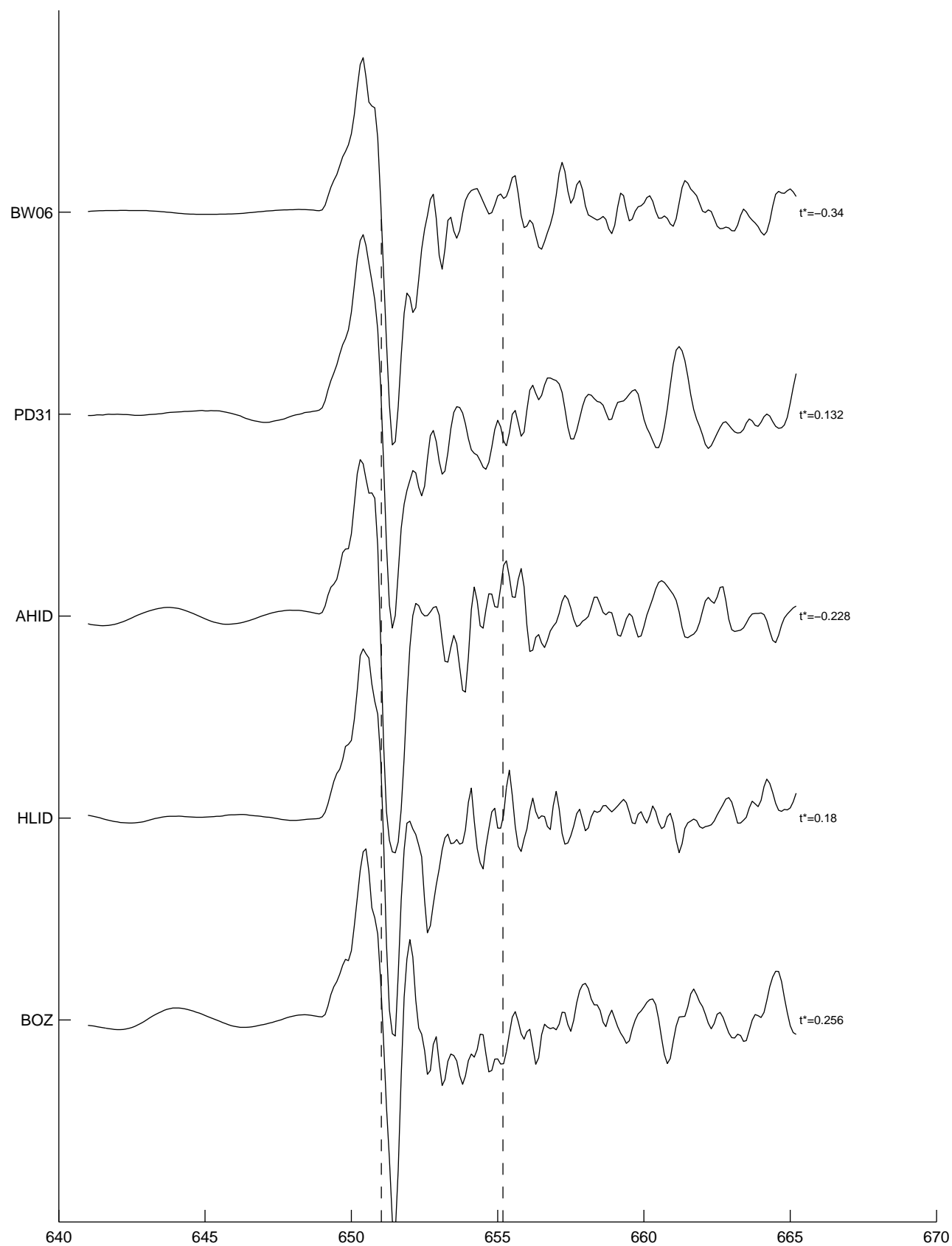
t\* values



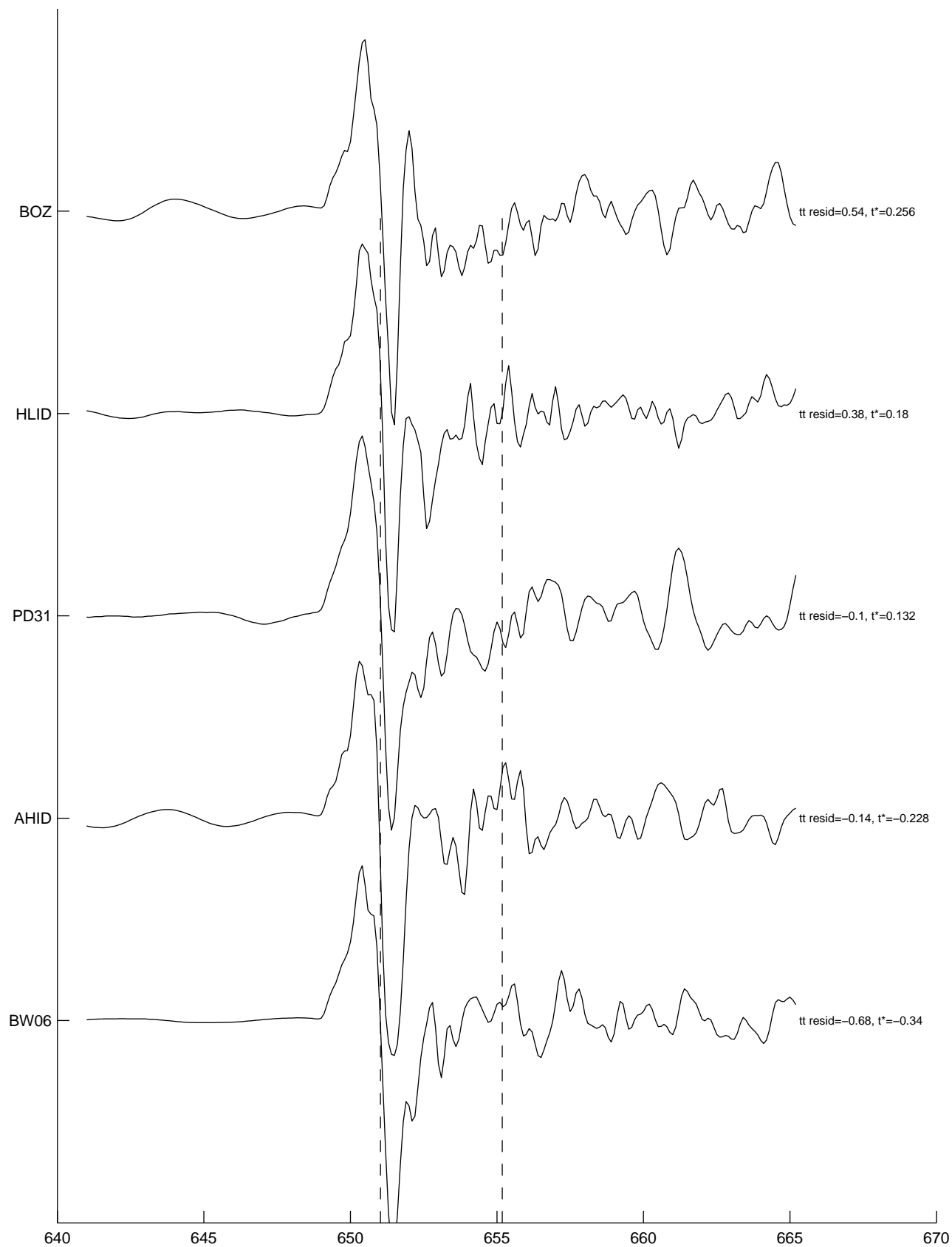
# Event\_2002\_258\_08\_39\_32



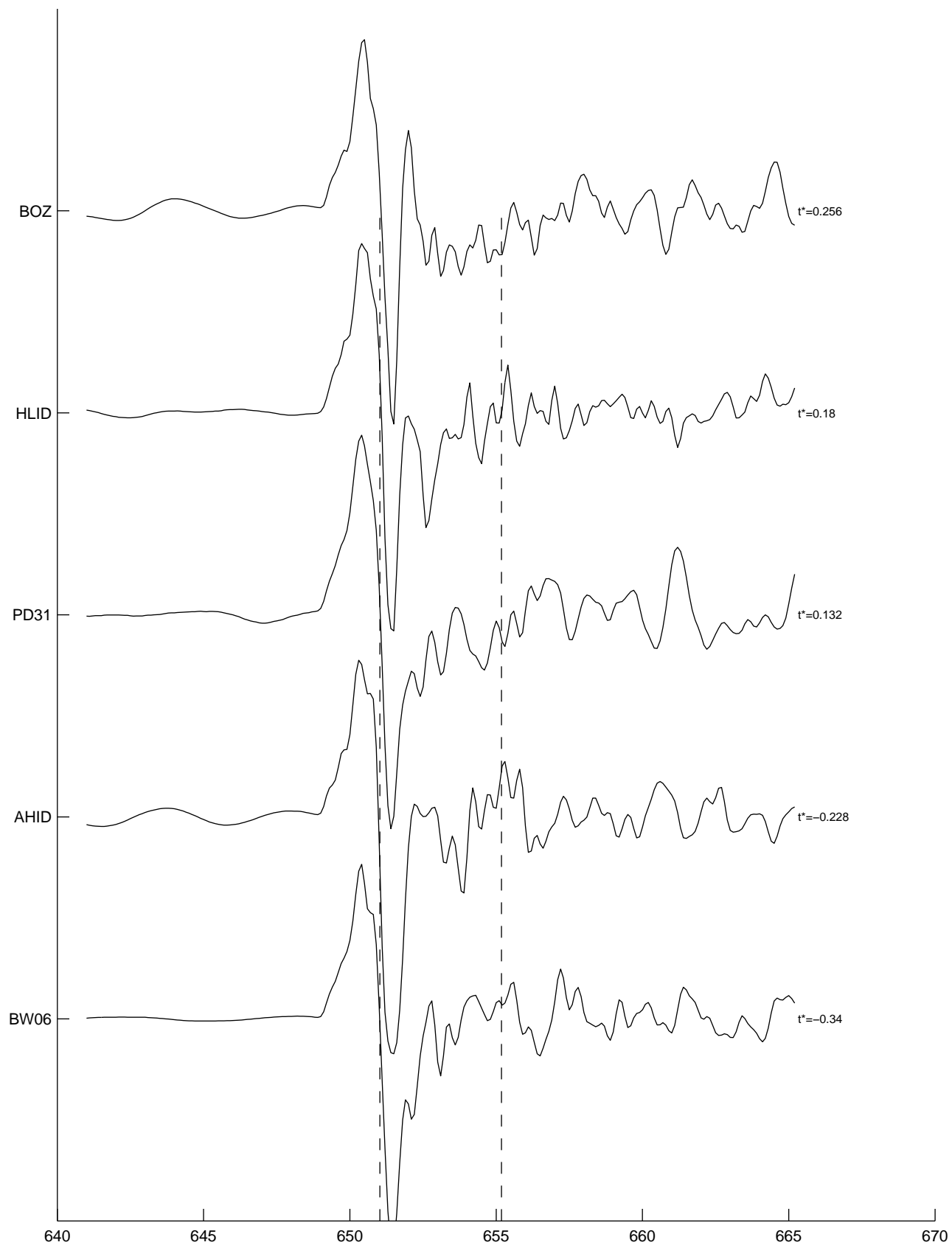
# Sorted by Delta:Event\_2002\_258\_08\_39\_32



# Sorted by travel time:Event\_2002\_258\_08\_39\_32



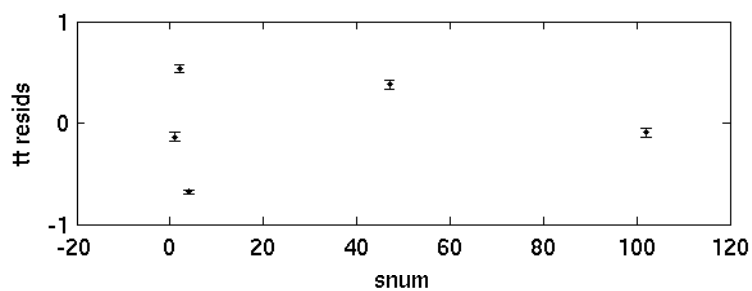
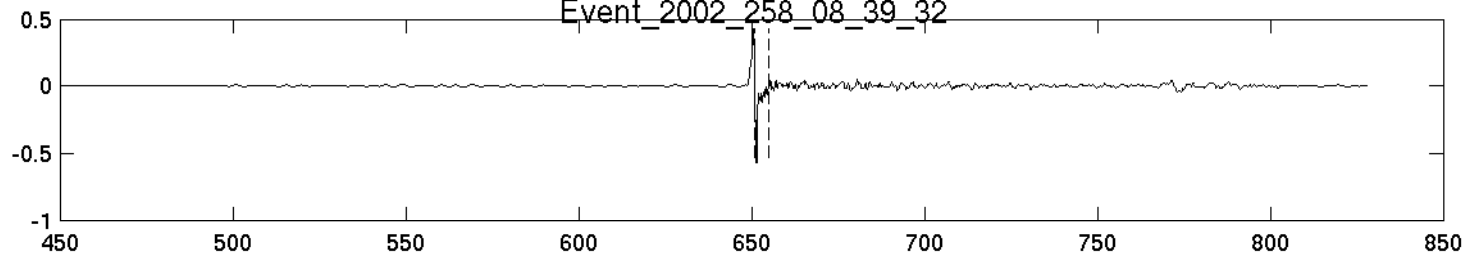
Sorted by t\*:Event\_2002\_258\_08\_39\_32



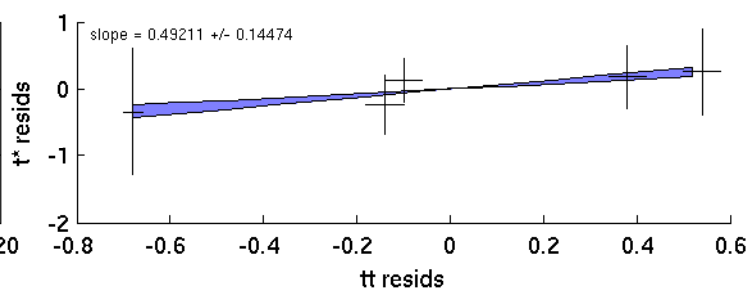
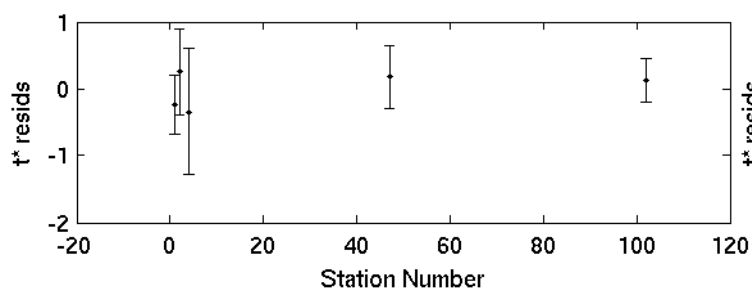


Event\_2002\_258\_08\_39\_32

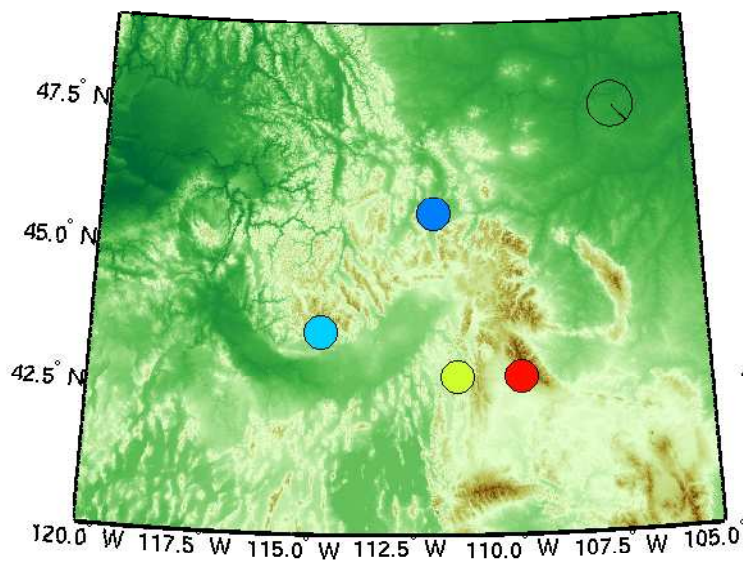
Stack



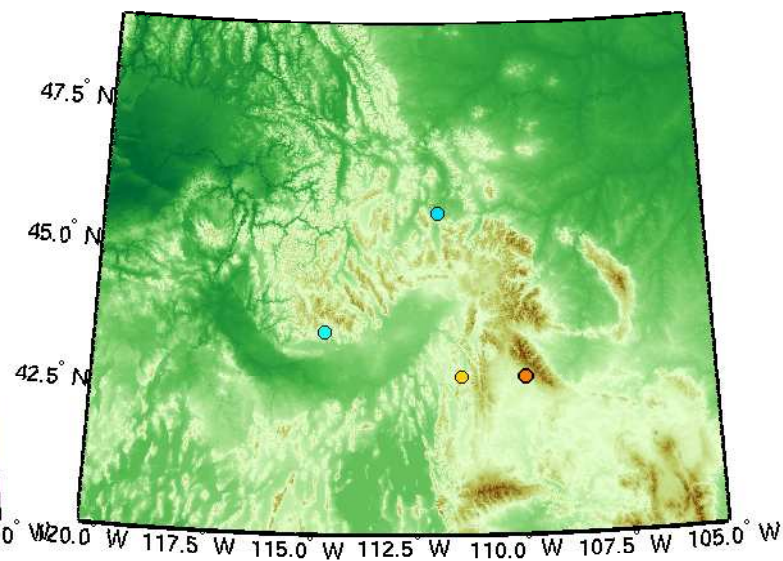
Baz = 319.9782  
Mean xcor value = 0.688  
Range of  $t^*$  values is 0.596  
Median  $t^*$  err is 0.46858  
Slope = 0.49211 +/- 0.14474



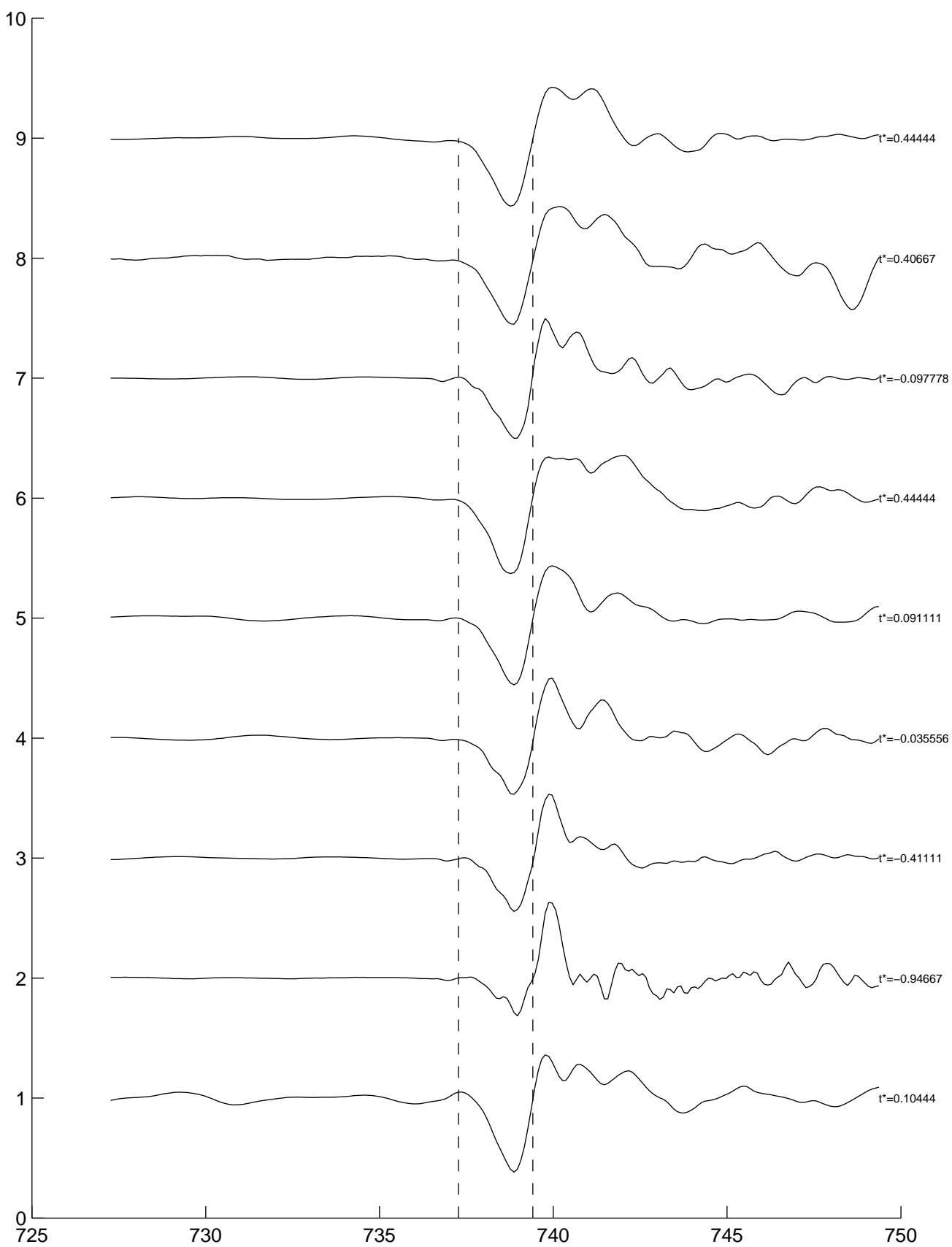
travel time residuals



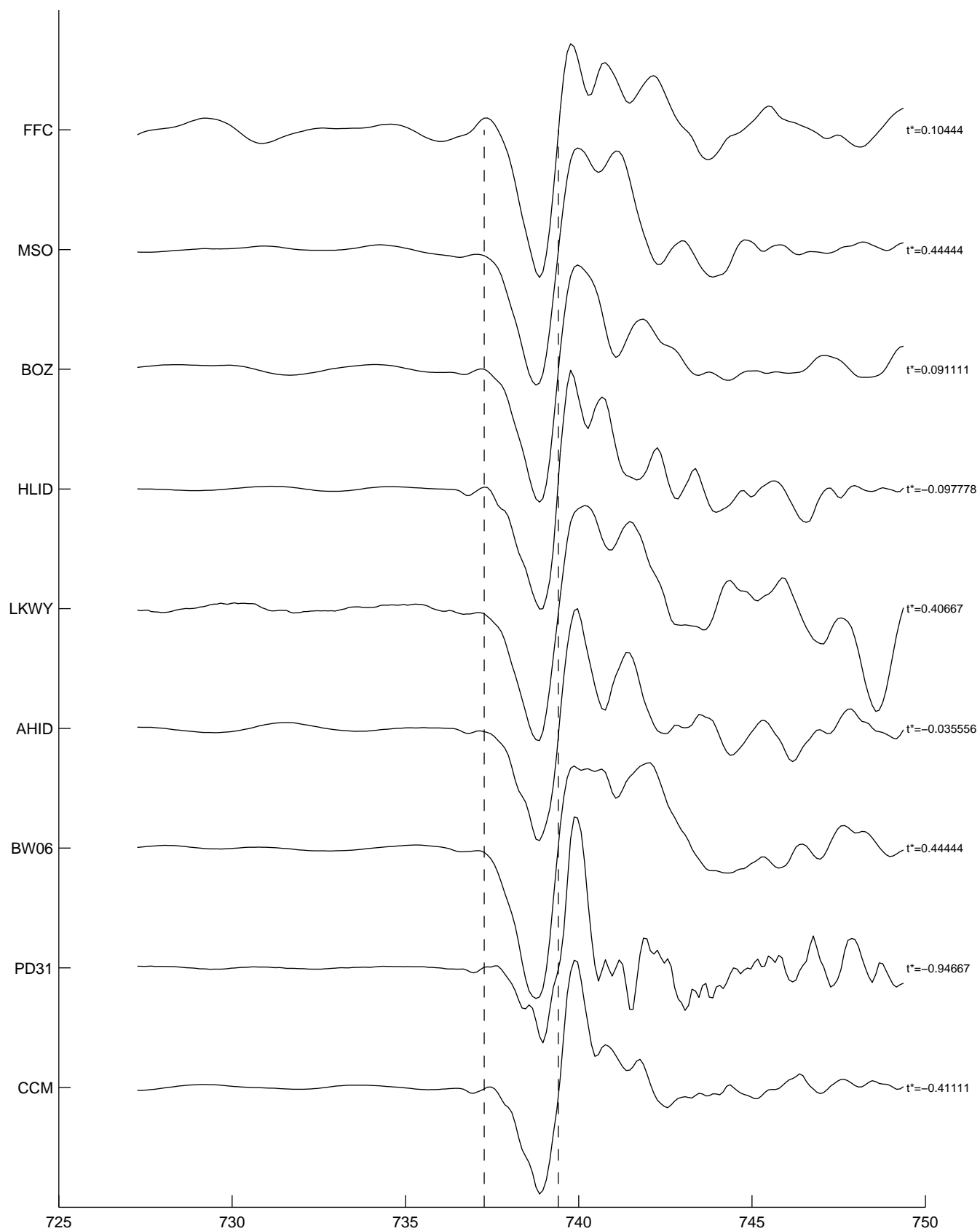
$t^*$  values



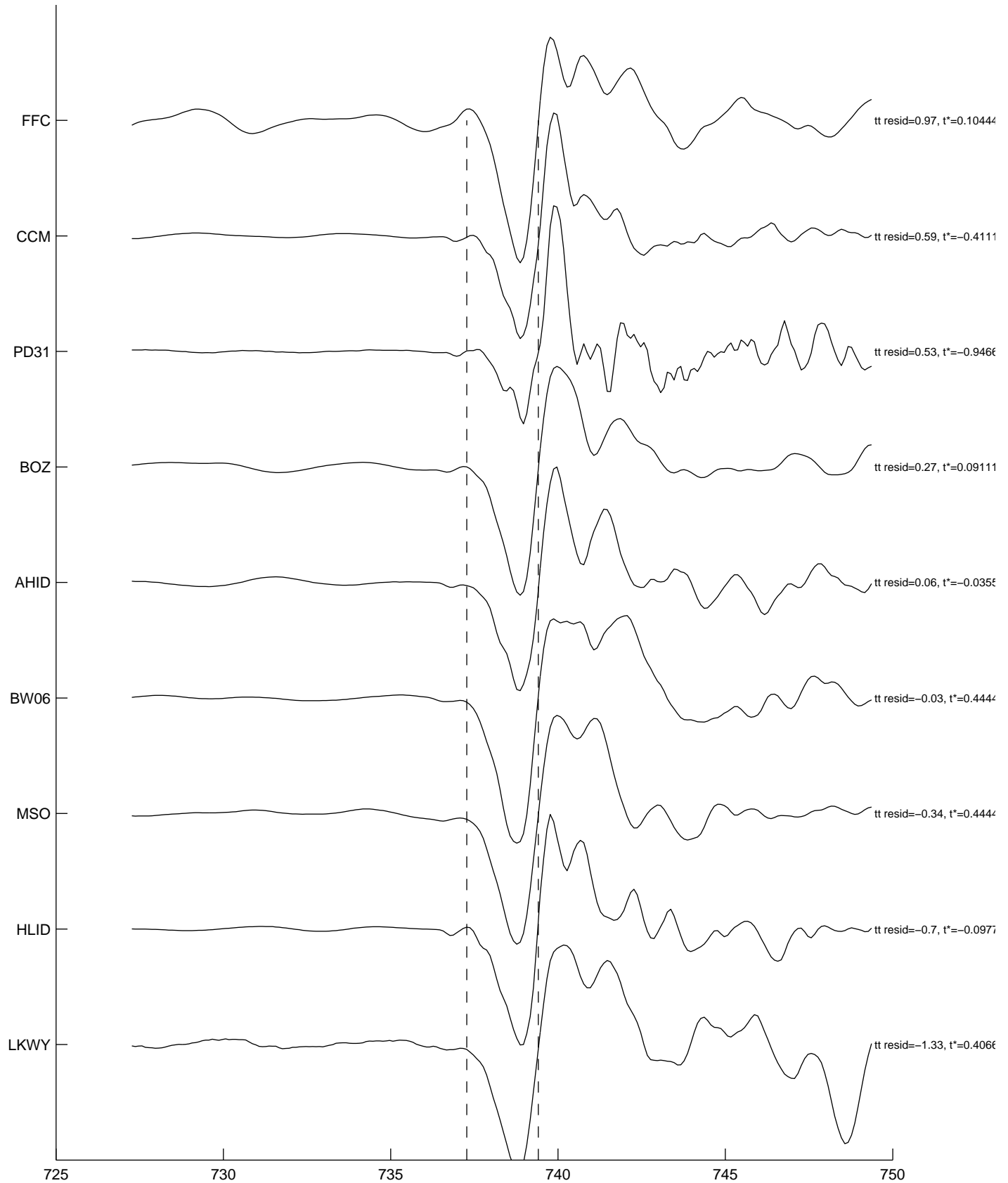
# Event\_2002\_267\_03\_57\_22



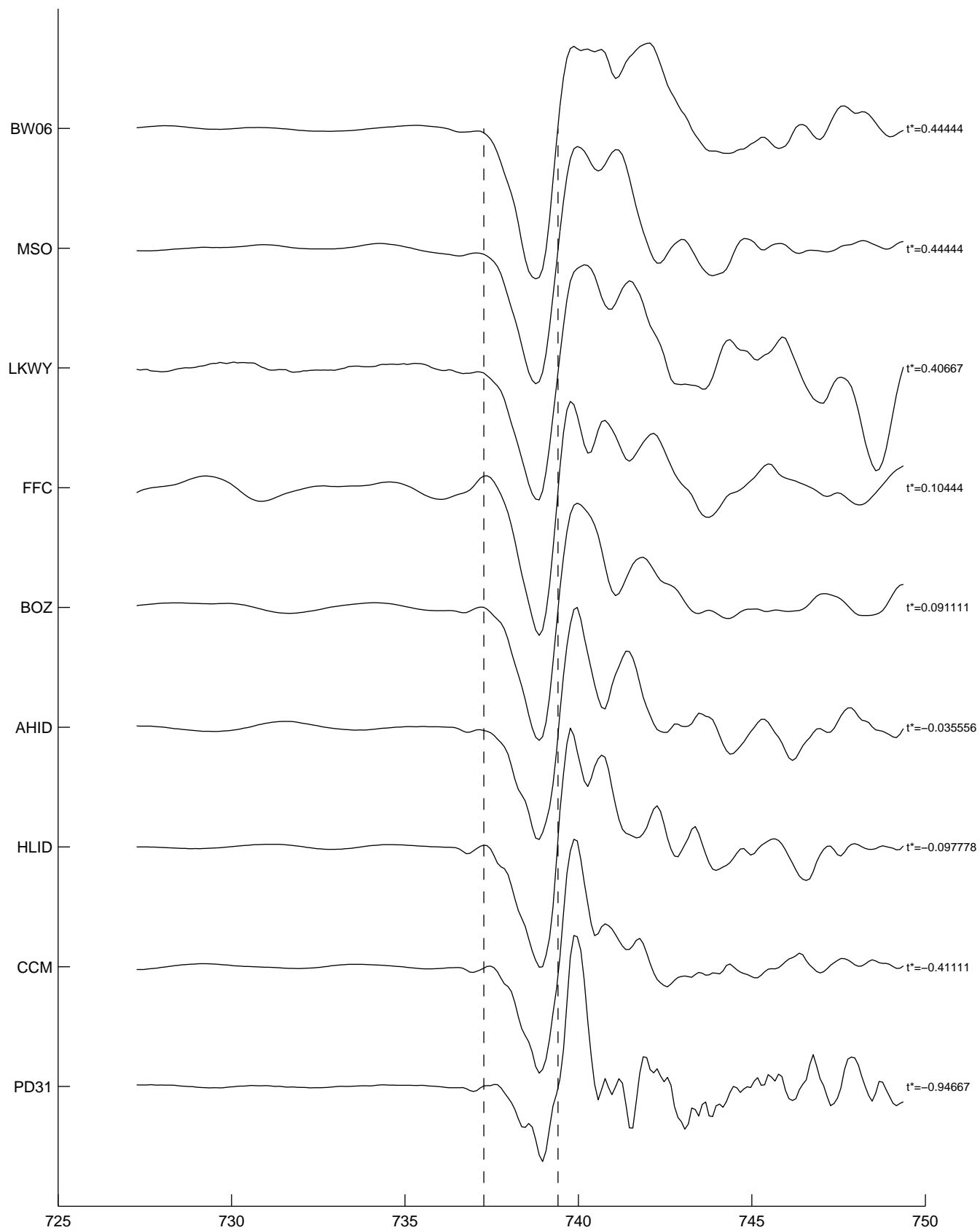
# Sorted by Delta:Event\_2002\_267\_03\_57\_22



# Sorted by travel time: Event\_2002\_267\_03\_57\_22

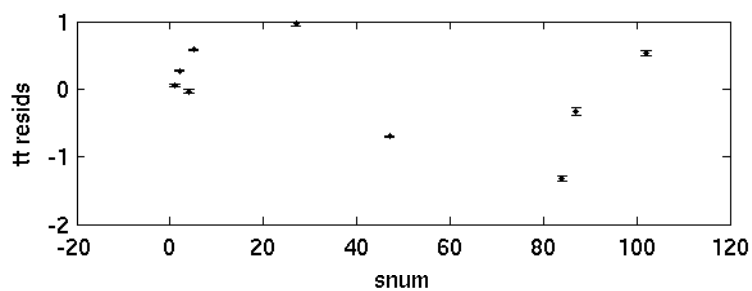
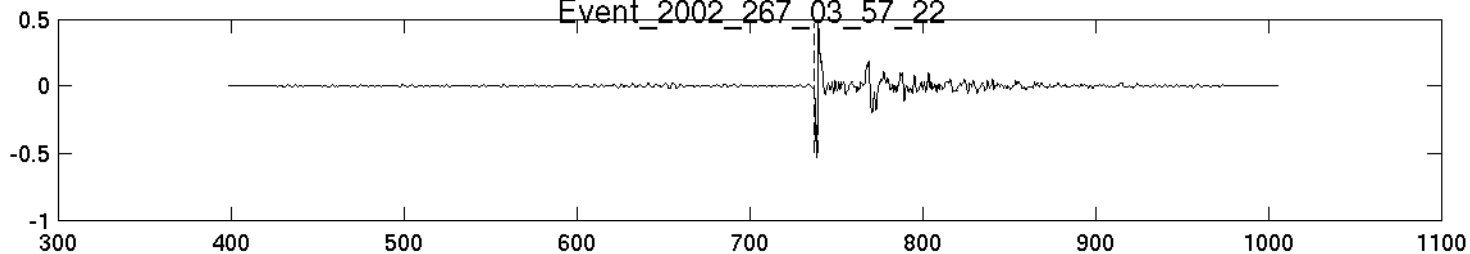


Sorted by  $t^*$ :Event\_2002\_267\_03\_57\_22

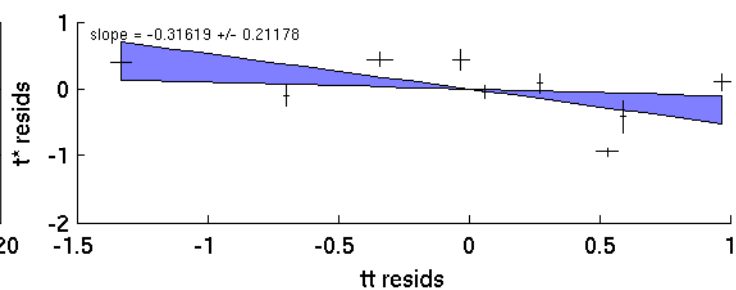
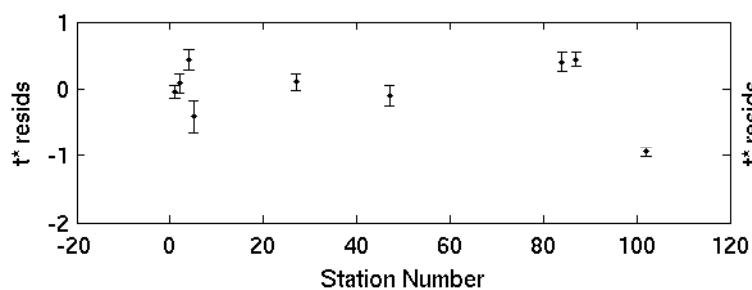


Event\_2002\_267\_03\_57\_22

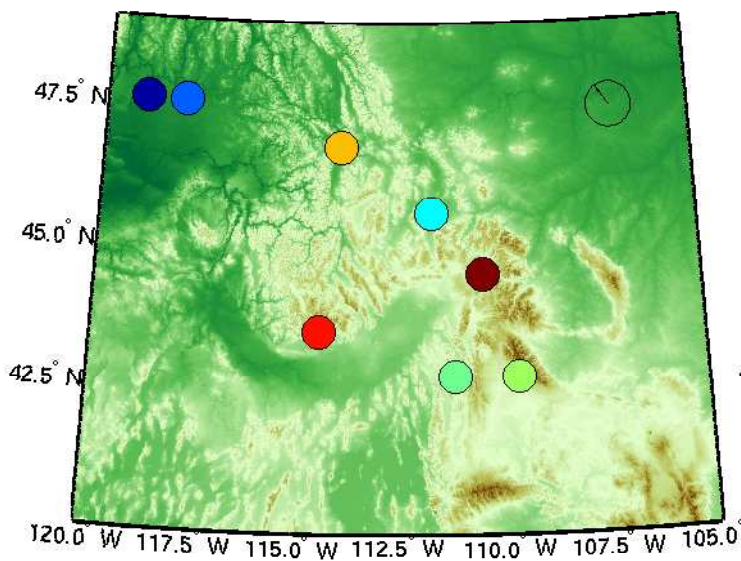
Stack



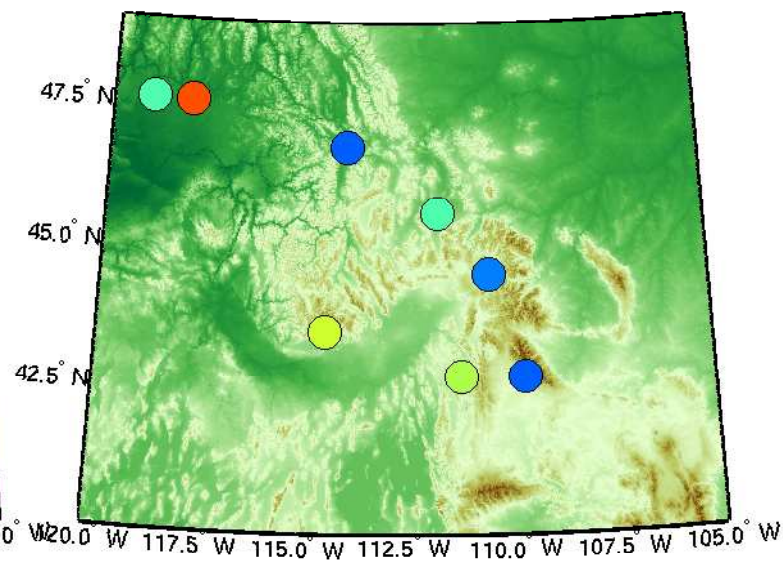
Baz = 147.4018  
Mean xcor value = 0.79444  
Range of  $t^*$  values is 1.3911  
Median  $t^*$  err is 0.13735  
Slope = -0.31619 +/- 0.21178



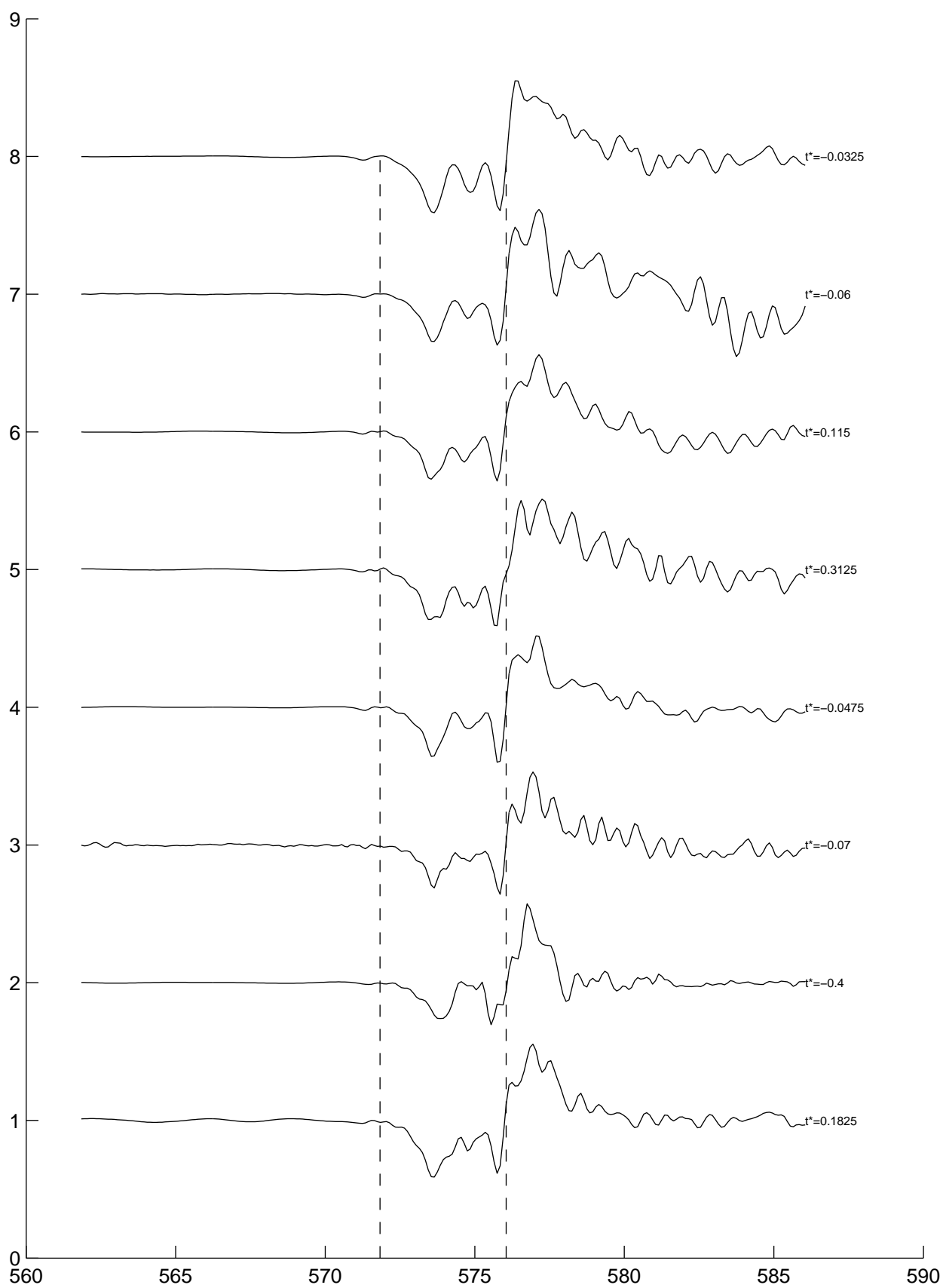
travel time residuals



$t^*$  values

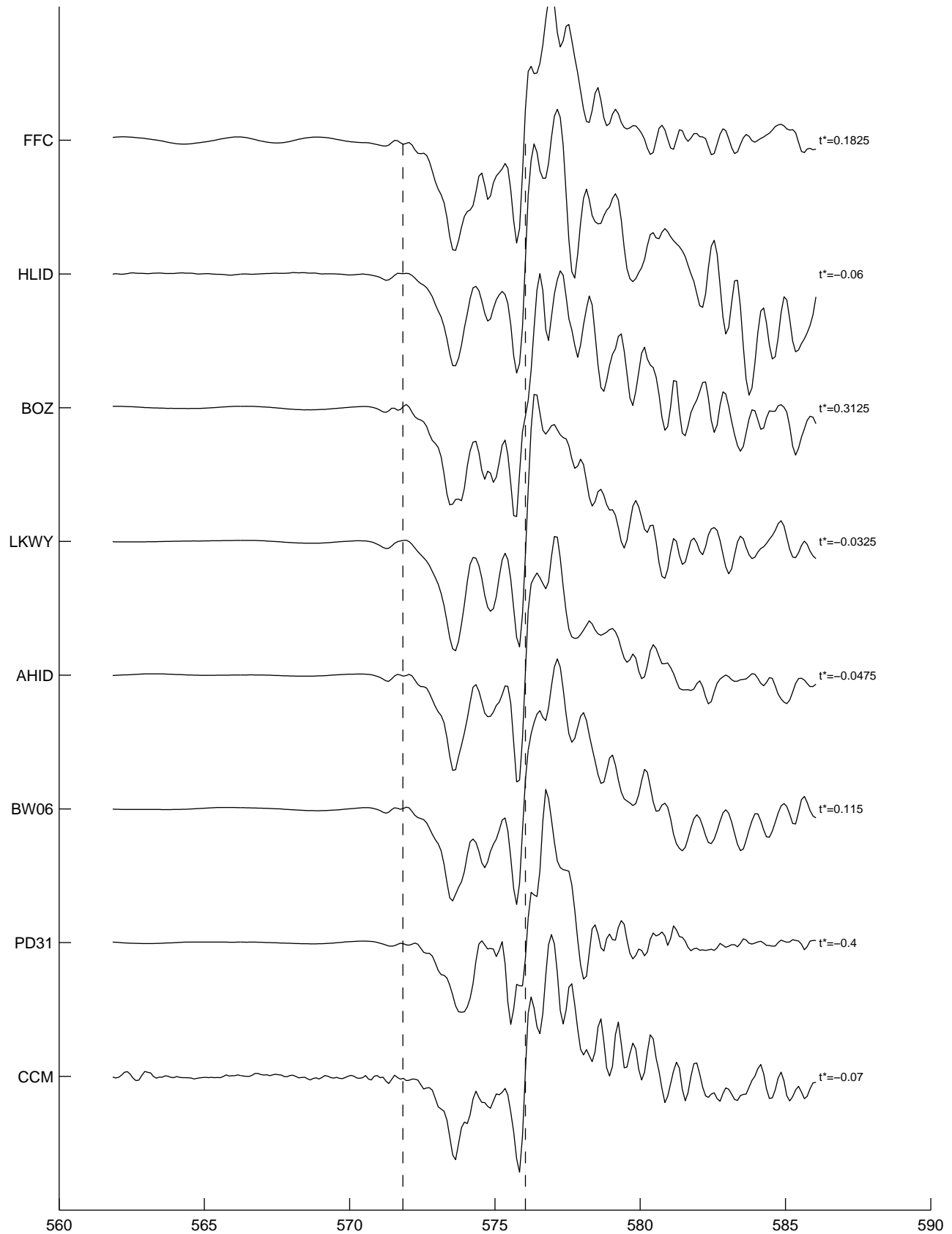


# Event\_2002\_285\_20\_09\_11

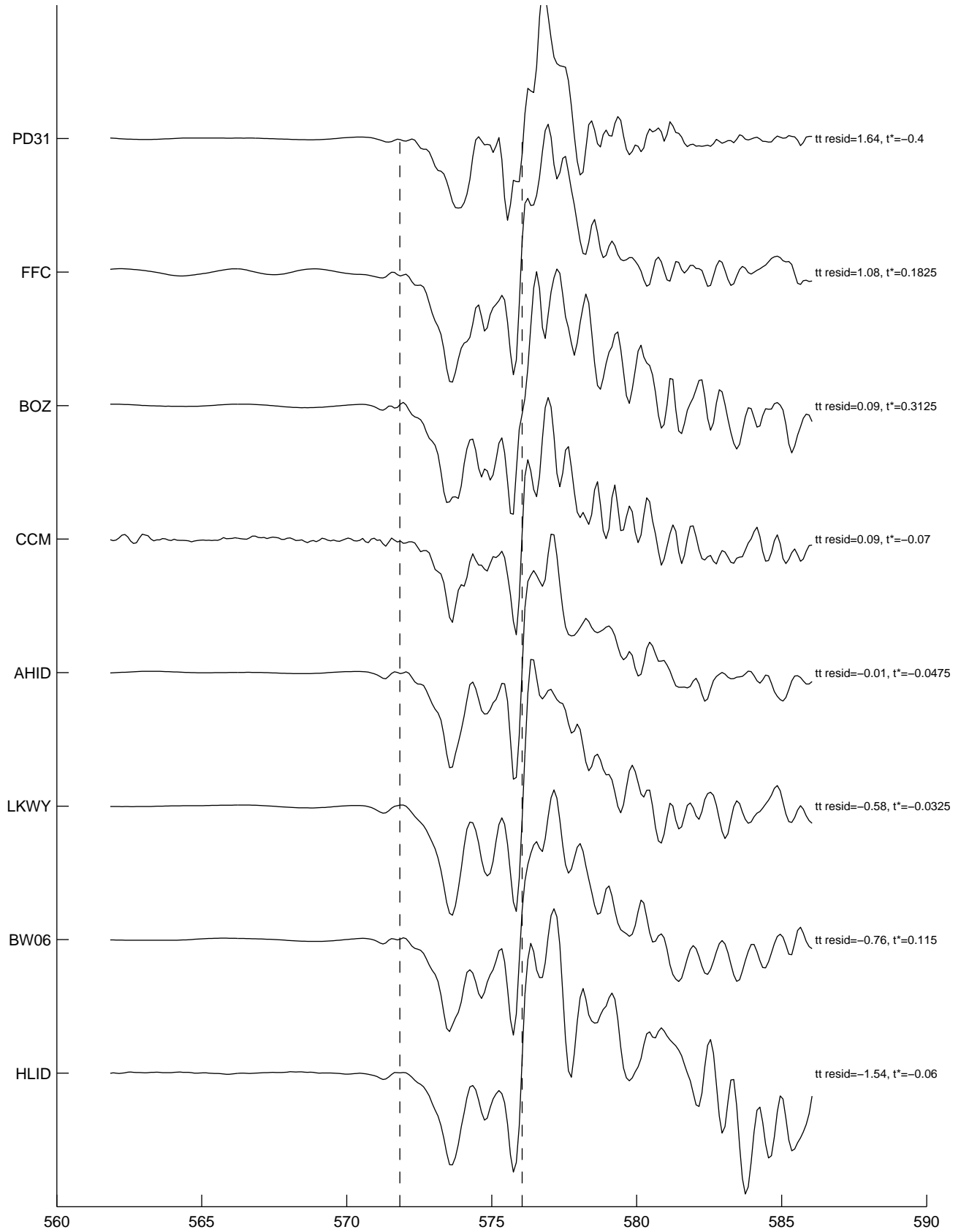




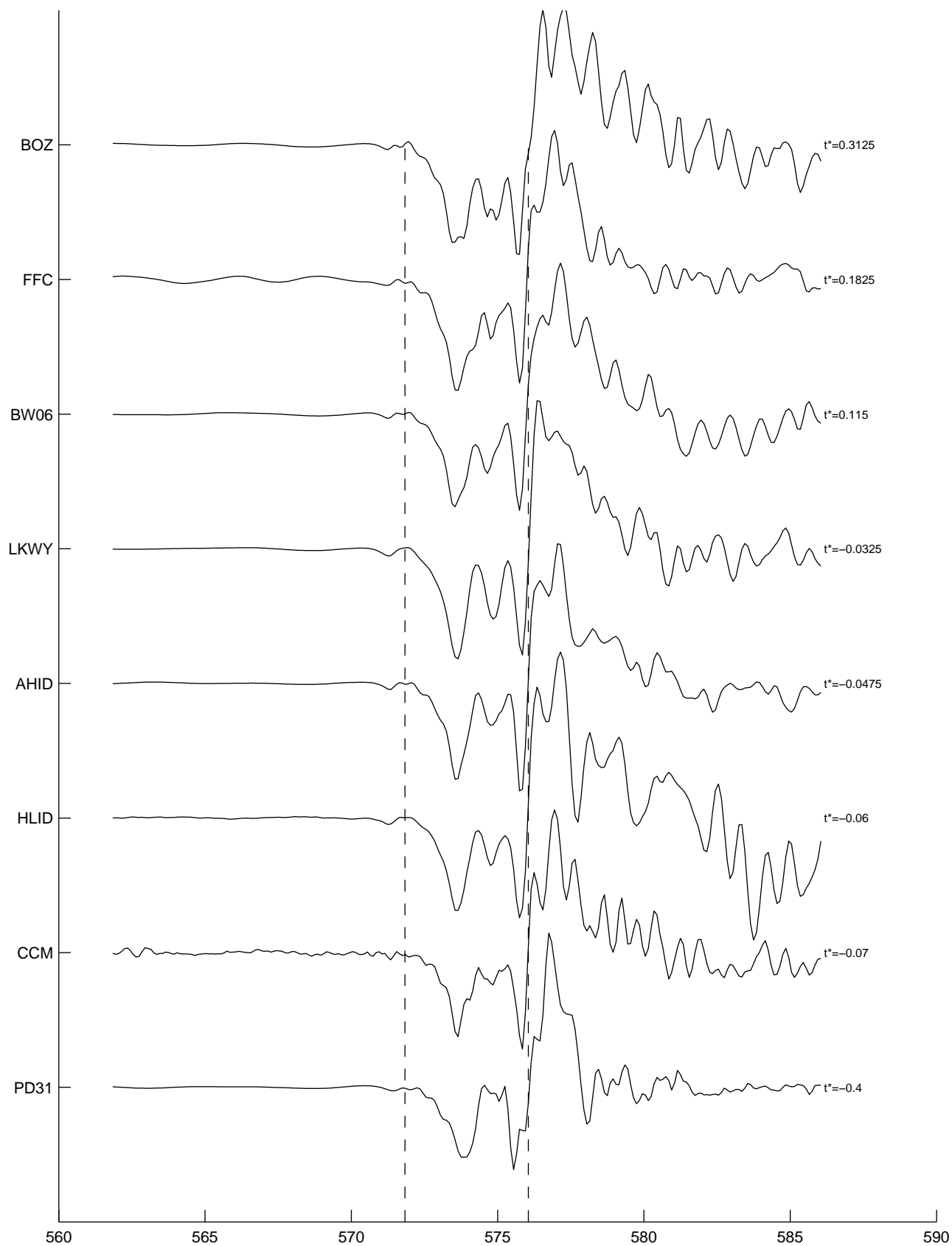
# Sorted by Delta:Event\_2002\_285\_20\_09\_11



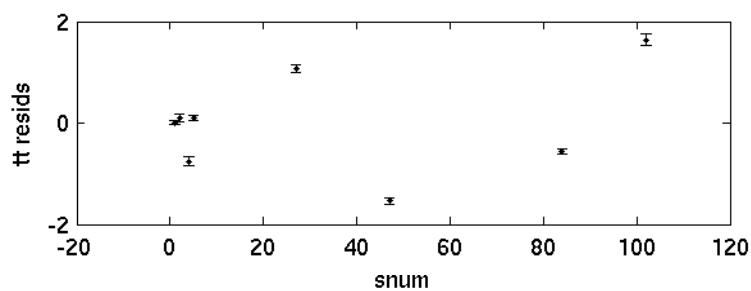
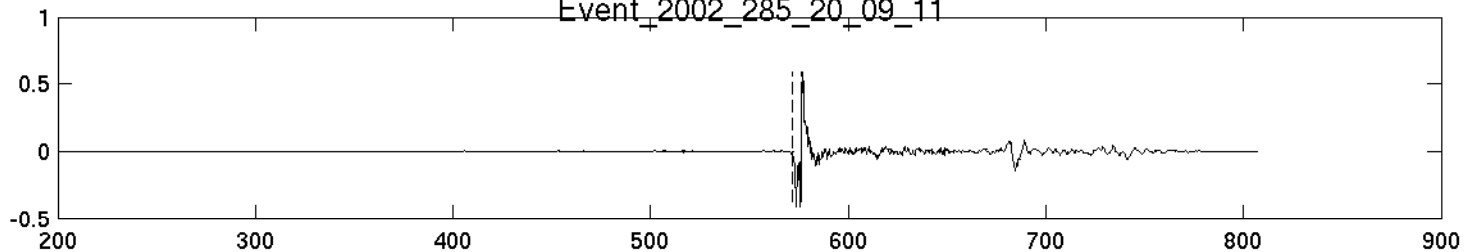
# Sorted by travel time:Event\_2002\_285\_20\_09\_11



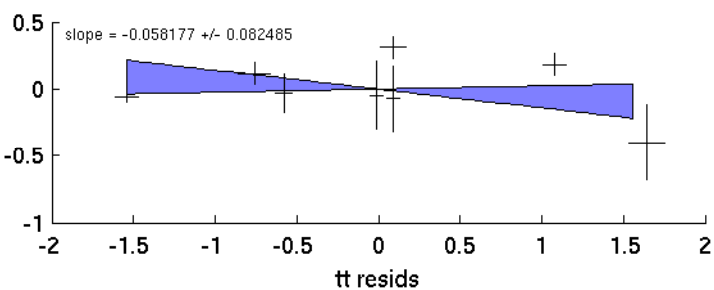
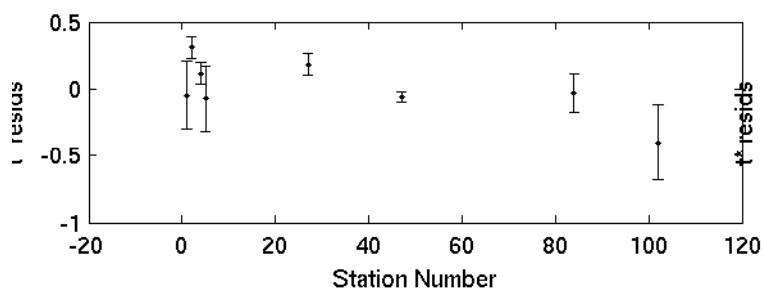
Sorted by  $t^*$ : Event\_2002\_285\_20\_09\_11



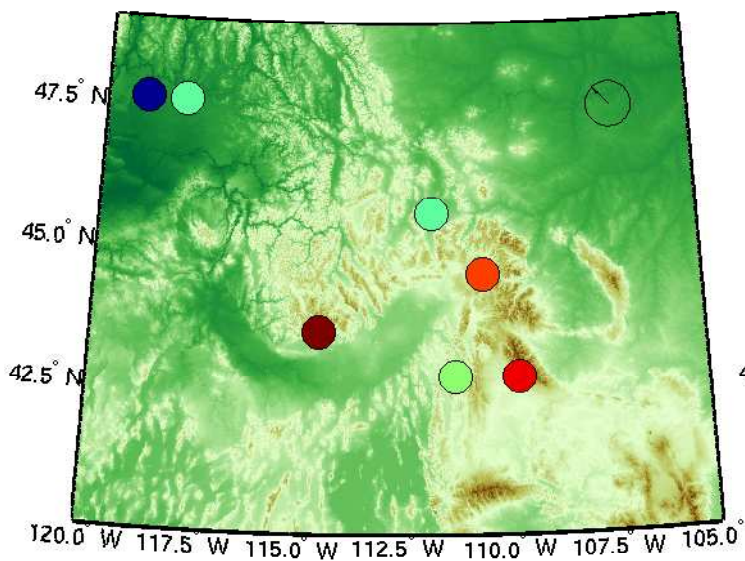
# Stack Event\_2002\_285\_20\_09\_11



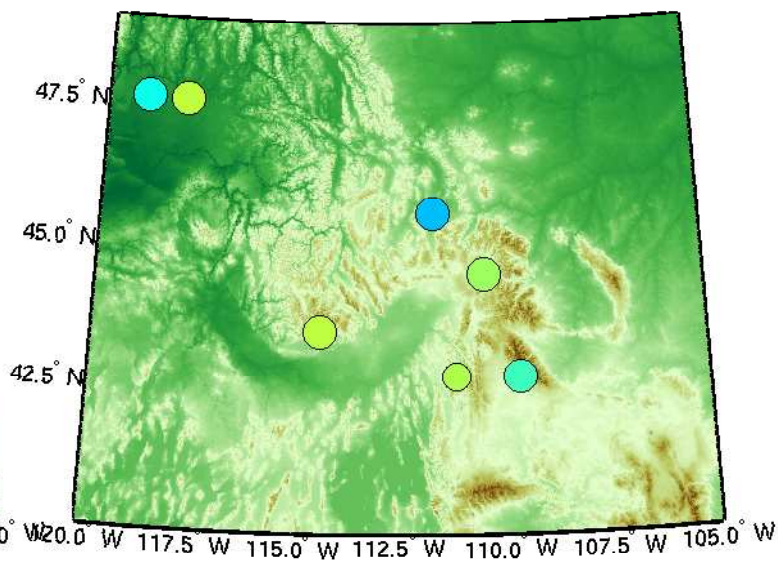
Baz = 138.5351  
Mean xcor value = 0.75  
Range of  $t^*$  values is 0.7125  
Median  $t^*$  err is 0.11334  
Slope =  $-0.058177 \pm 0.082485$



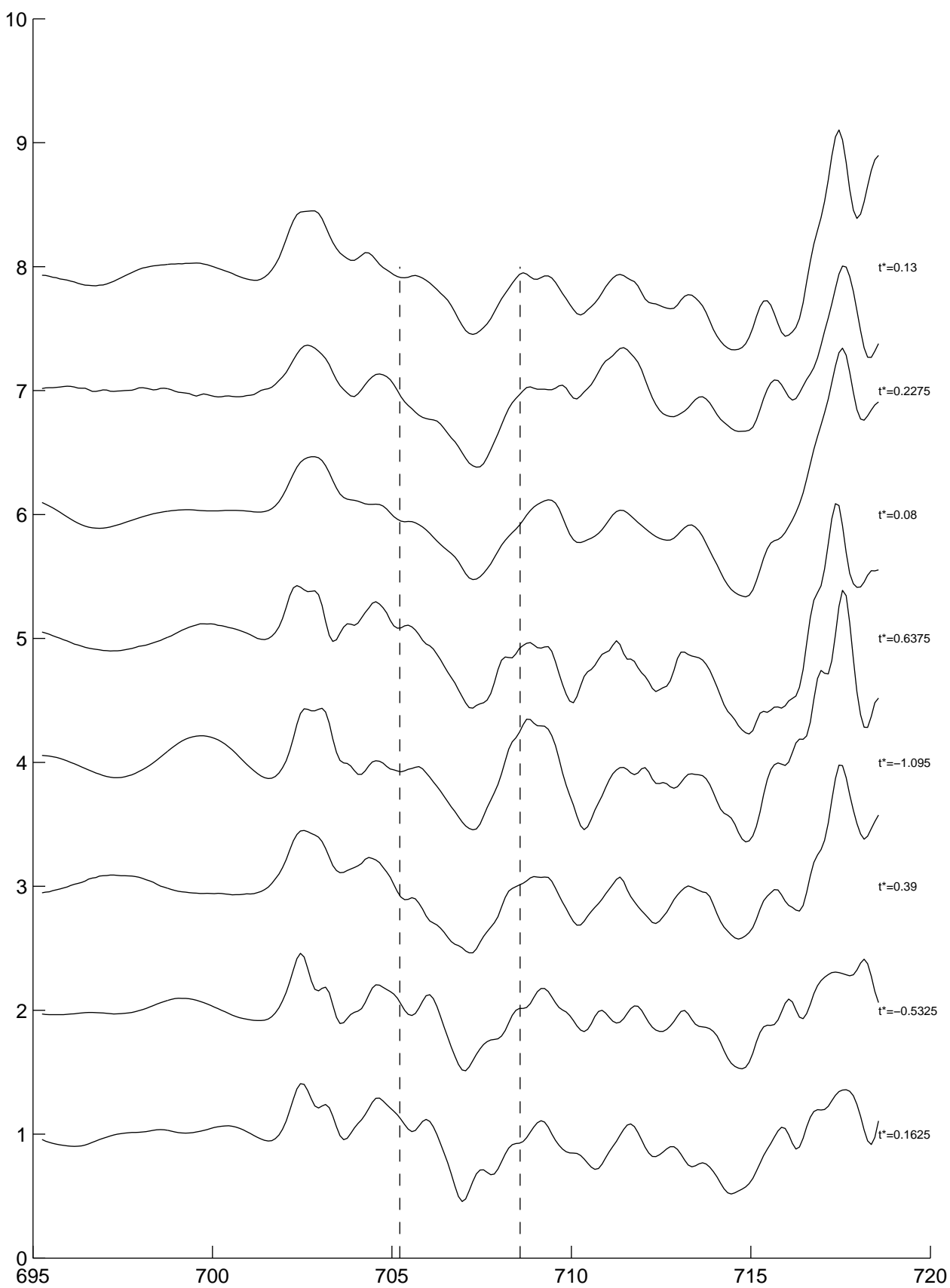
travel time residuals



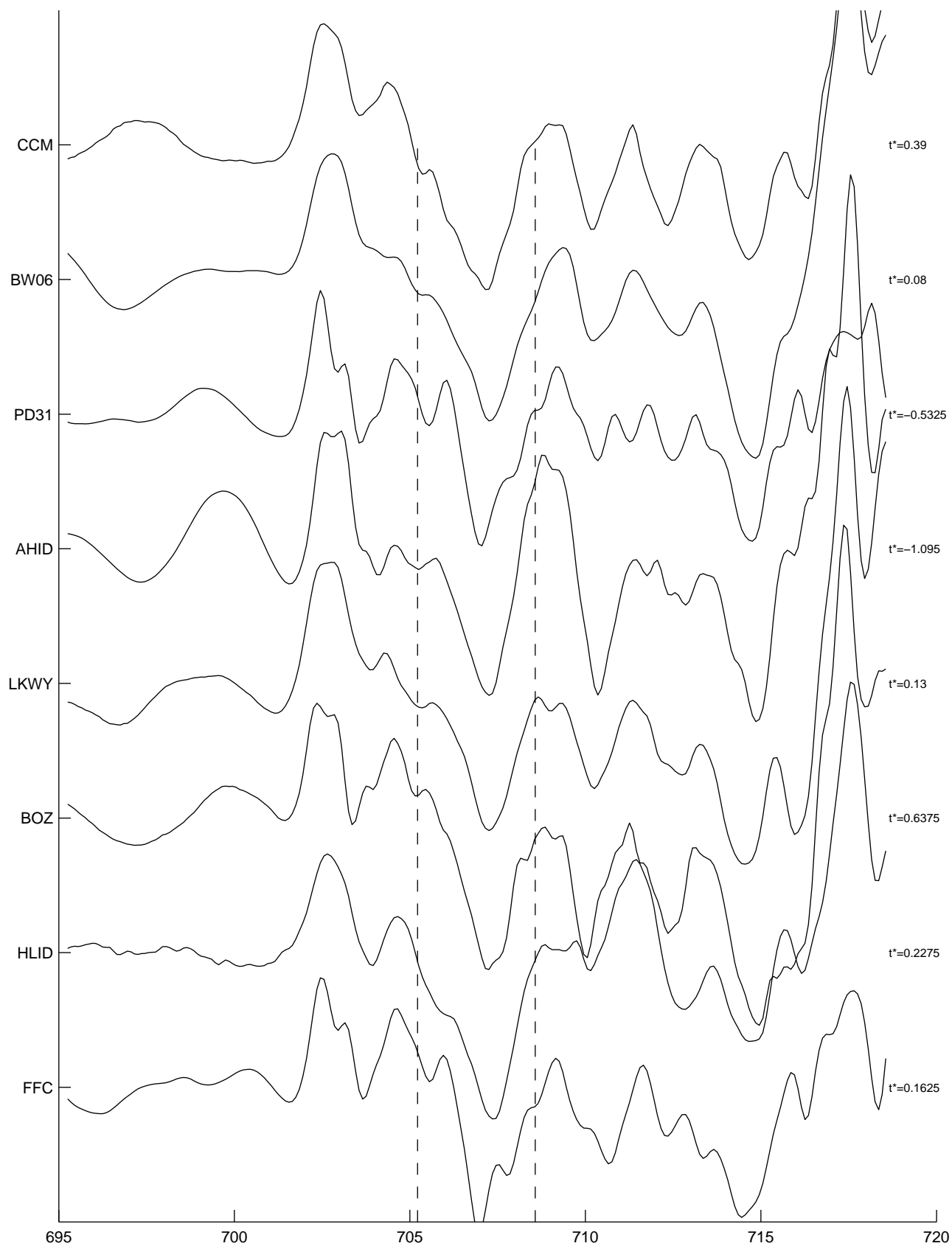
$t^*$  values



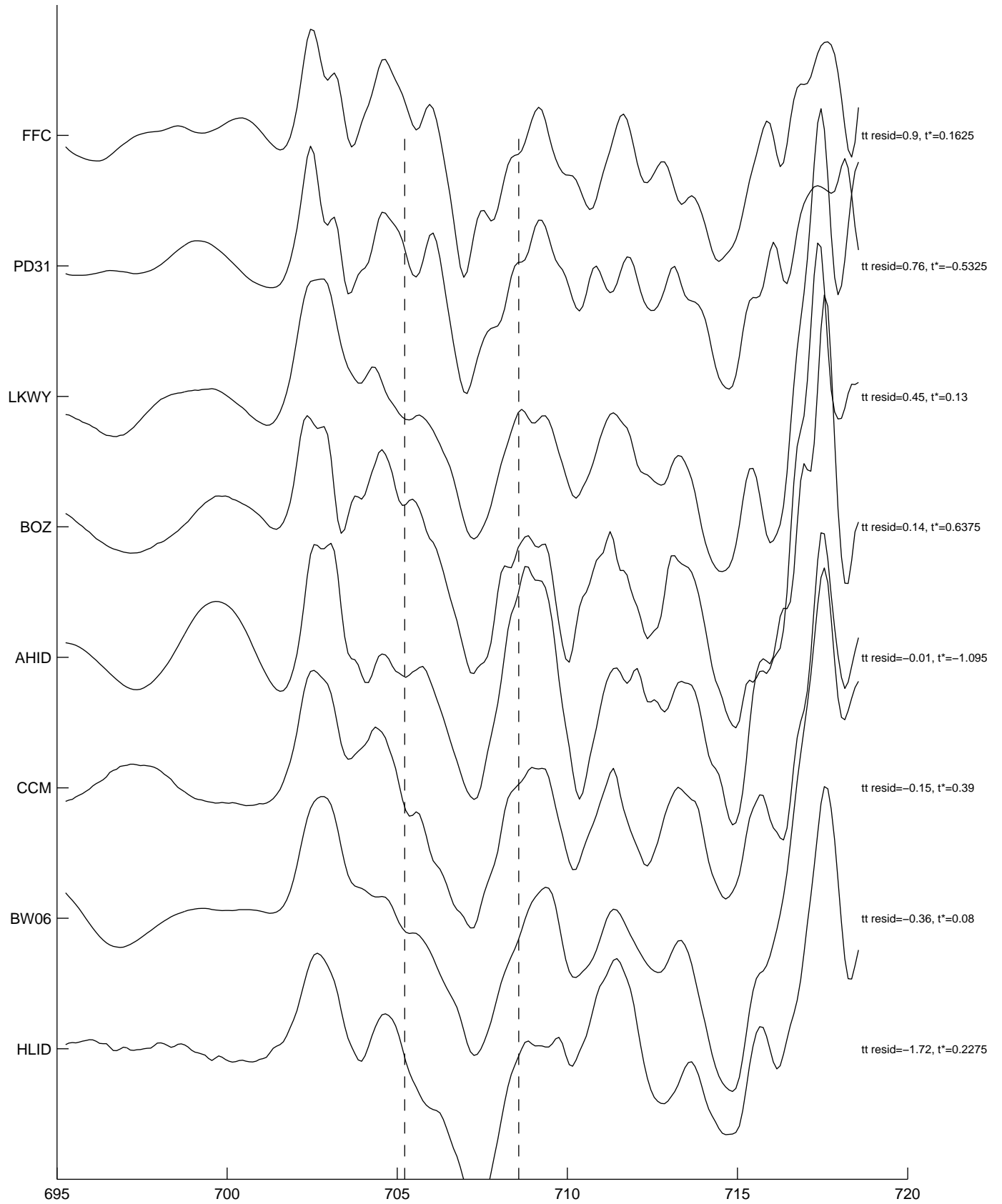
# Event\_2002\_307\_03\_37\_42



# Sorted by Delta:Event\_2002\_307\_03\_37\_42

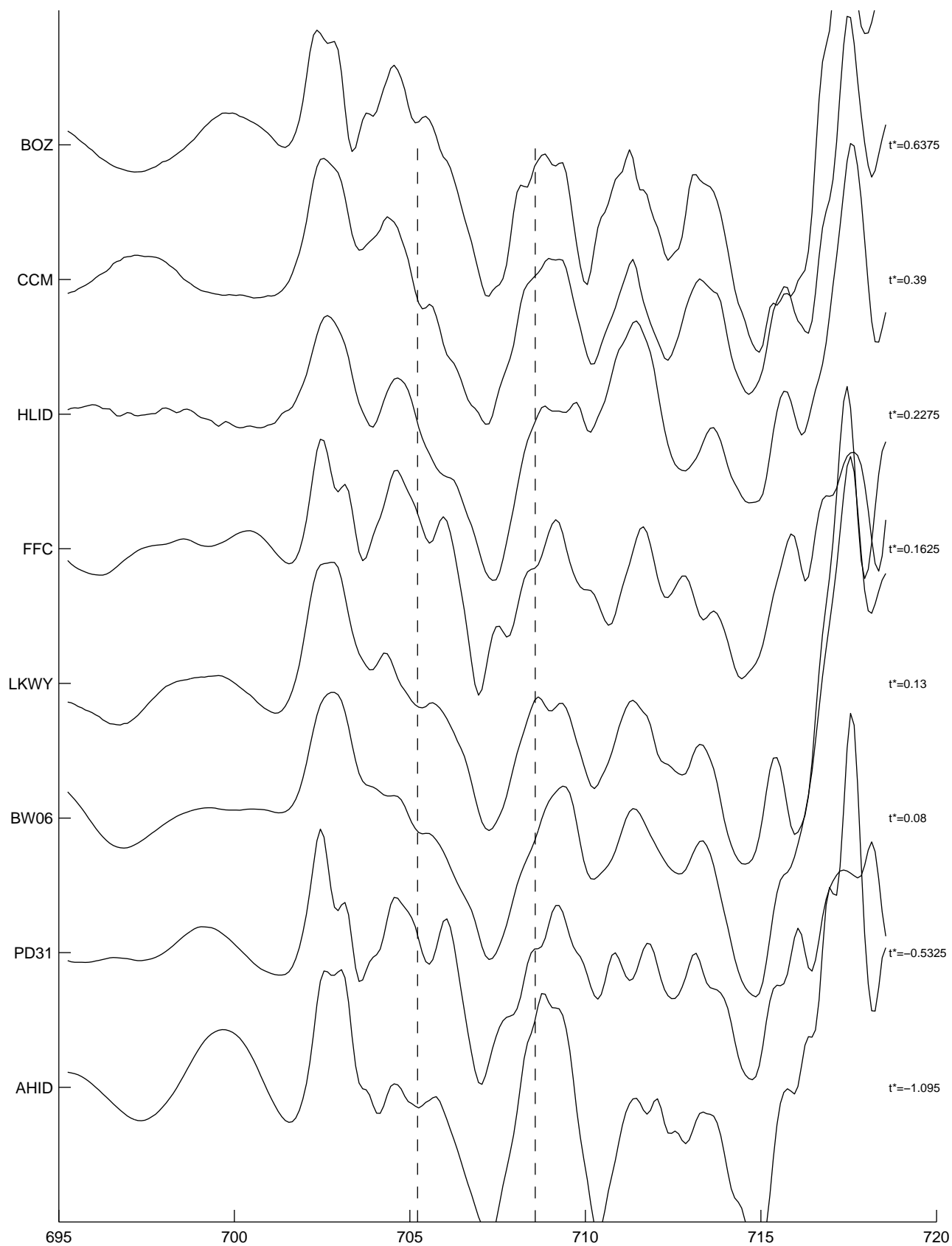


# Sorted by travel time:Event\_2002\_307\_03\_37\_42

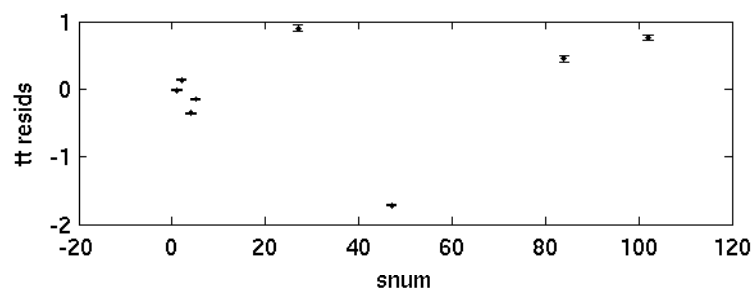
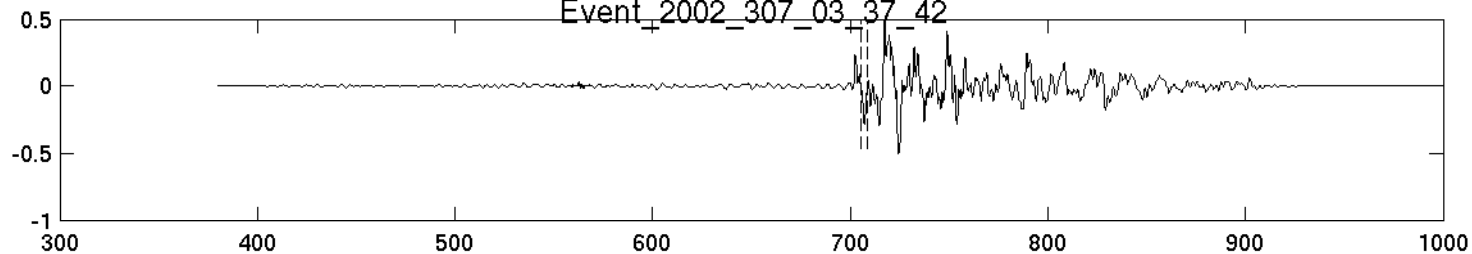




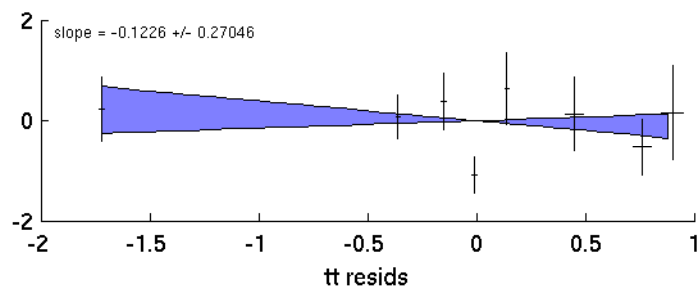
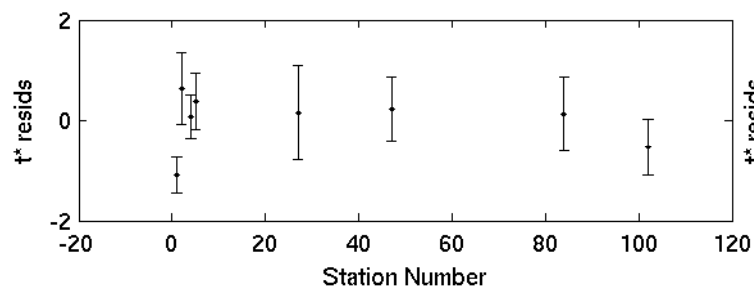
Sorted by t\*:Event\_2002\_307\_03\_37\_42



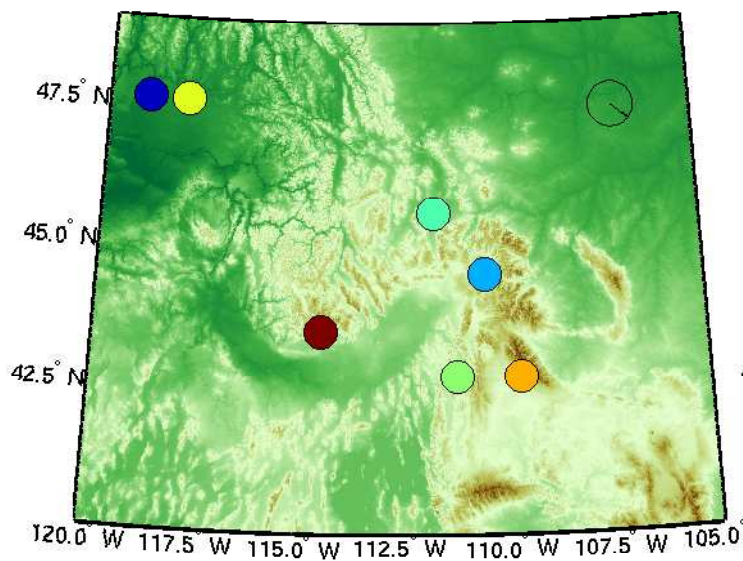
Stack  
Event\_2002\_307\_03\_37\_42



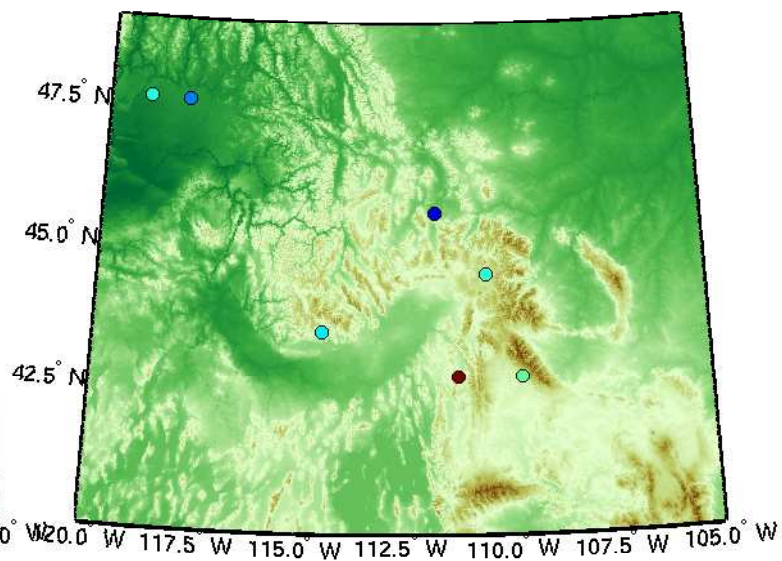
Baz = 310.7656  
Mean xcor value = 0.72875  
Range of  $t^*$  values is 1.7325  
Median  $t^*$  err is 0.6035  
Slope =  $-0.1226 \pm 0.27046$



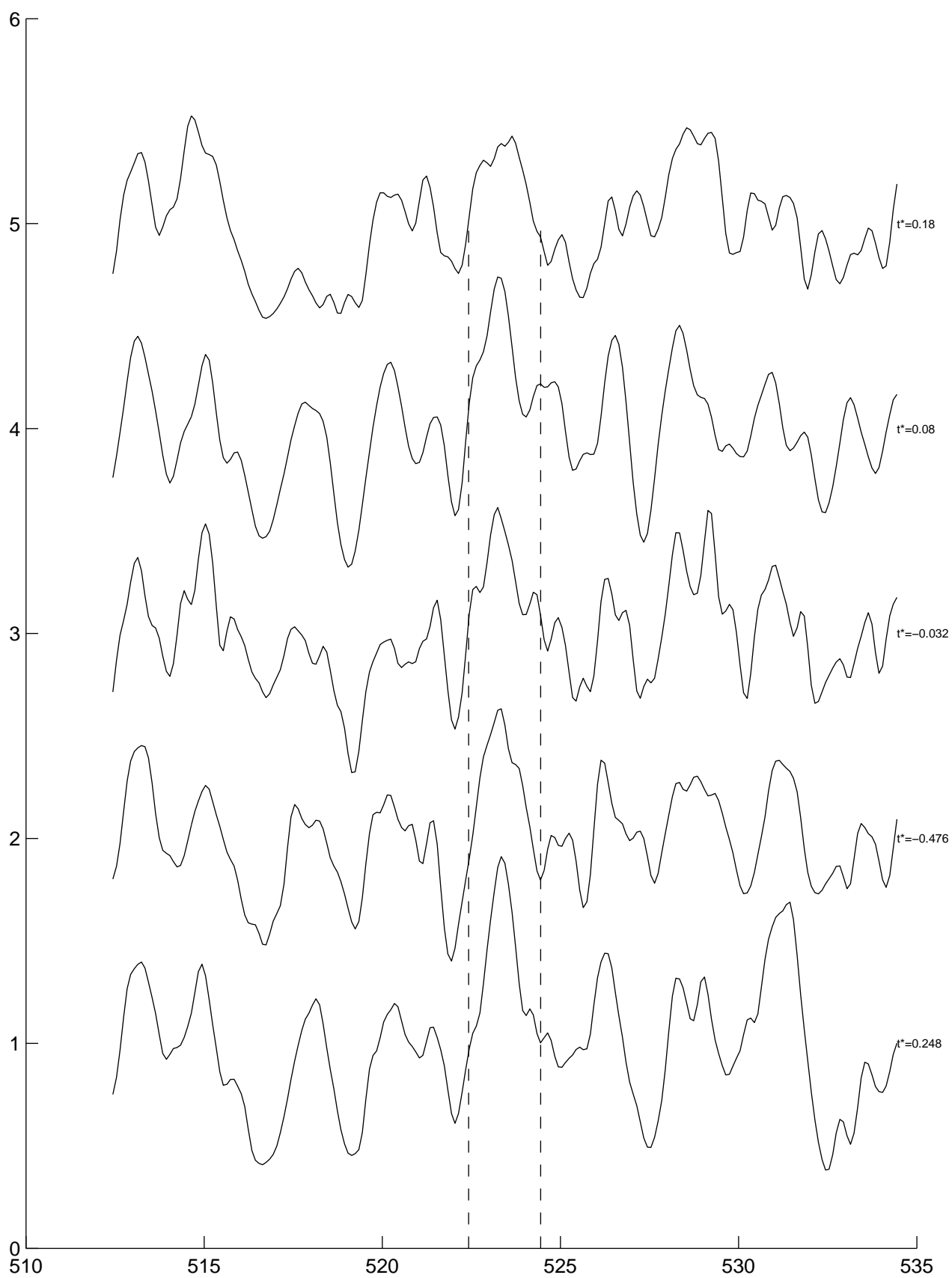
travel time residuals



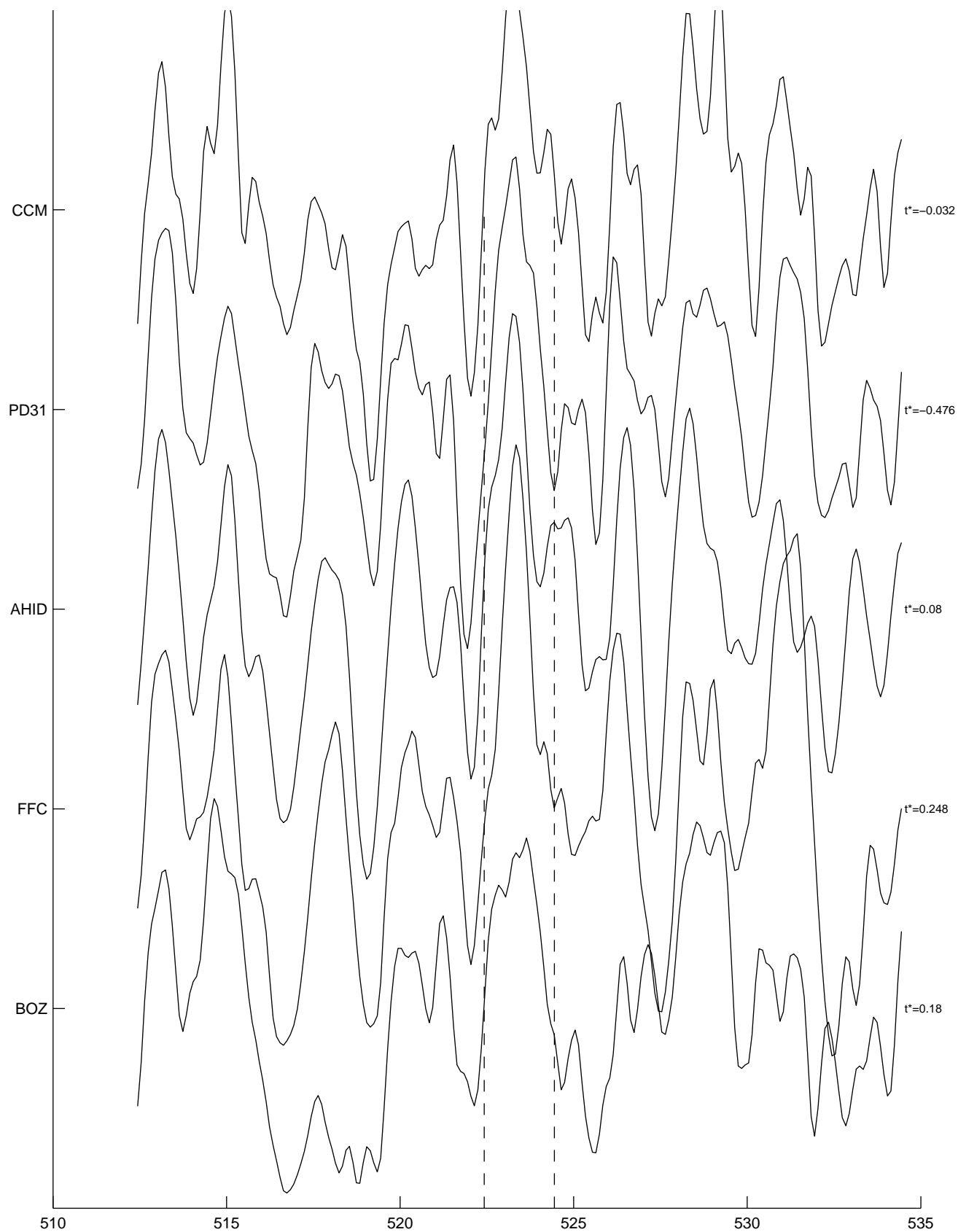
$t^*$  values



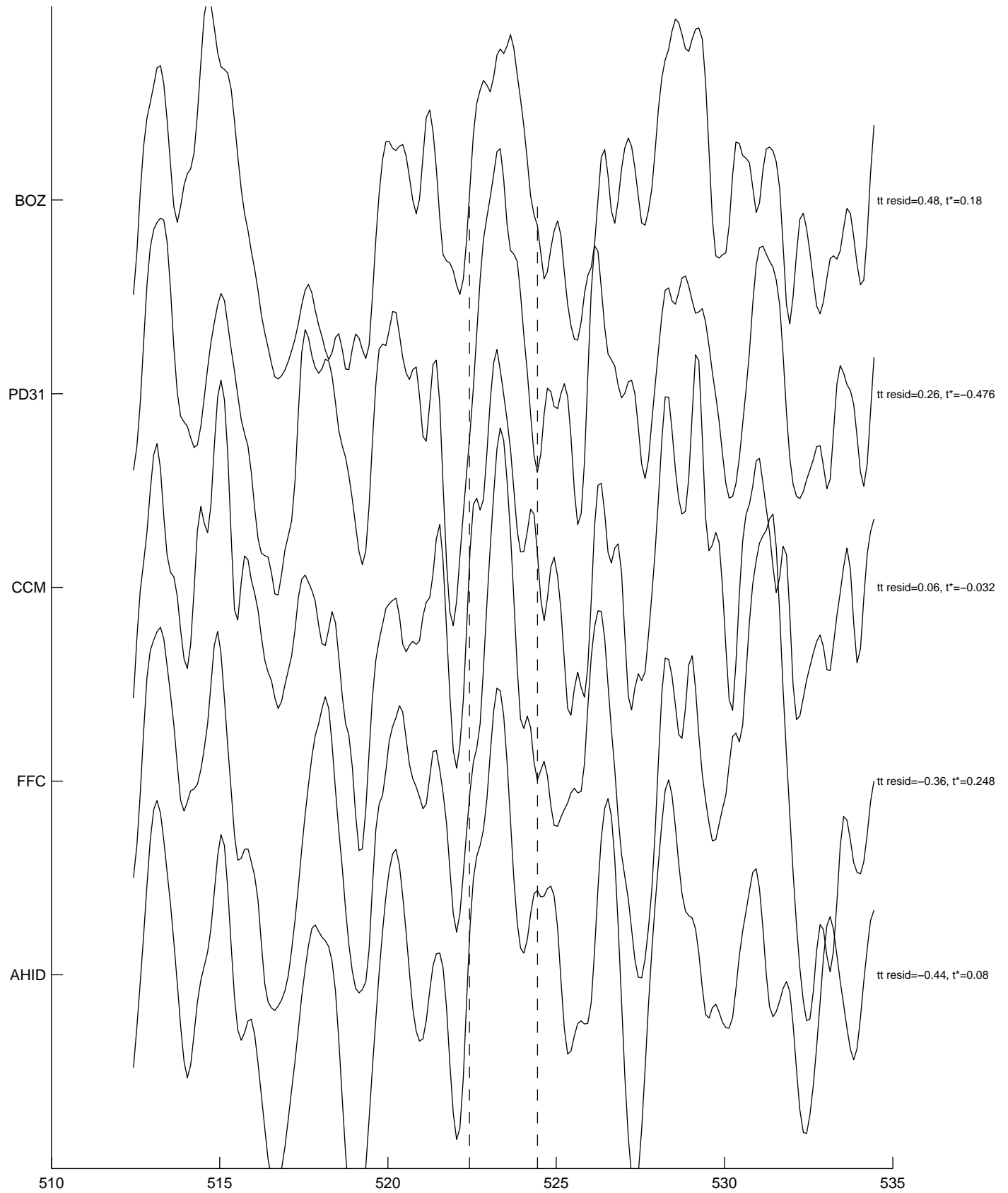
# Event\_2002\_311\_15\_14\_06



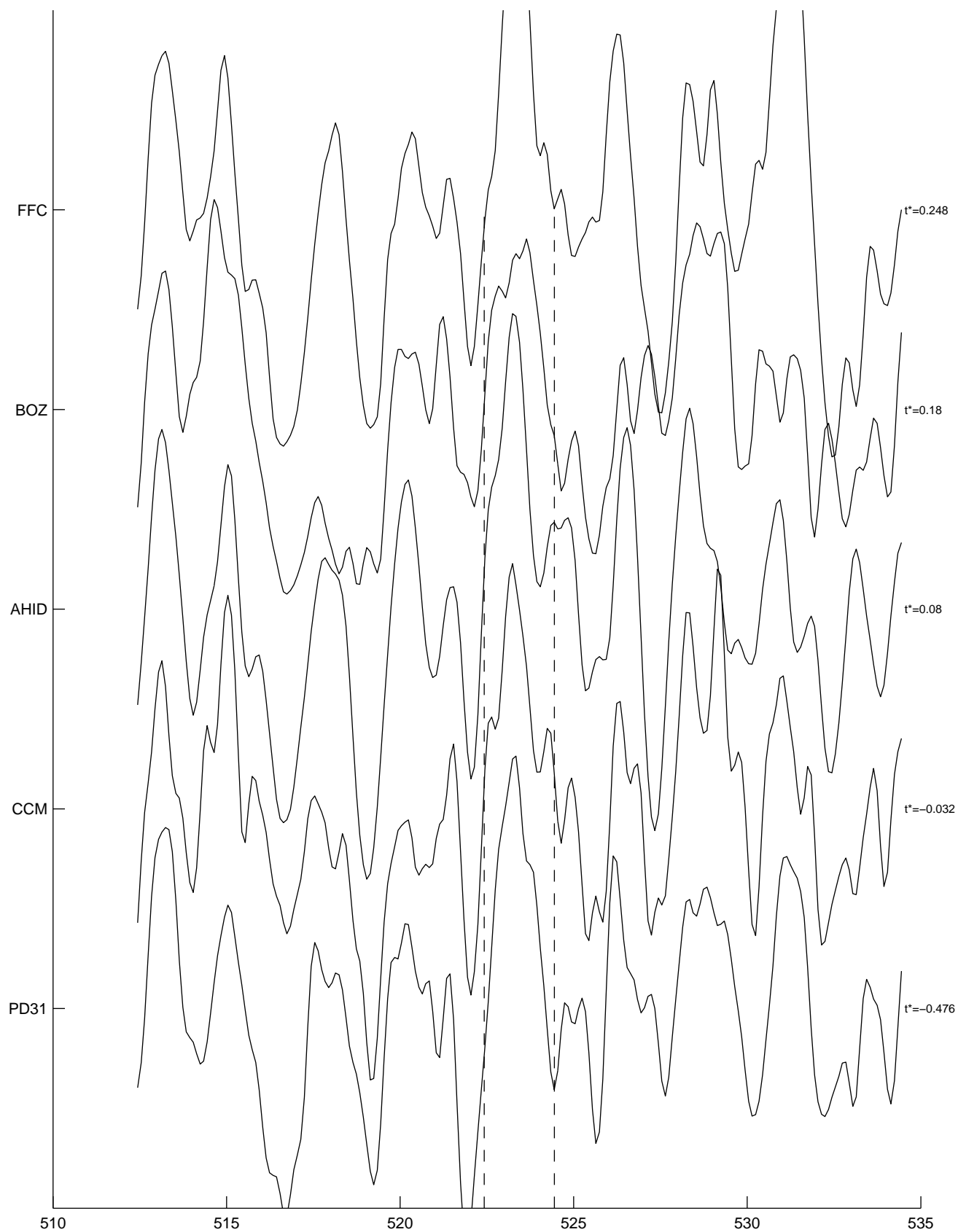
# Sorted by Delta:Event\_2002\_311\_15\_14\_06

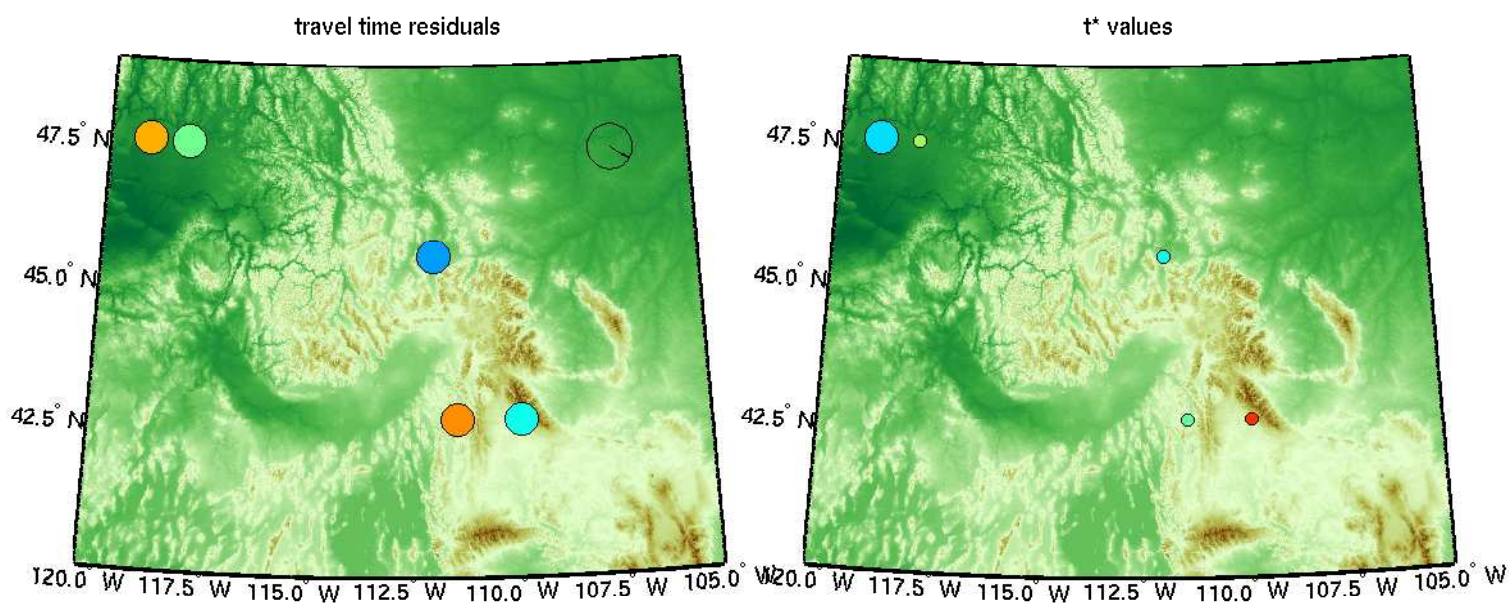
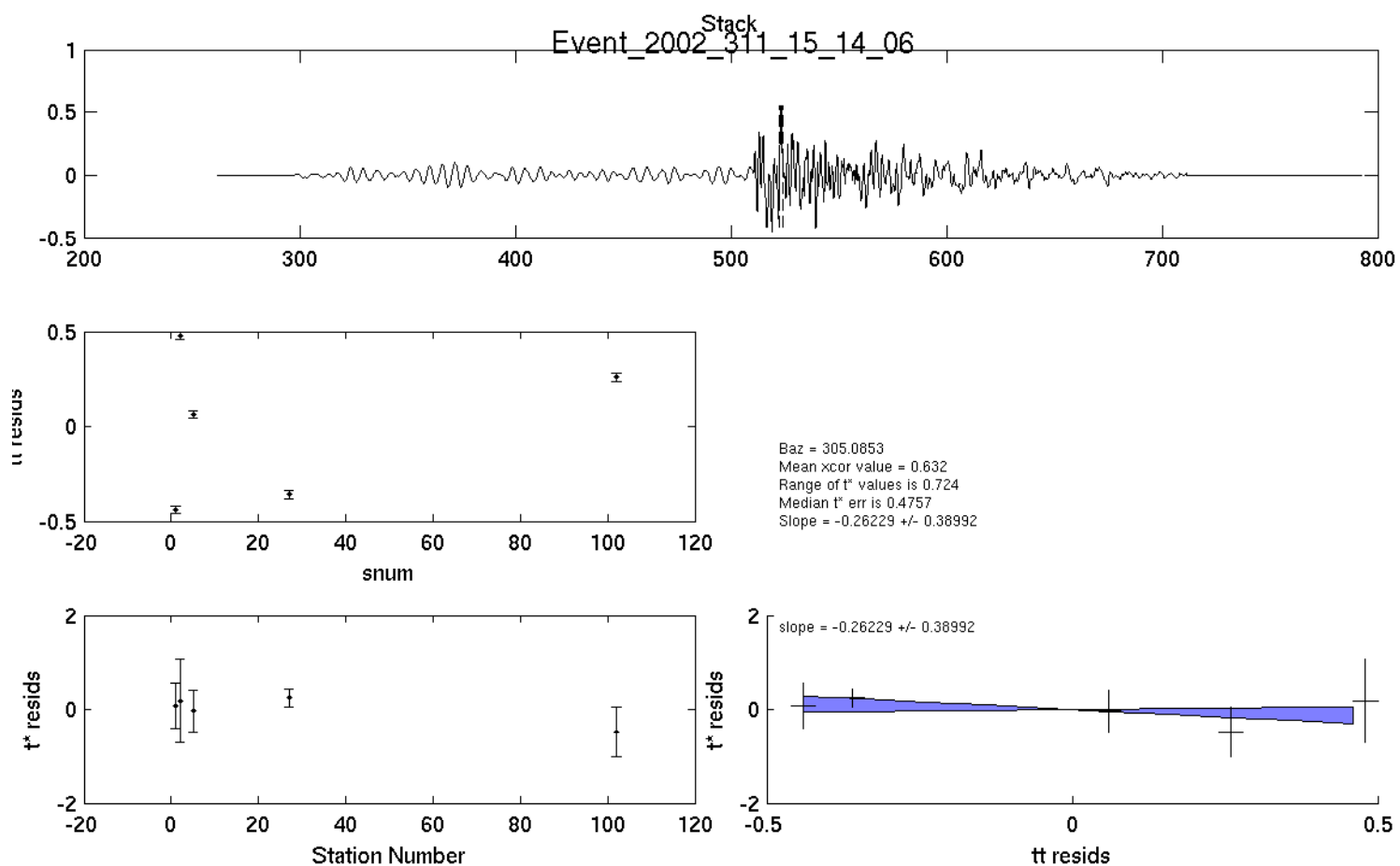


# Sorted by travel time:Event\_2002\_311\_15\_14\_06



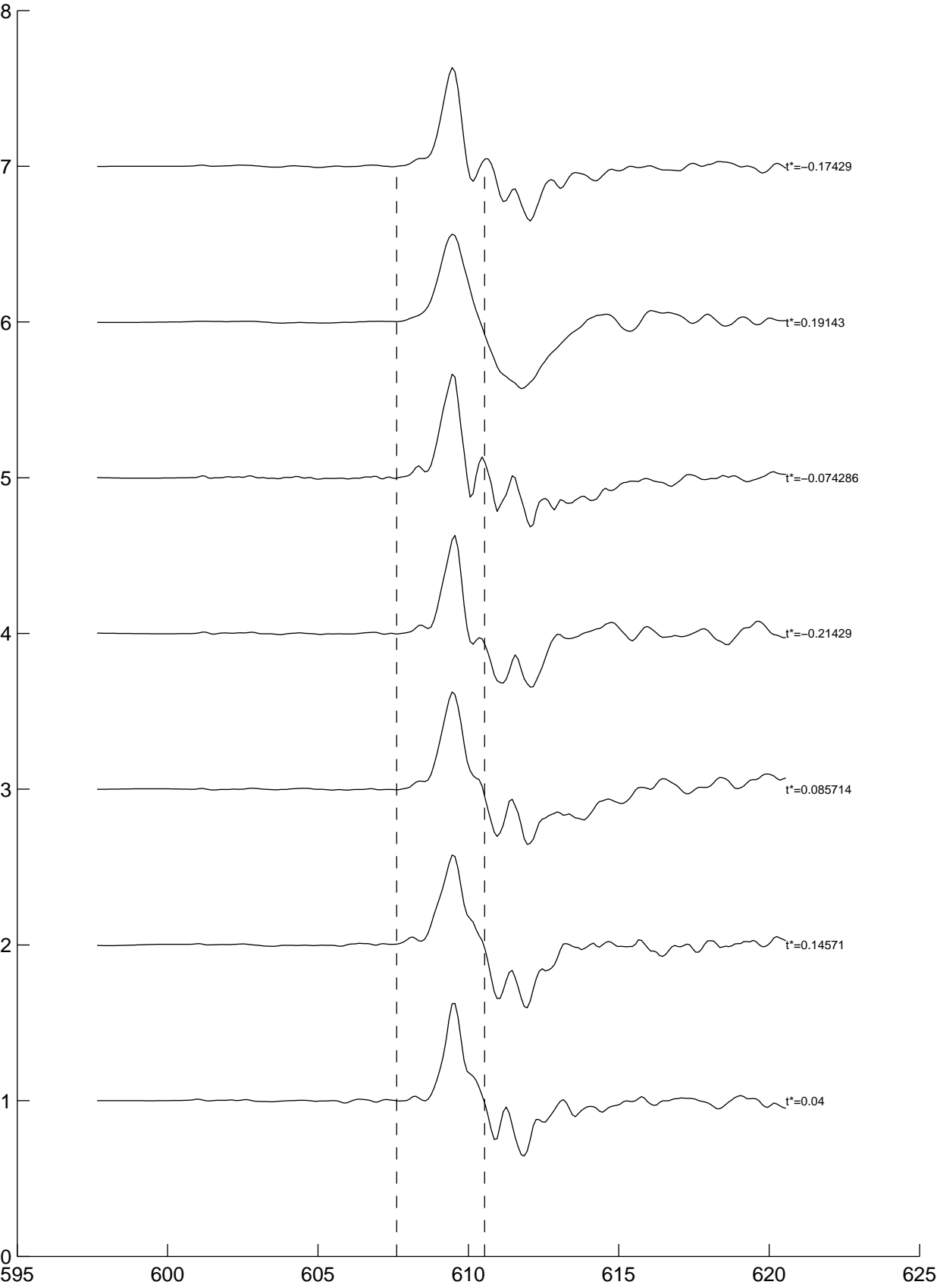
Sorted by t\*:Event\_2002\_311\_15\_14\_06



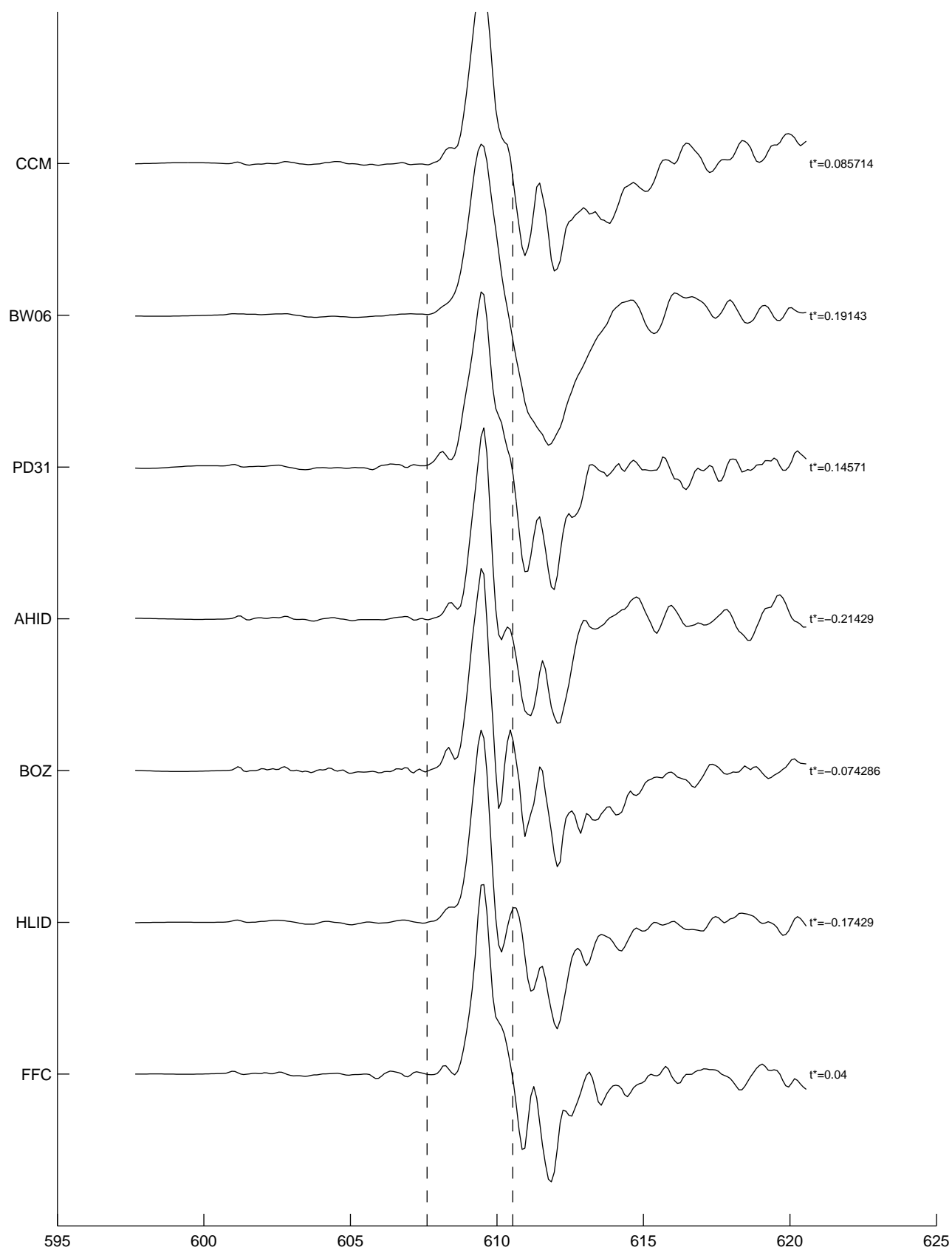




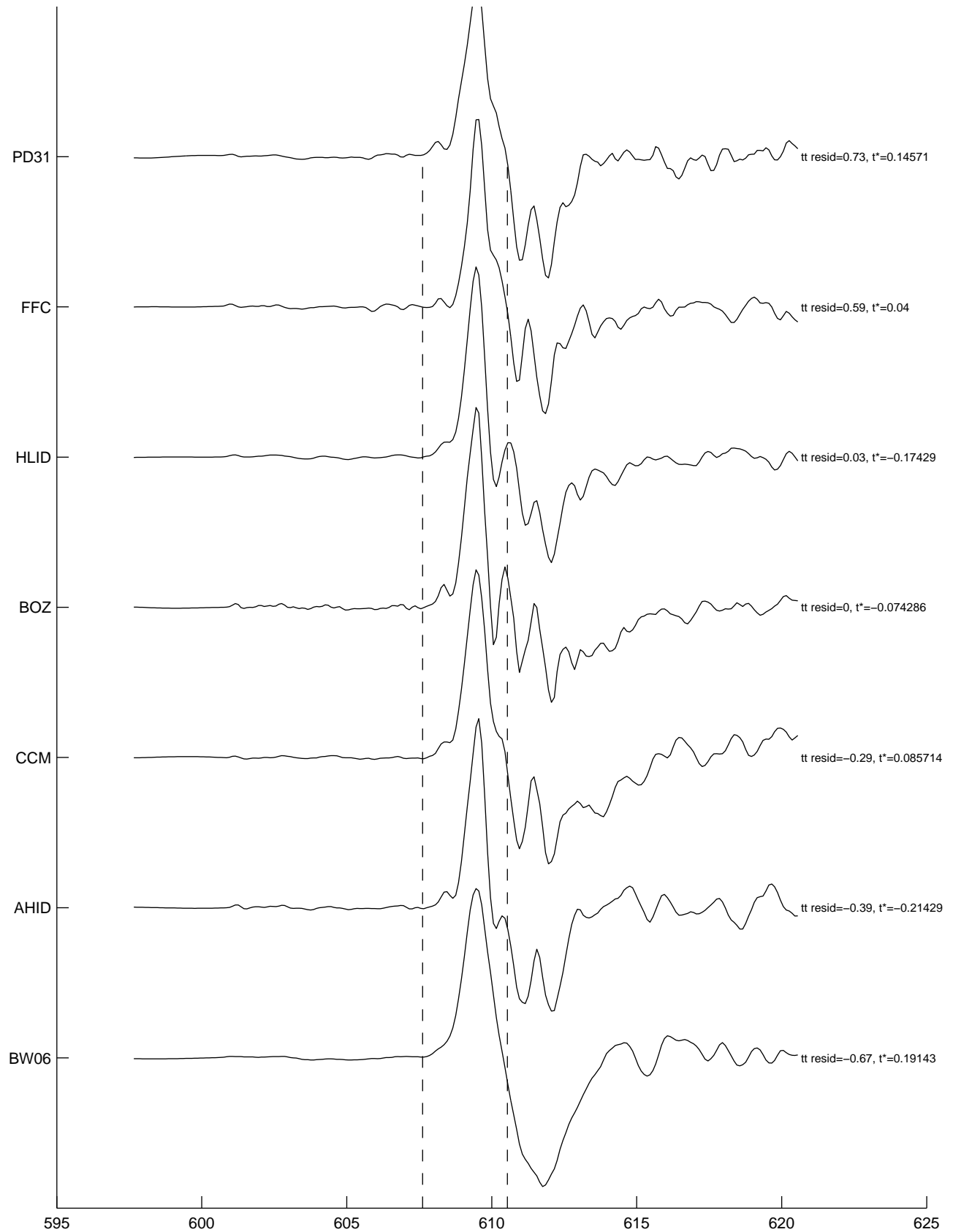
Event\_2002\_321\_04\_53\_53



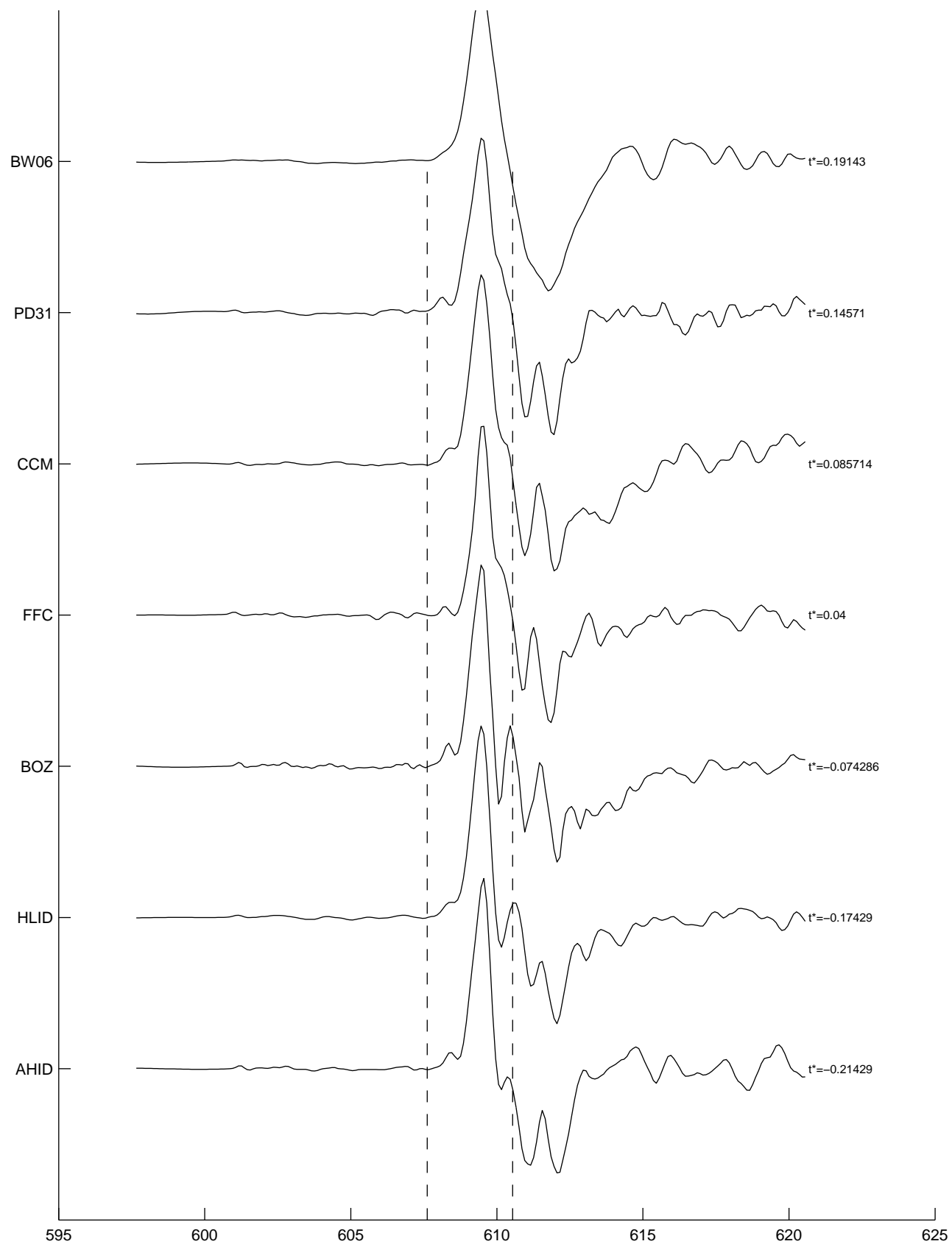
# Sorted by Delta:Event\_2002\_321\_04\_53\_53



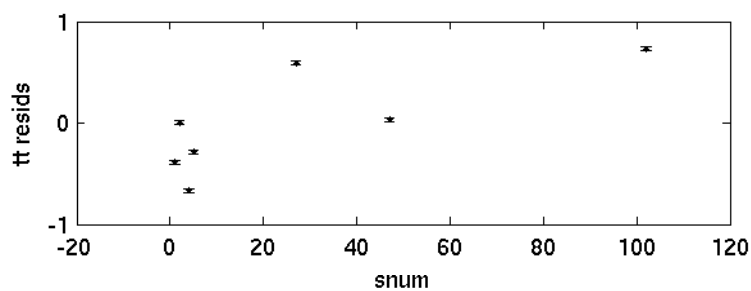
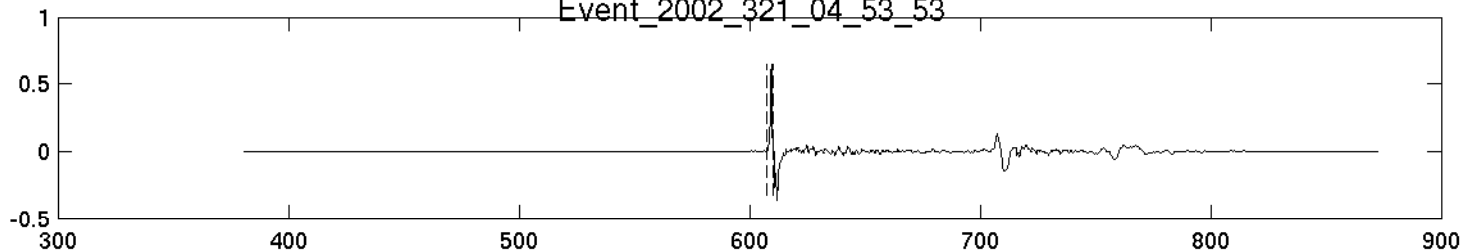
# Sorted by travel time: Event\_2002\_321\_04\_53\_53



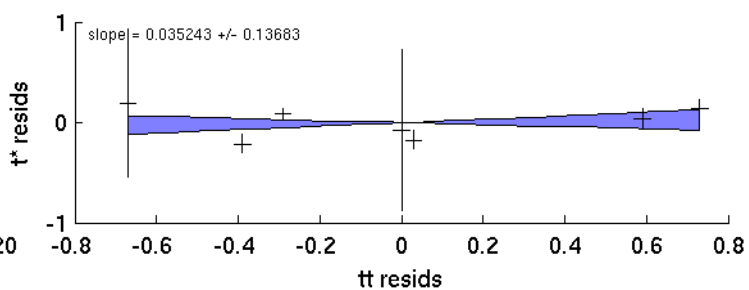
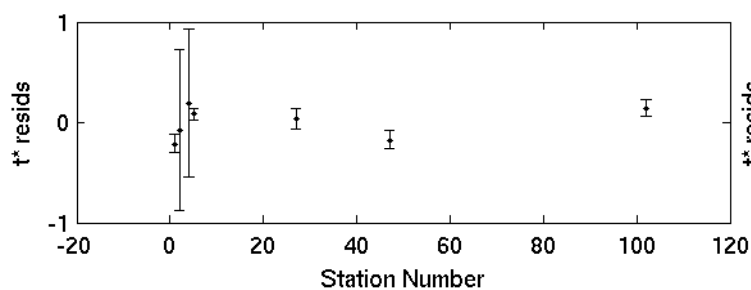
Sorted by  $t^*$ :Event\_2002\_321\_04\_53\_53



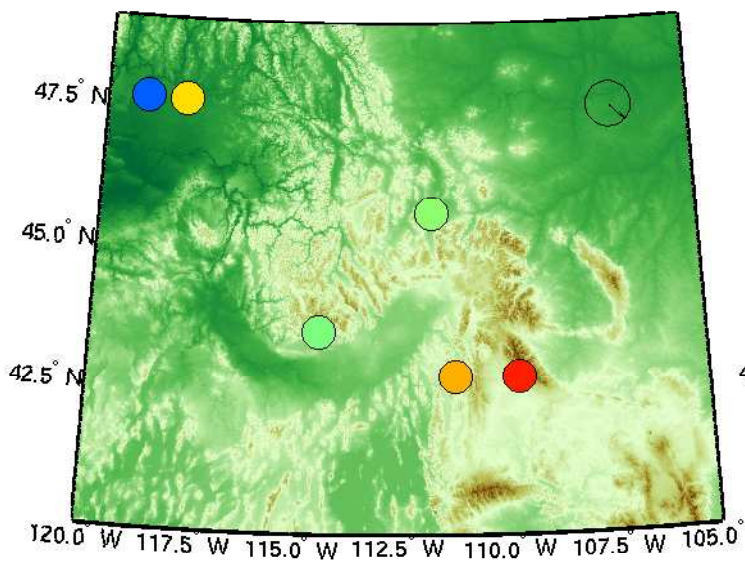
Stack  
Event\_2002\_321\_04\_53\_53



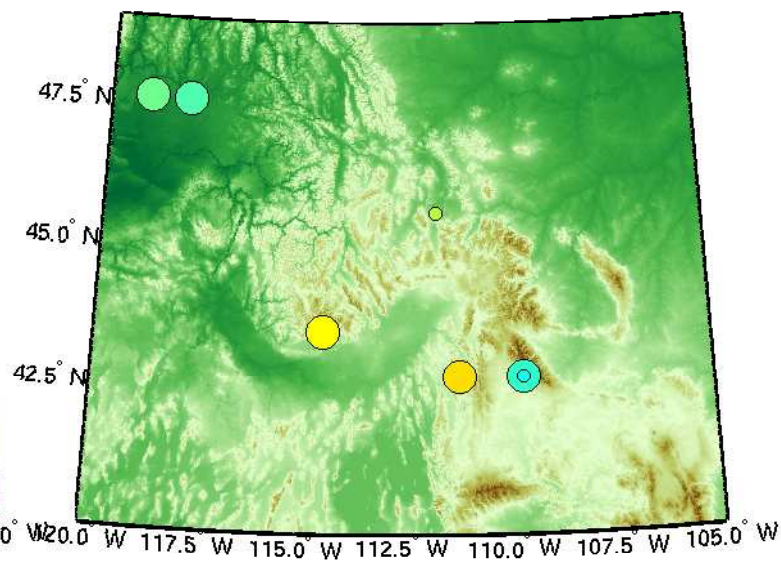
Baz = 315.3943  
Mean xcor value = 0.80714  
Range of  $t^*$  values is 0.40571  
Median  $t^*$  err is 0.096519  
Slope = 0.035243 +/- 0.13683



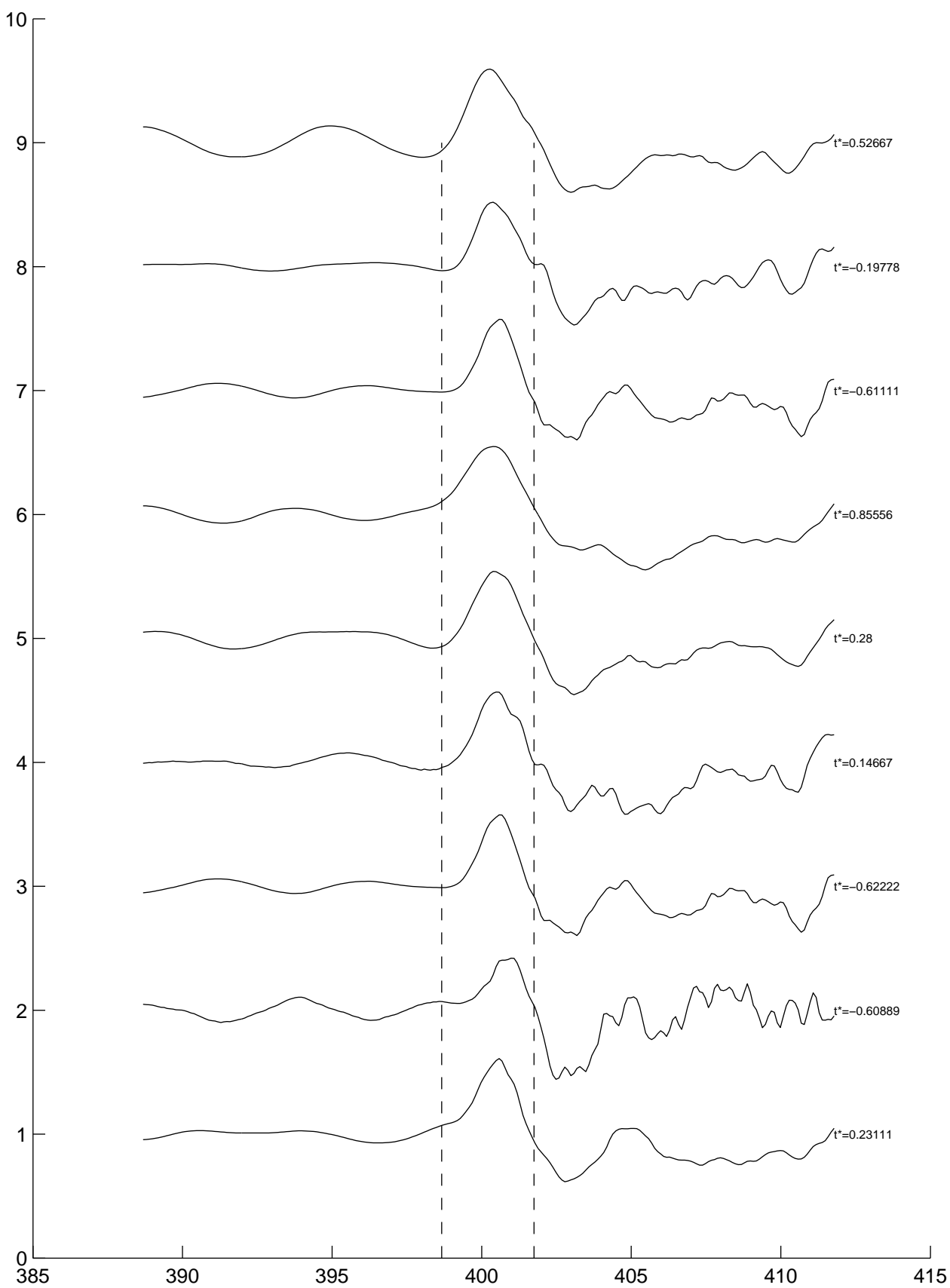
travel time residuals



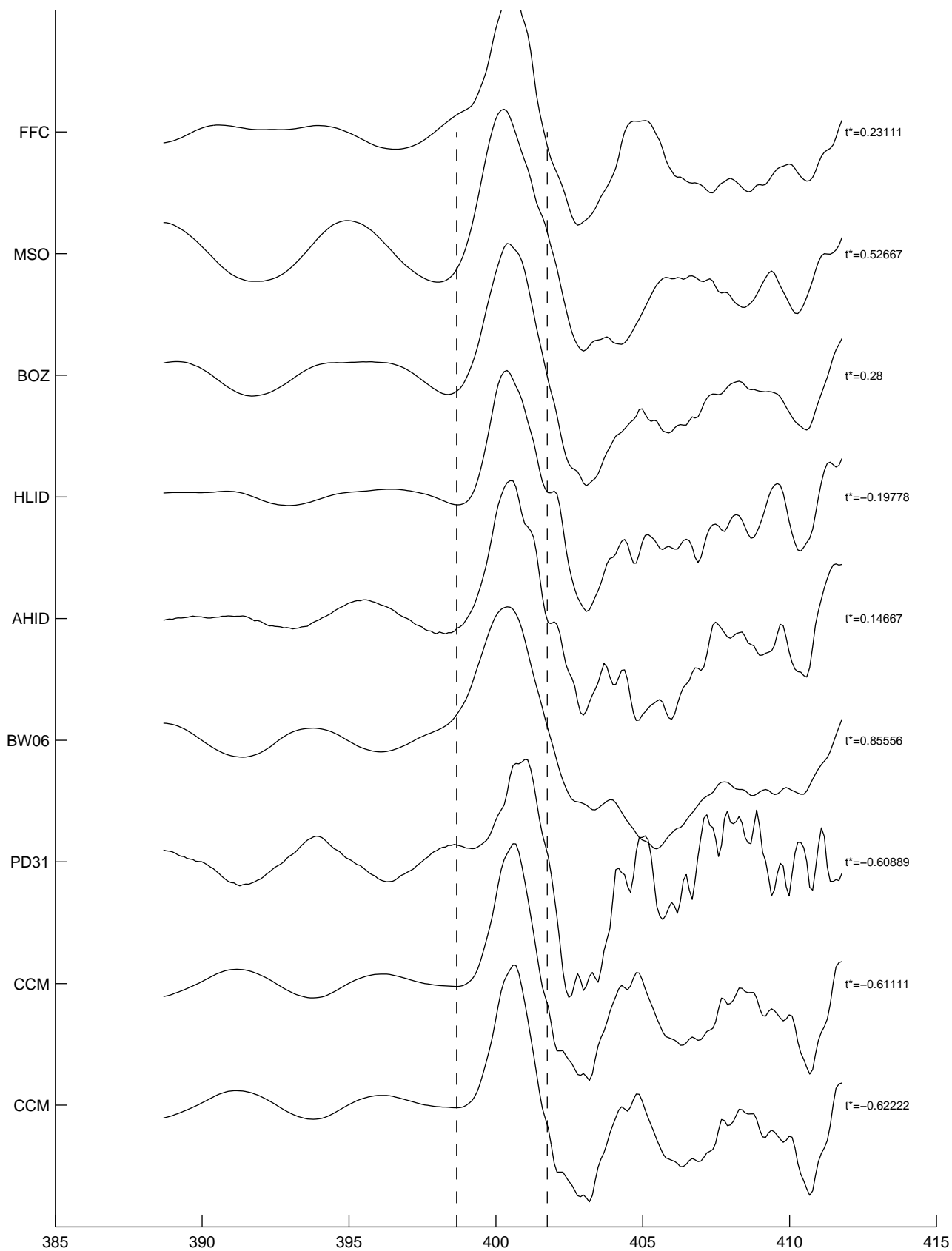
$t^*$  values



# Event\_2003\_021\_02\_46\_47

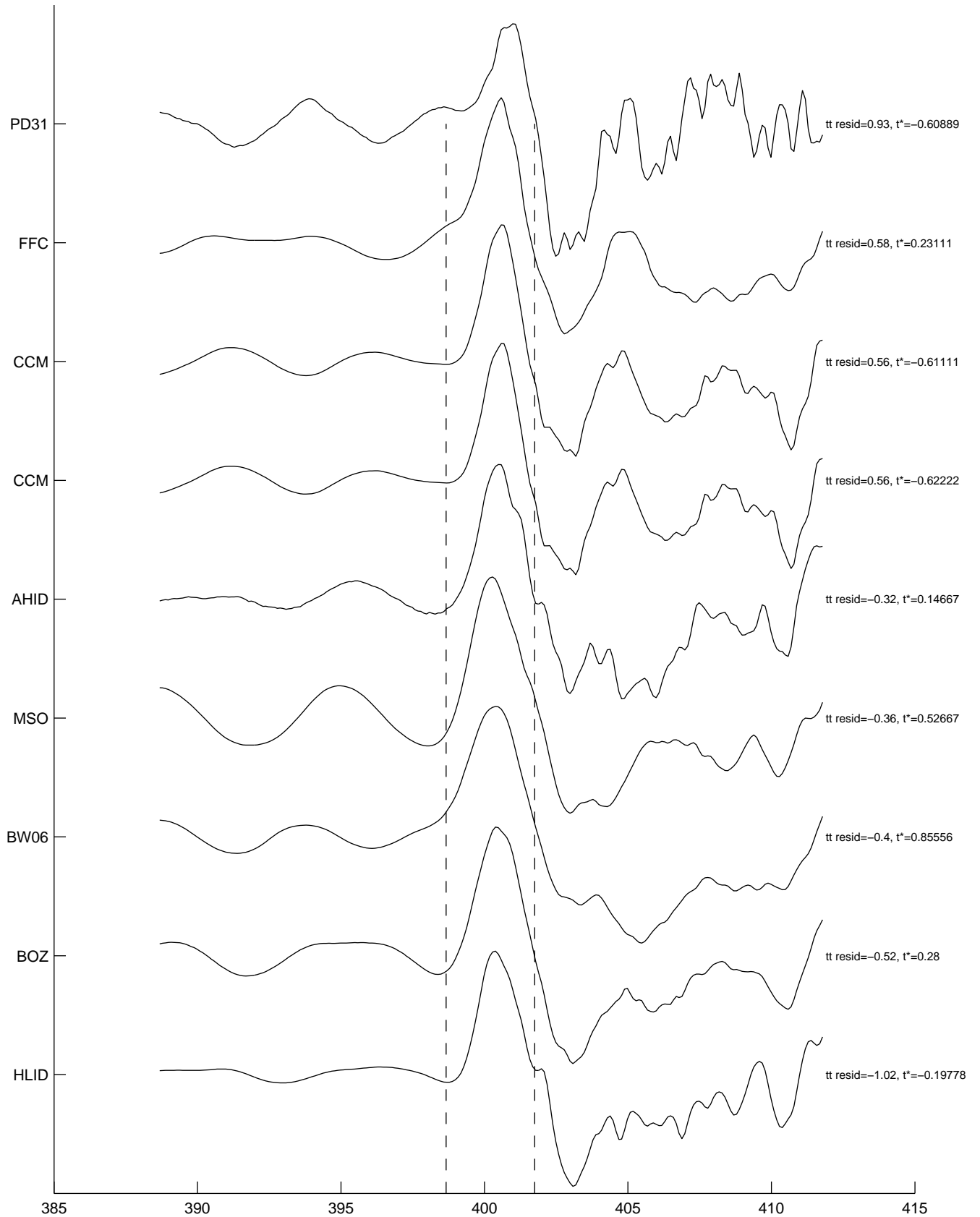


# Sorted by Delta:Event\_2003\_021\_02\_46\_47

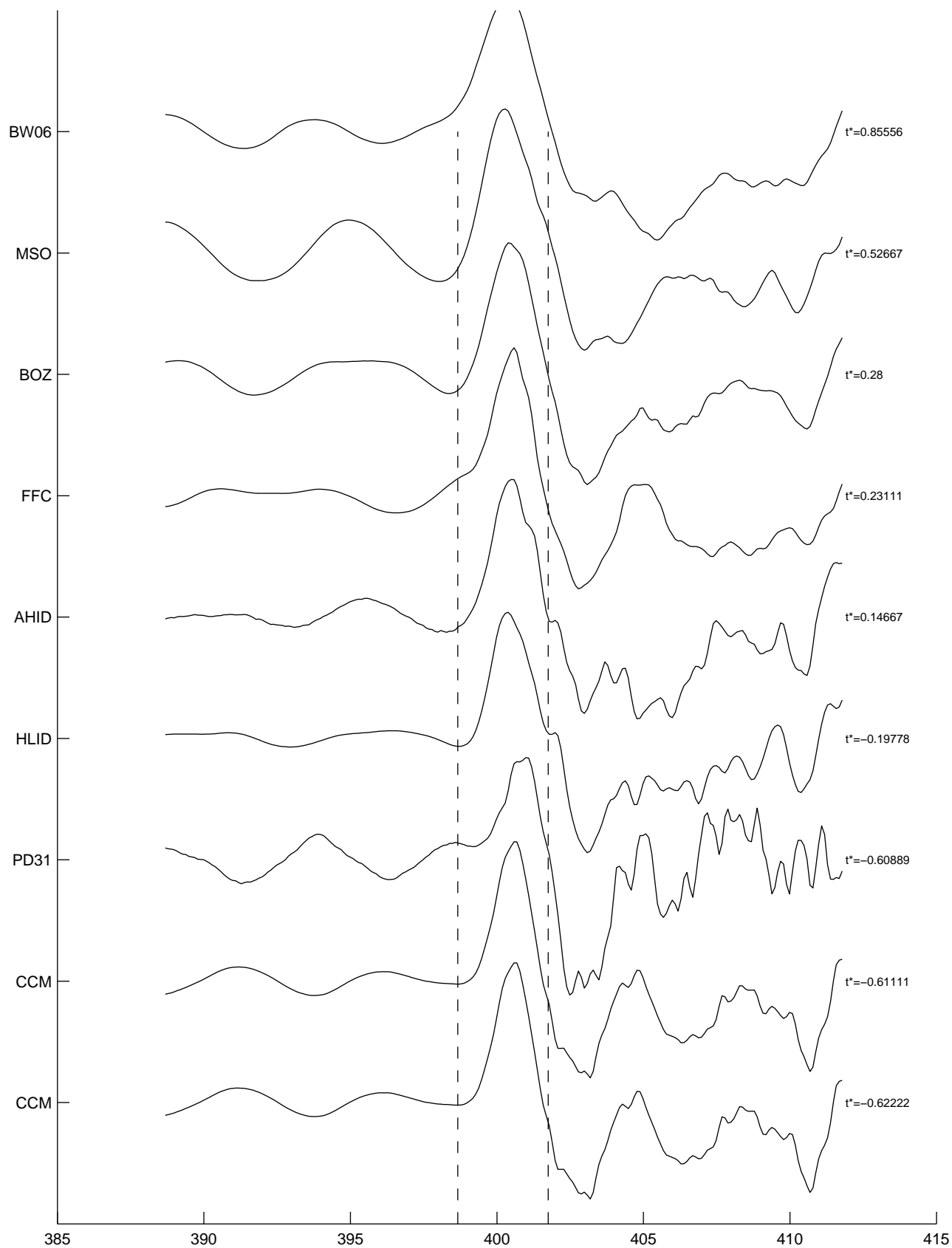




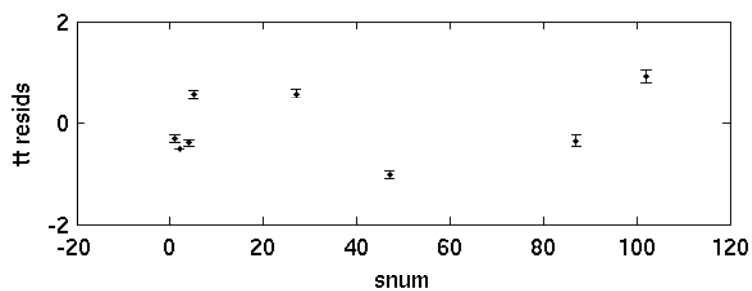
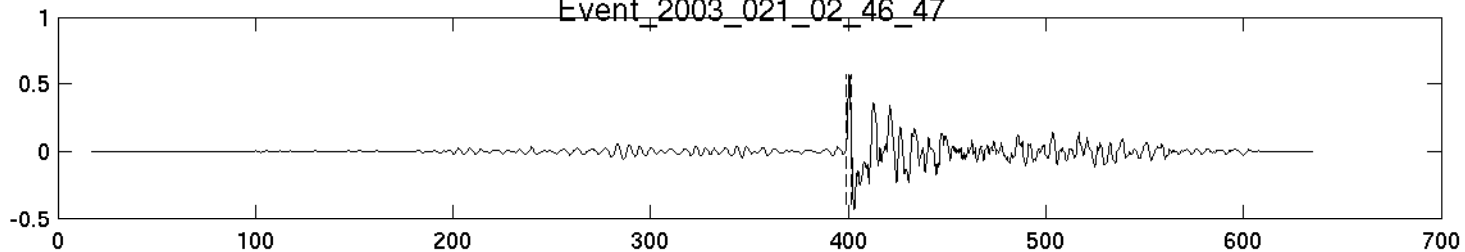
# Sorted by travel time:Event\_2003\_021\_02\_46\_47



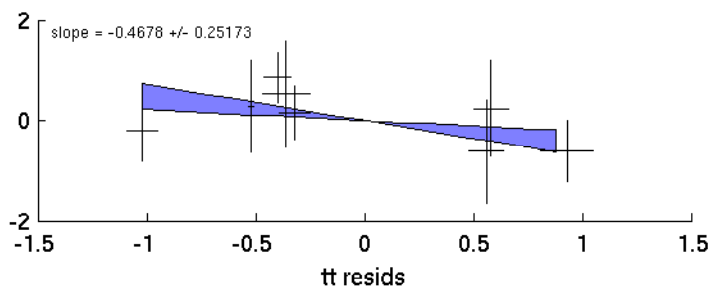
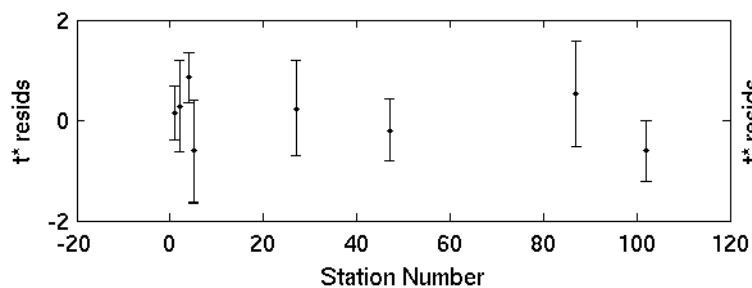
Sorted by  $t^*$ :Event\_2003\_021\_02\_46\_47



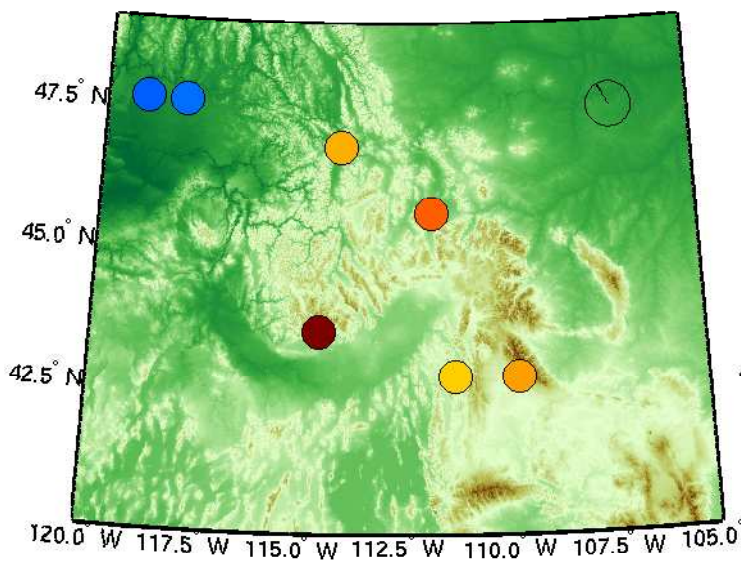
# Stack Event\_2003\_02\_02\_46\_47



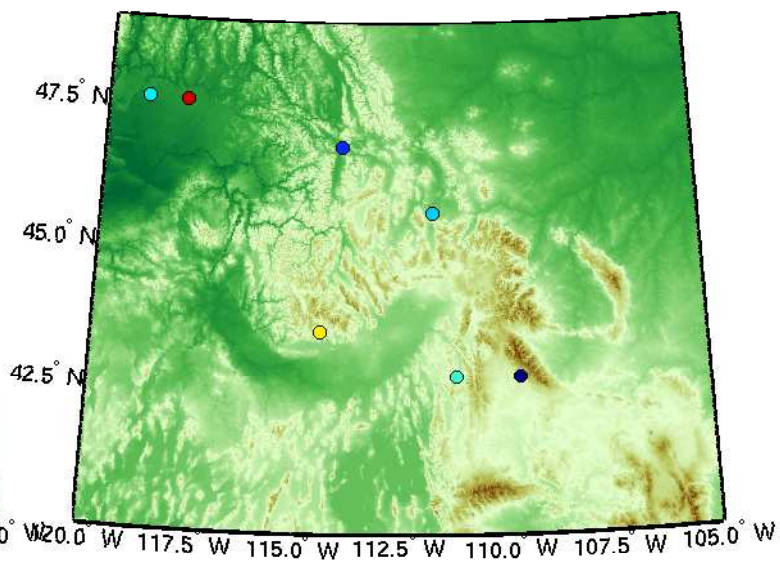
Baz = 153.3387  
Mean xcor value = 0.75111  
Range of t\* values is 1.4778  
Median t\* err is 0.91371  
Slope = -0.4678 +/- 0.25173



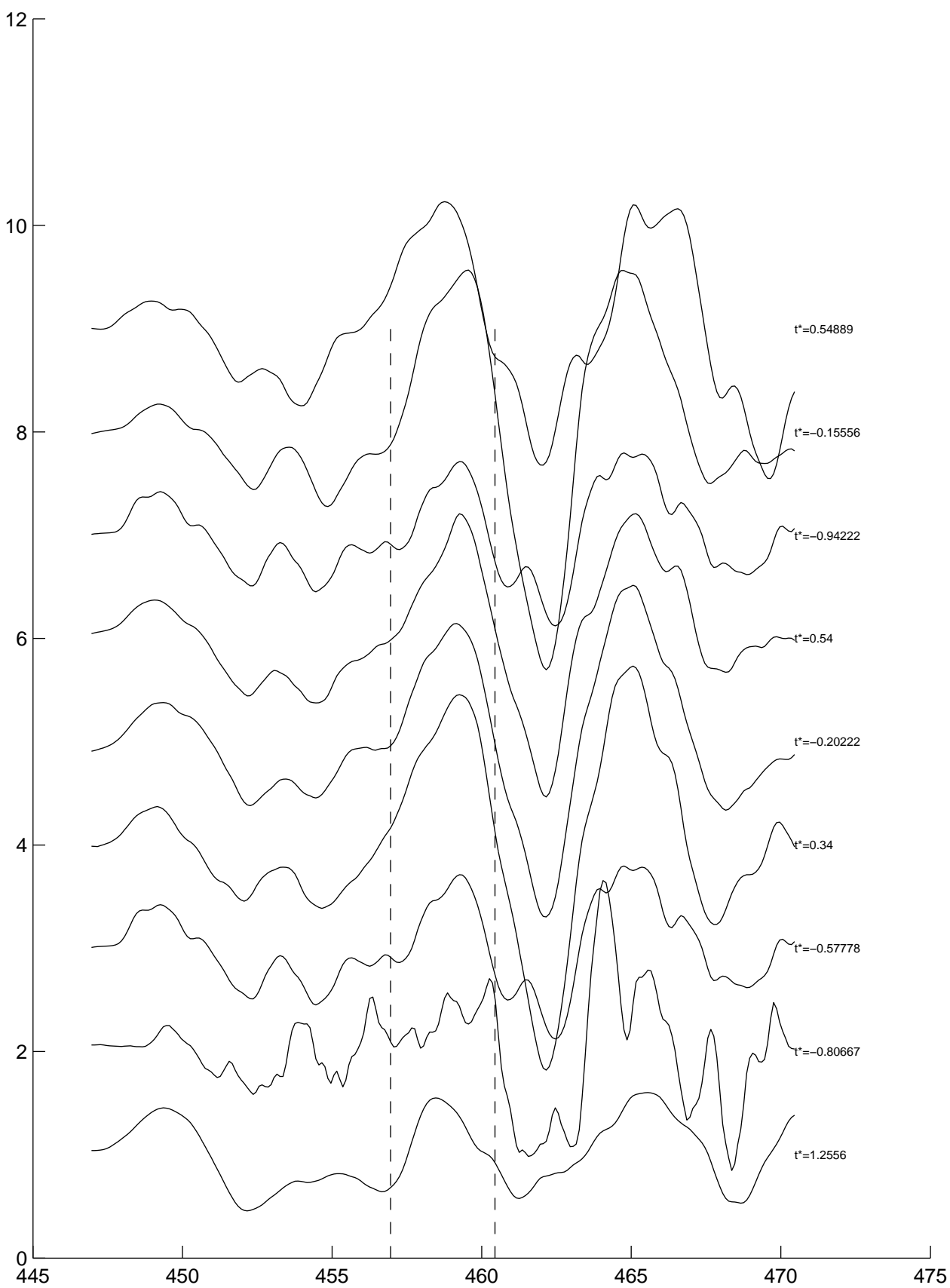
travel time residuals



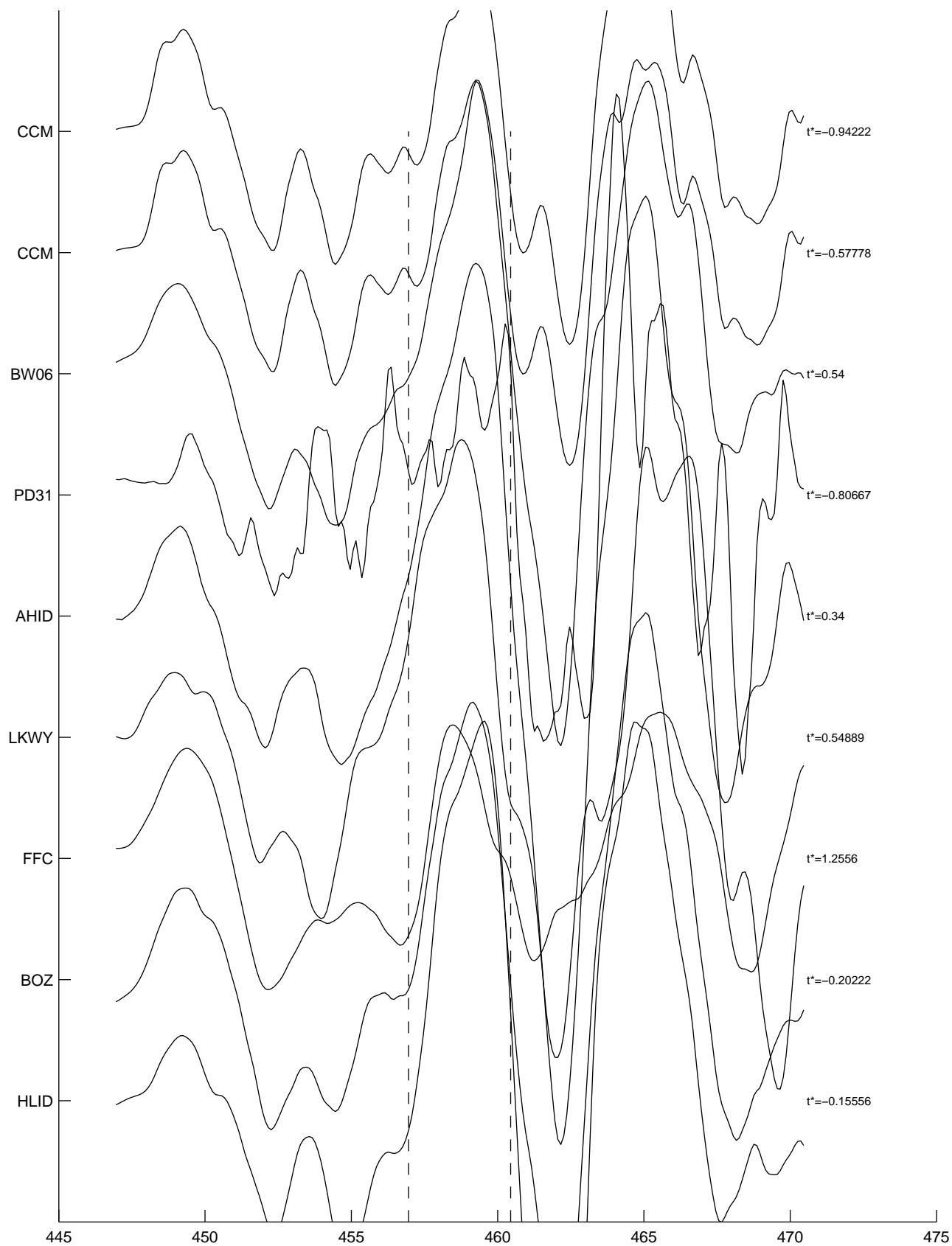
t\* values



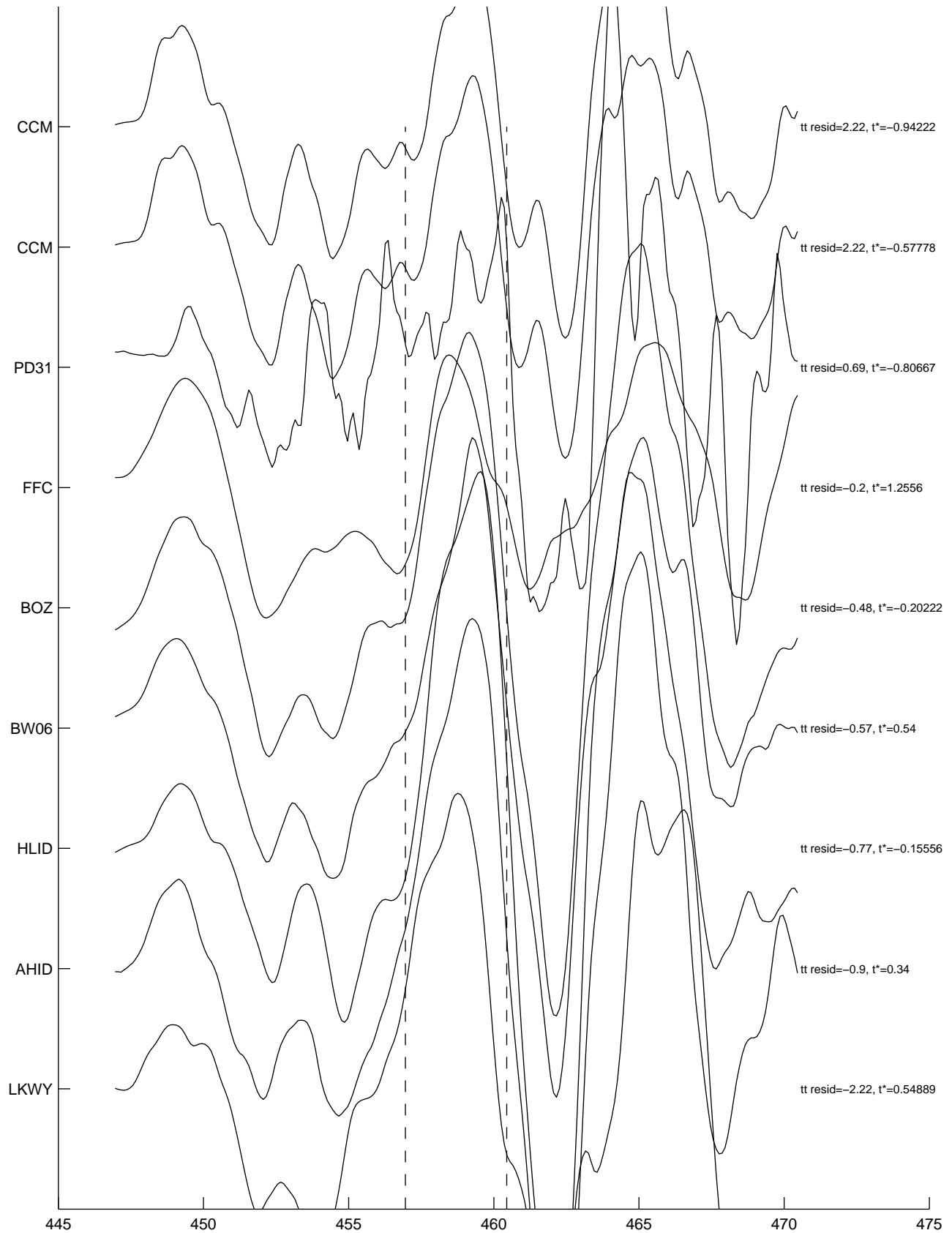
# Event\_2003\_050\_03\_32\_36



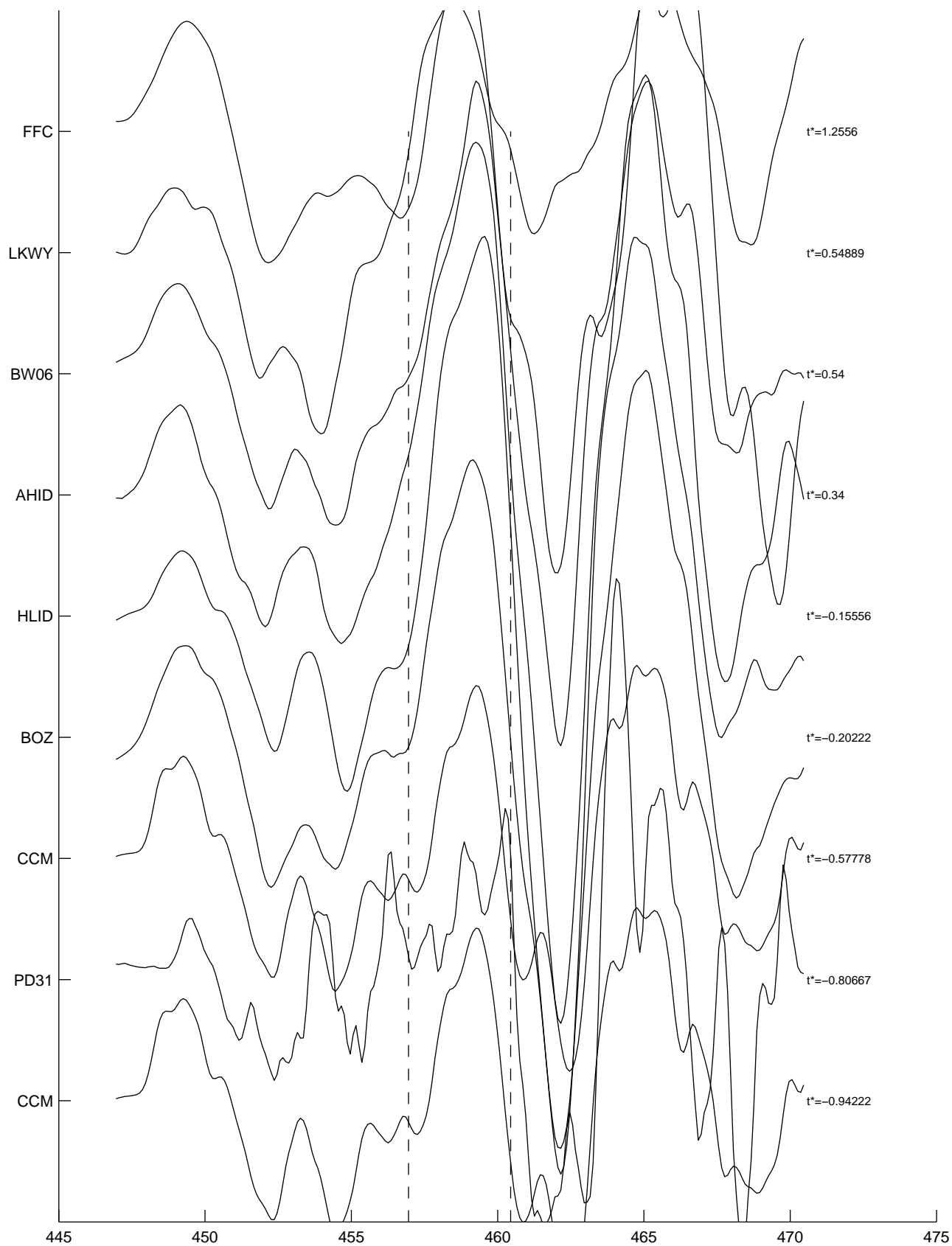
# Sorted by Delta:Event\_2003\_050\_03\_32\_36



# Sorted by travel time:Event\_2003\_050\_03\_32\_36

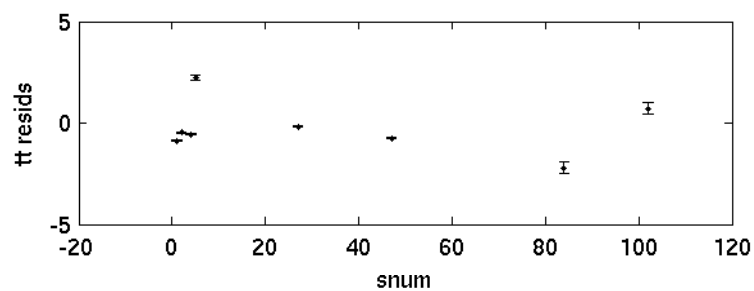
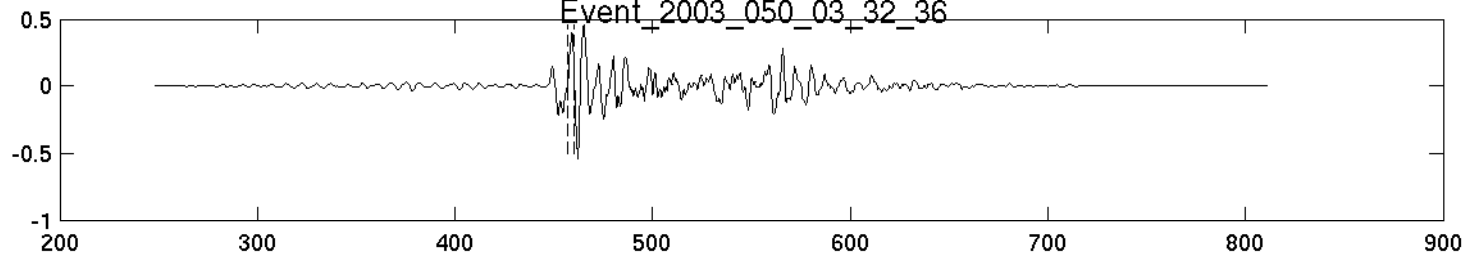


Sorted by  $t^*$ :Event\_2003\_050\_03\_32\_36

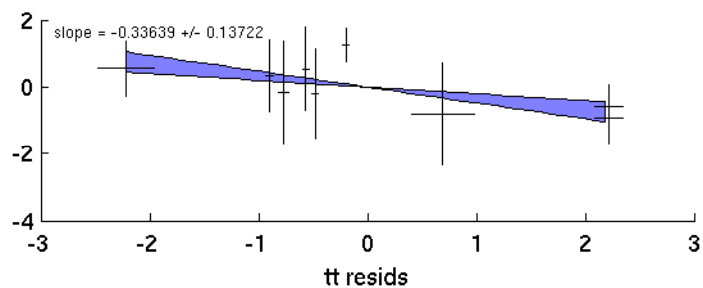
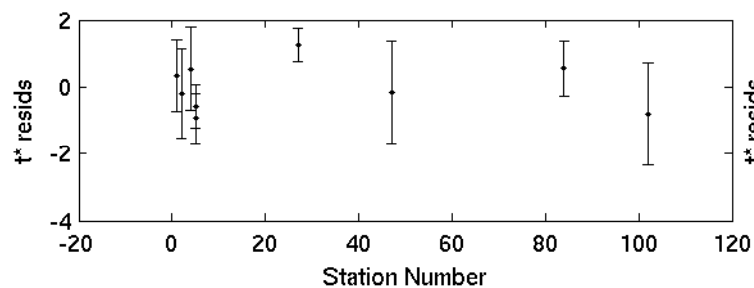




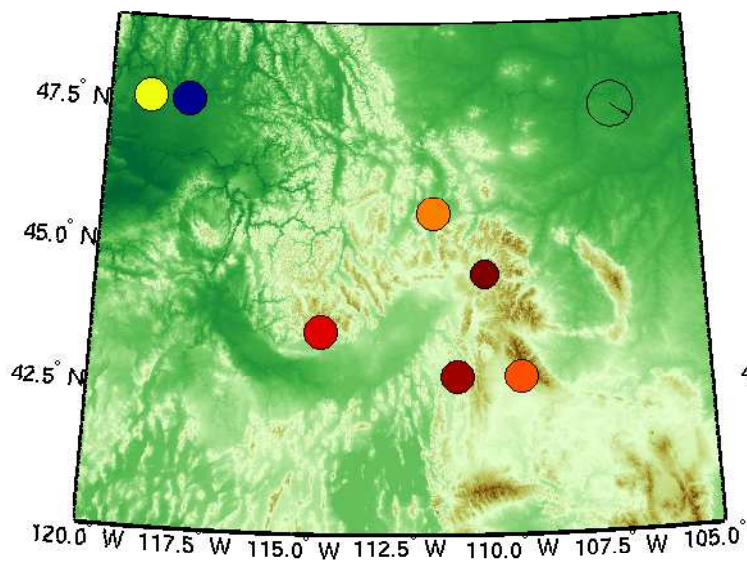
Stack  
Event\_2003\_050\_03\_32\_36



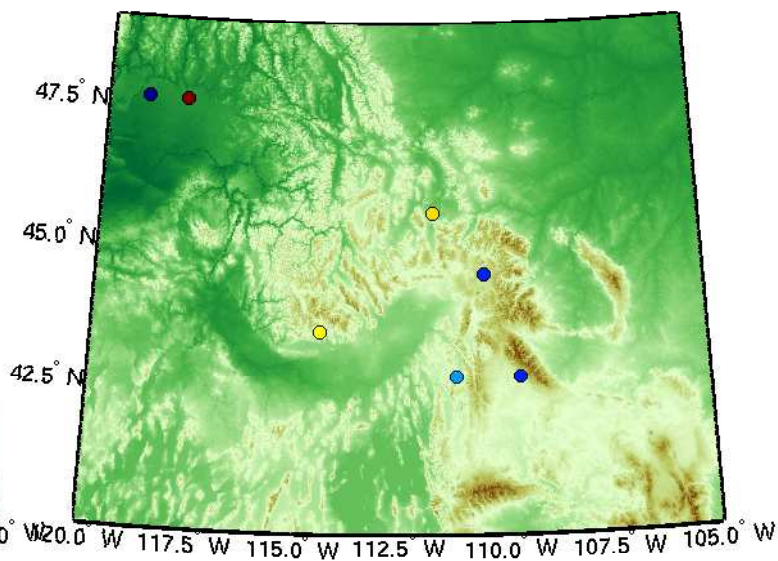
Baz = 305.9113  
Mean xcor value = 0.79889  
Range of  $t^*$  values is 2.1978  
Median  $t^*$  err is 1.0826  
Slope = -0.33639 +/- 0.13722



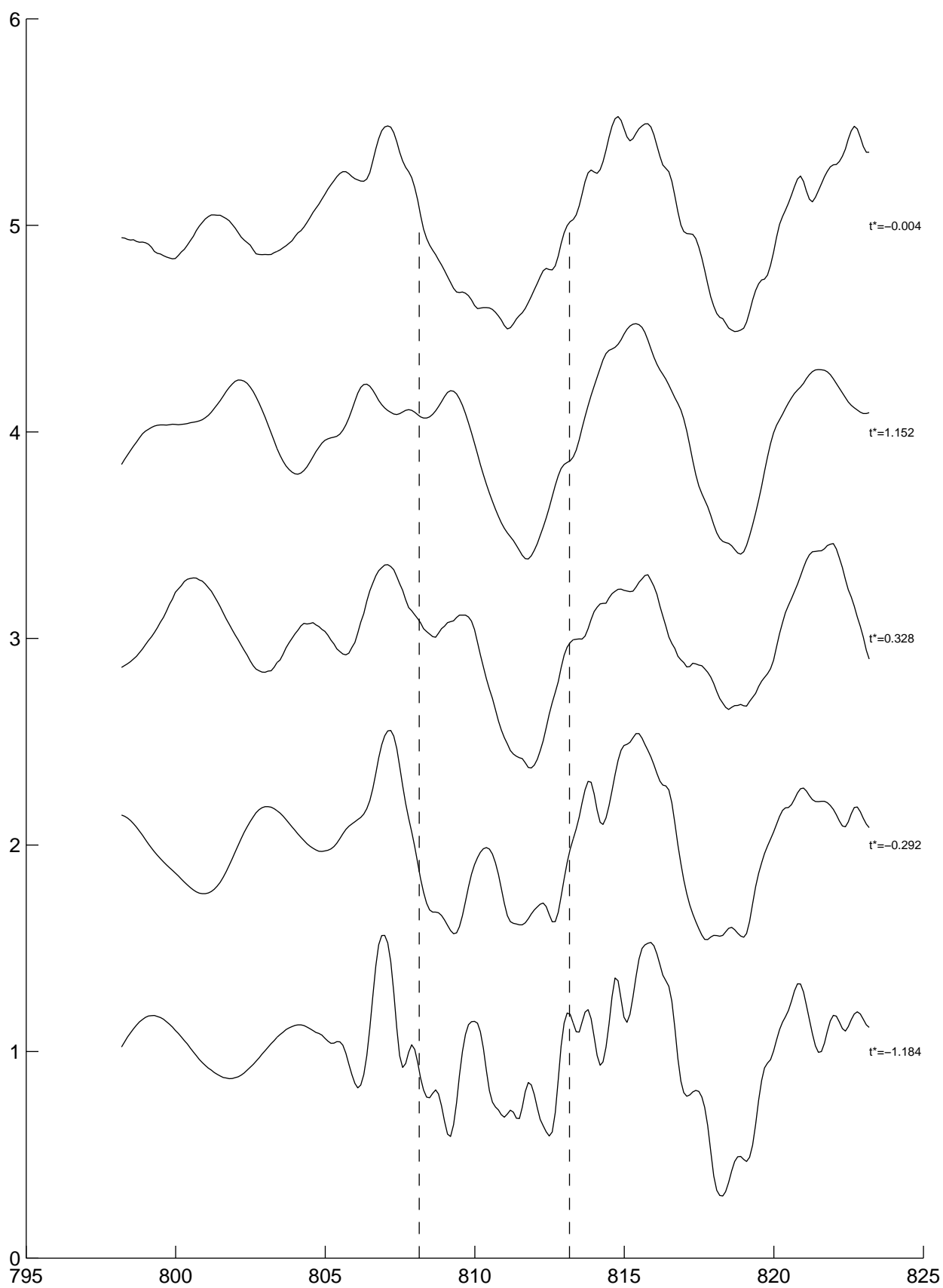
travel time residuals



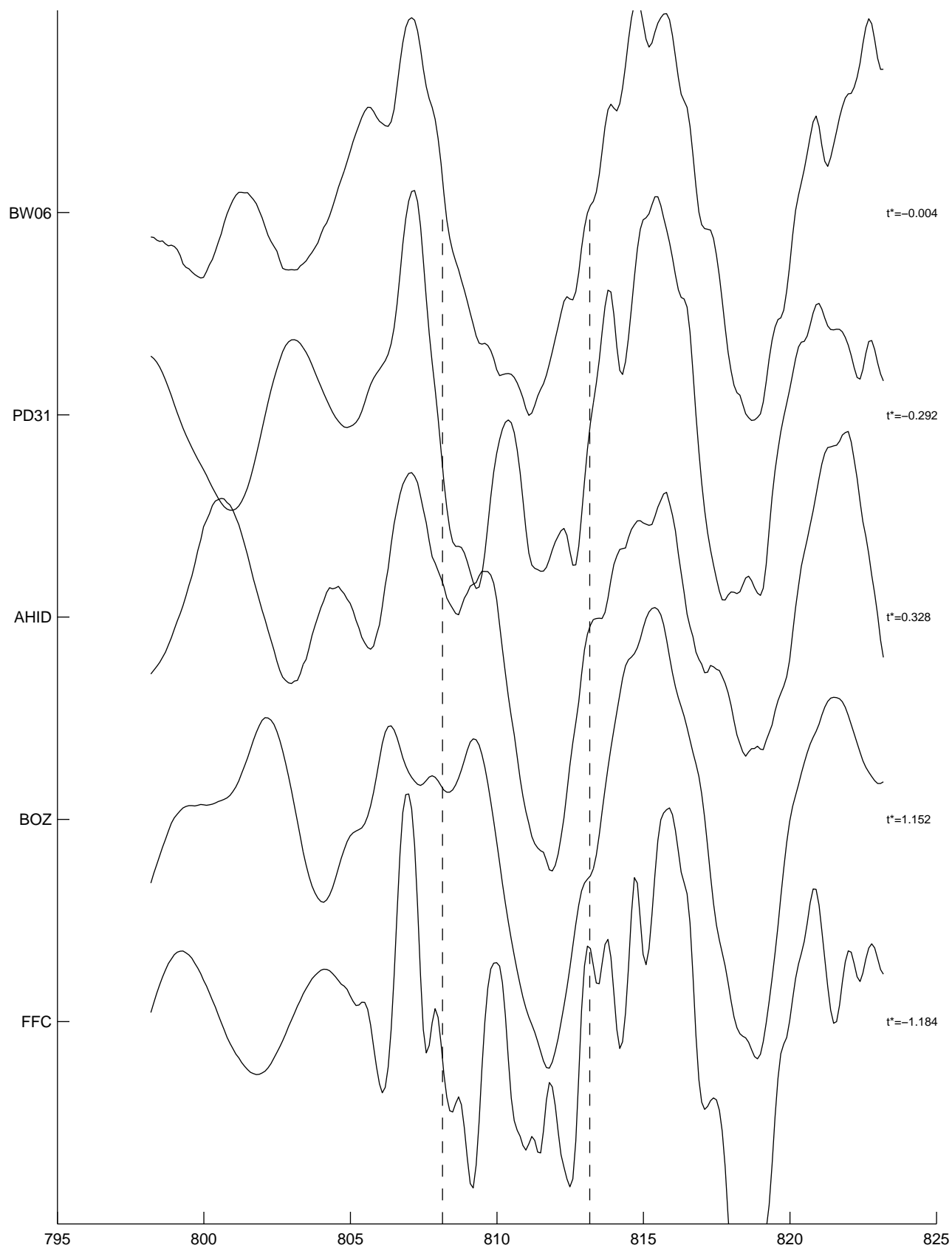
$t^*$  values



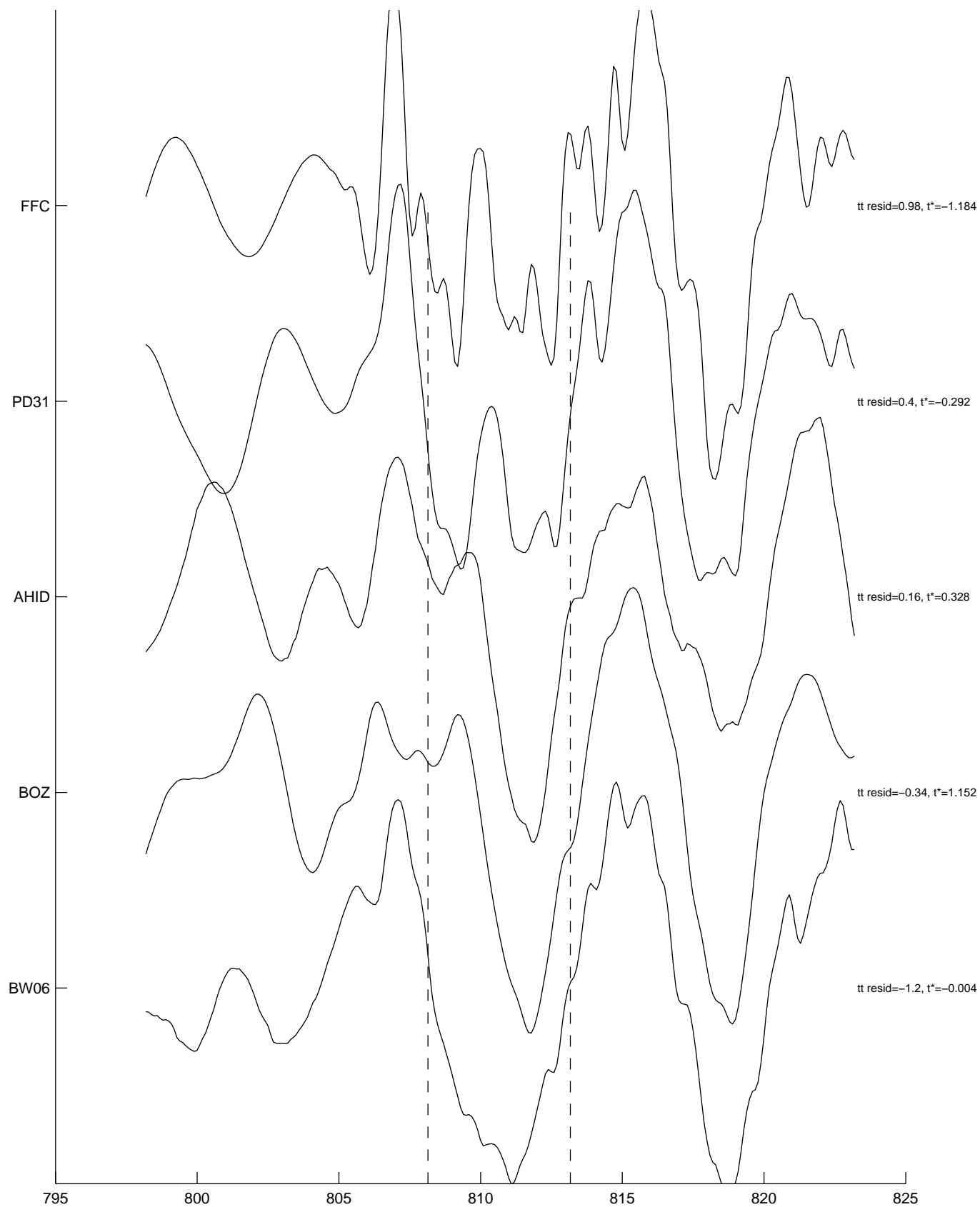
# Event\_2003\_055\_02\_03\_41



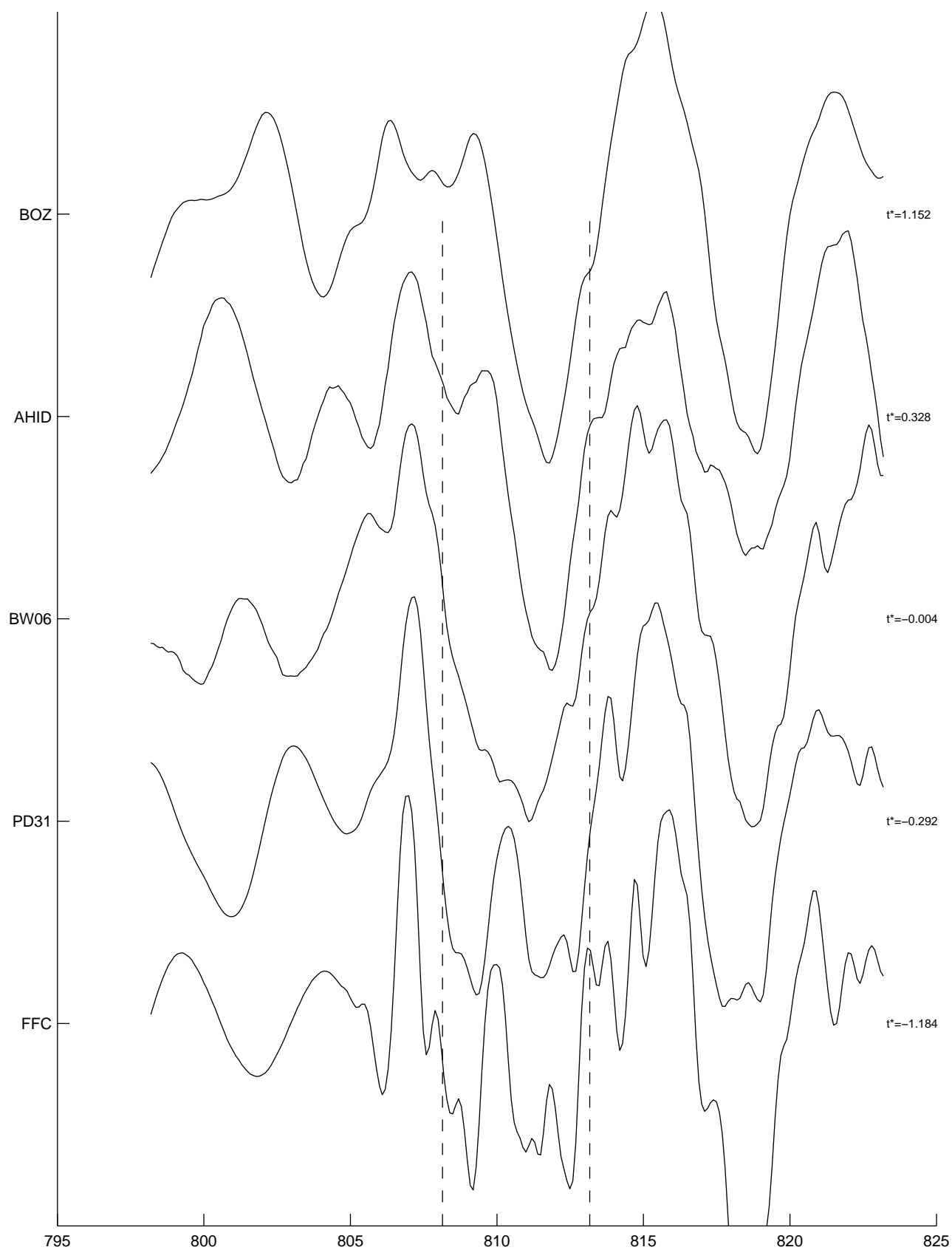
# Sorted by Delta:Event\_2003\_055\_02\_03\_41



# Sorted by travel time:Event\_2003\_055\_02\_03\_41

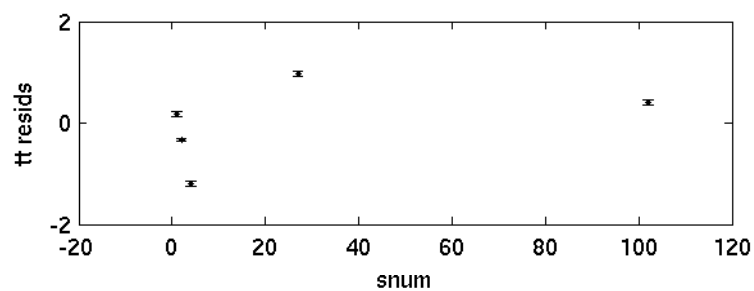
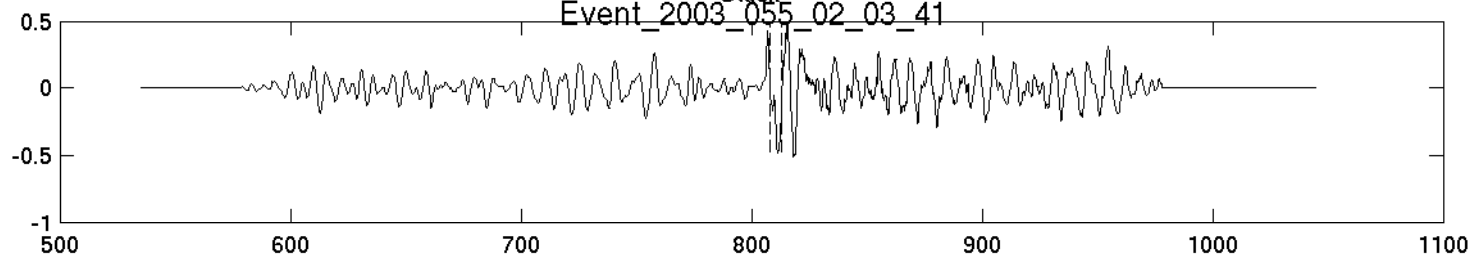


Sorted by t\*:Event\_2003\_055\_02\_03\_41

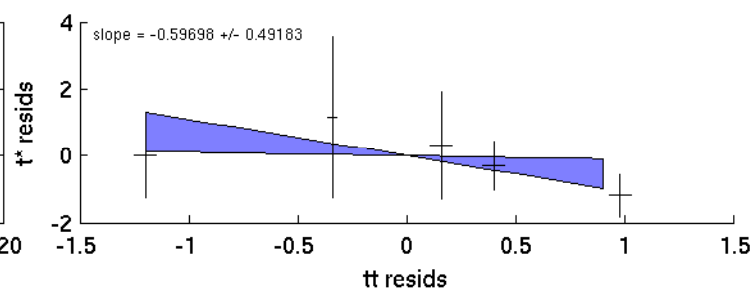
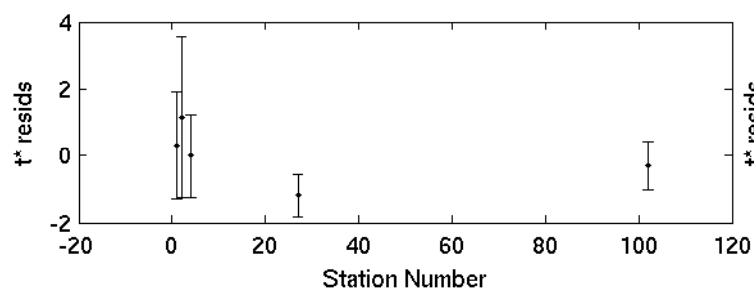


Event\_2003\_055\_02\_03\_41

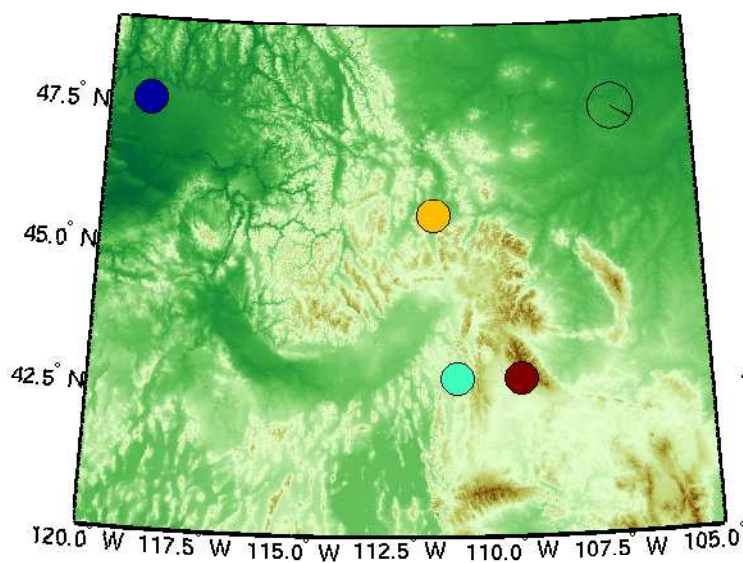
Stack



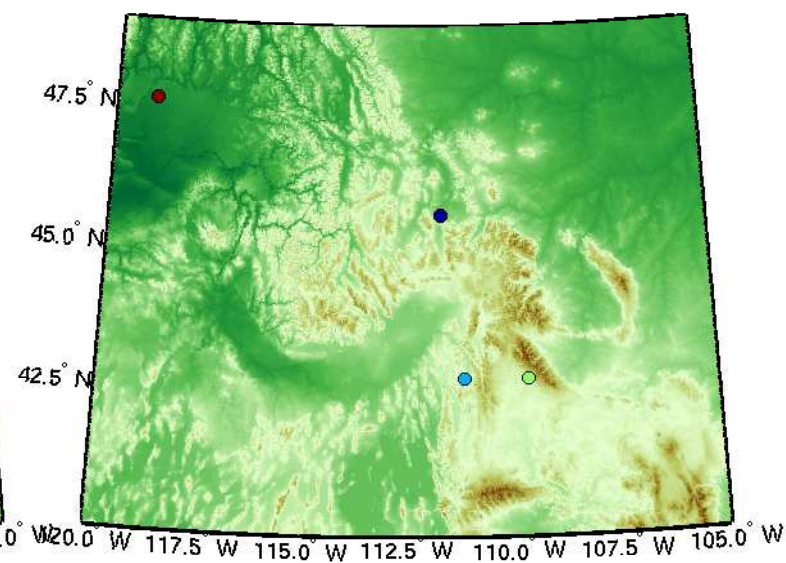
Baz = 303.1261  
Mean xcor value = 0.67  
Range of  $t^*$  values is 2.336  
Median  $t^*$  err is 1.2384  
Slope = -0.59698 +/- 0.49183



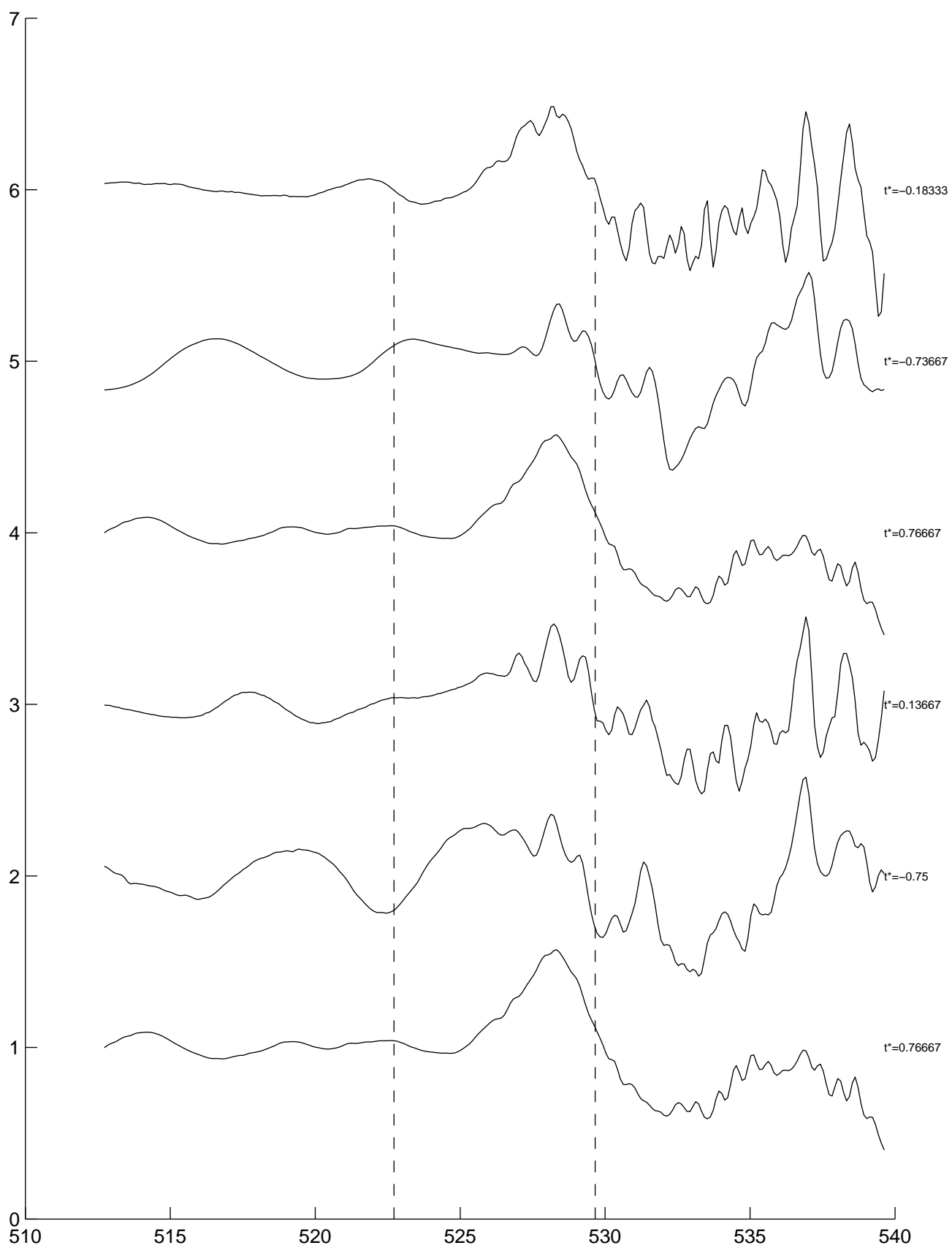
travel time residuals



$t^*$  values

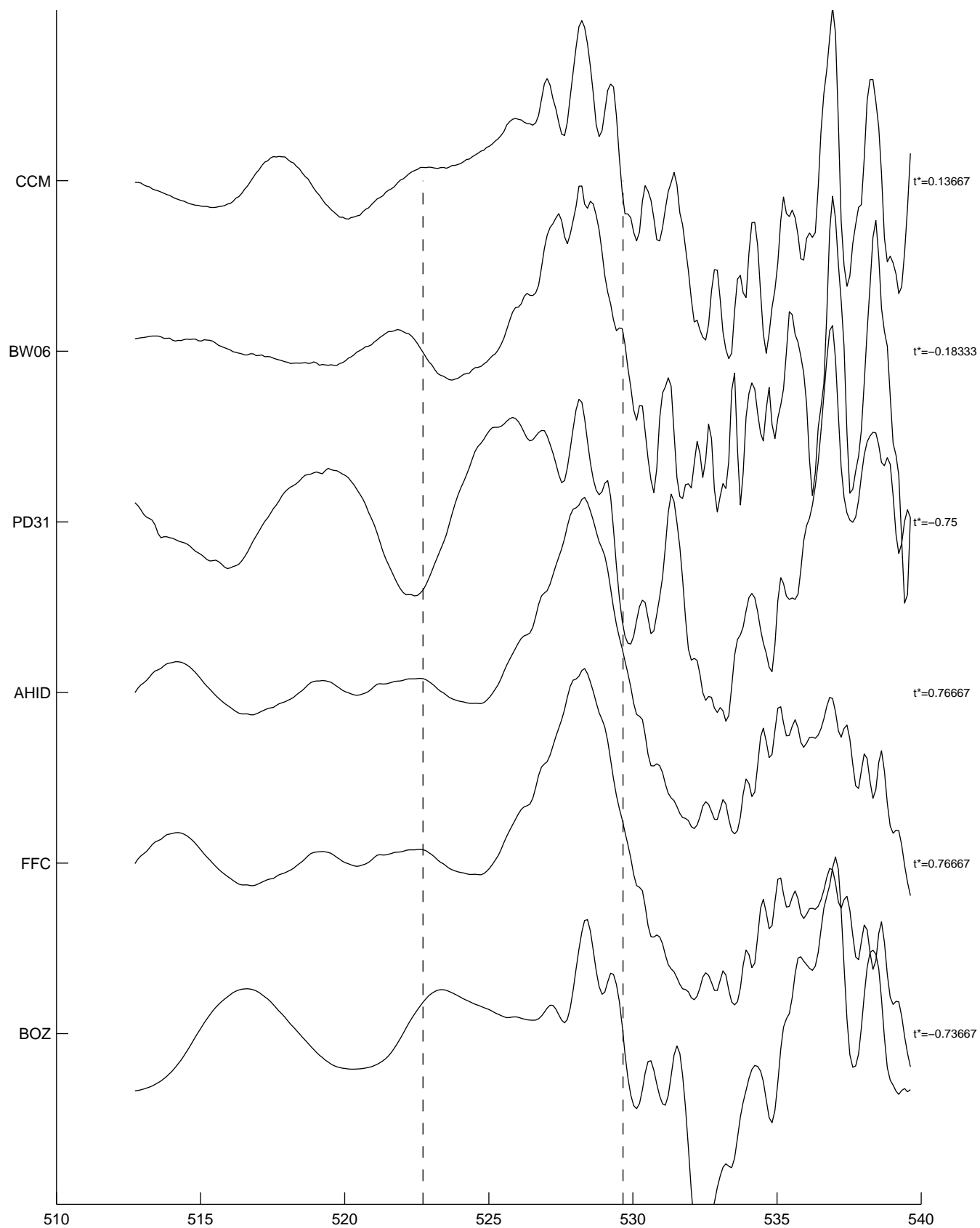


# Event\_2003\_076\_16\_36\_17

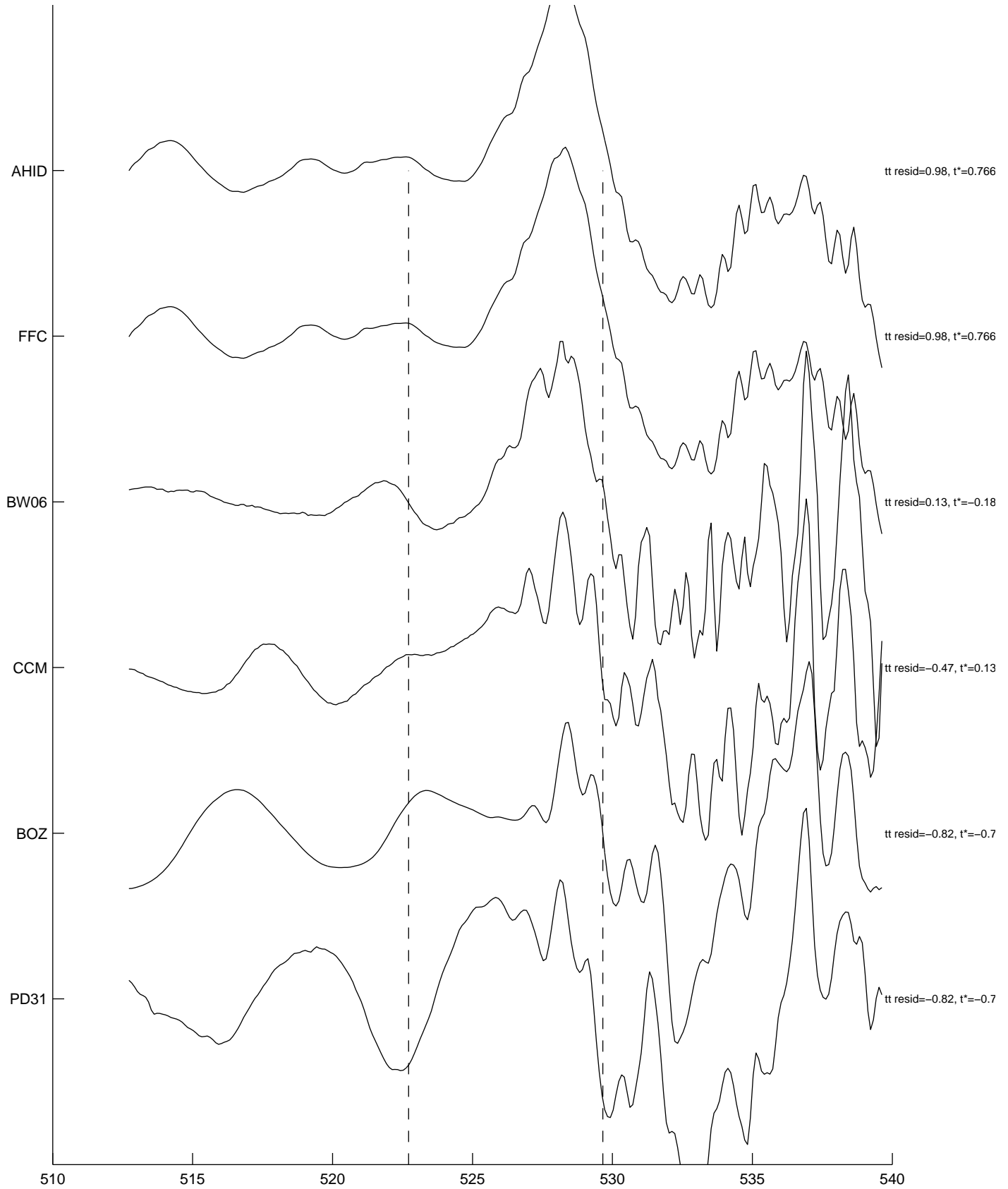




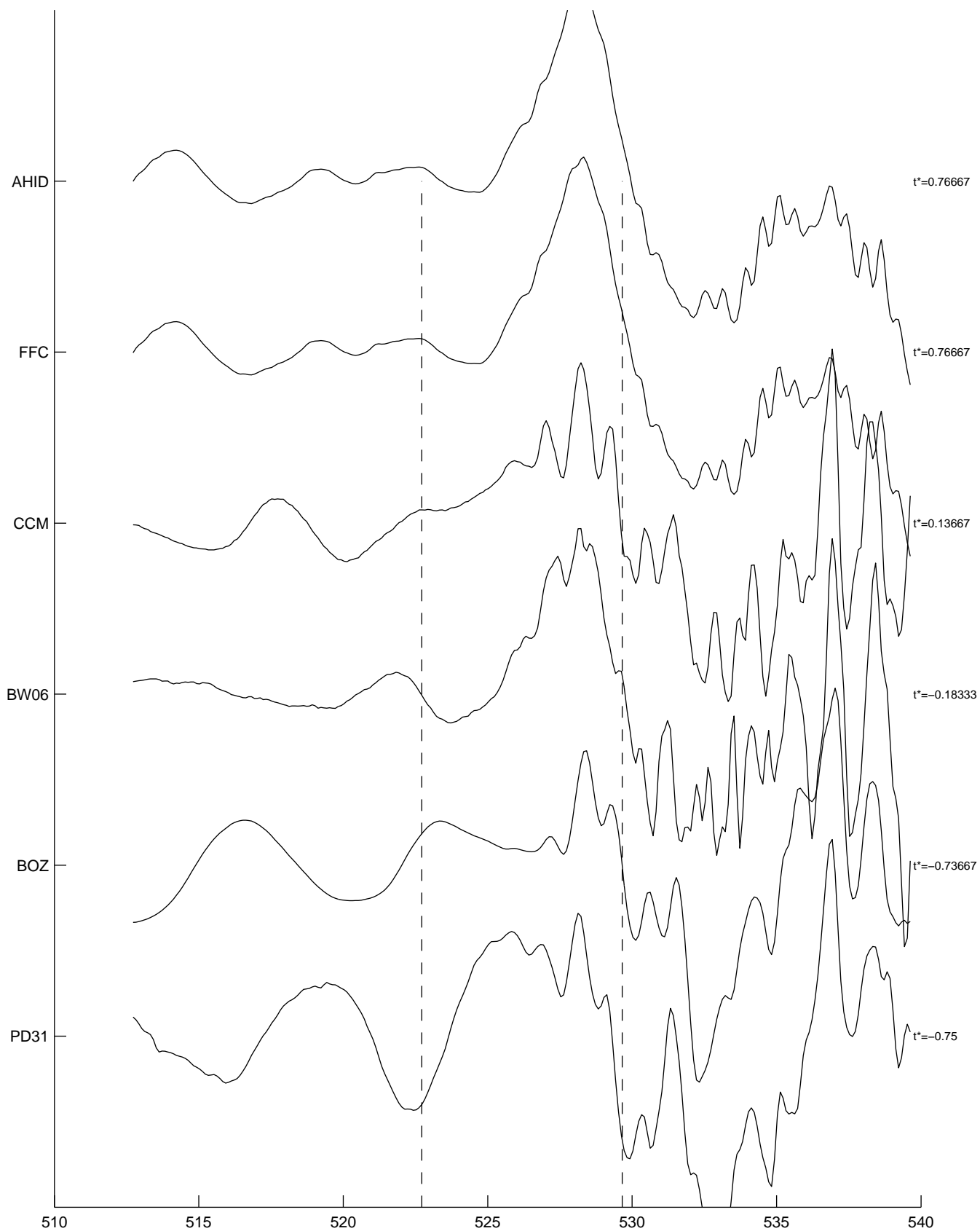
# Sorted by Delta:Event\_2003\_076\_16\_36\_17



# Sorted by travel time:Event\_2003\_076\_16\_36\_17

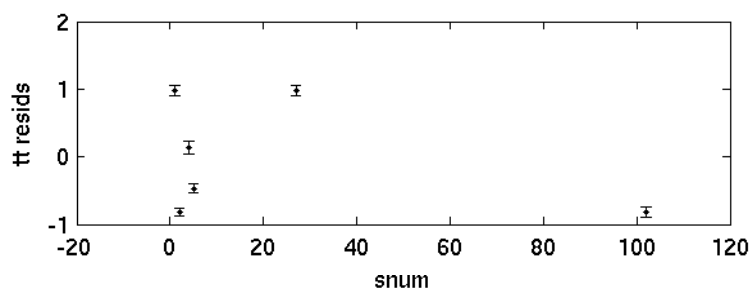
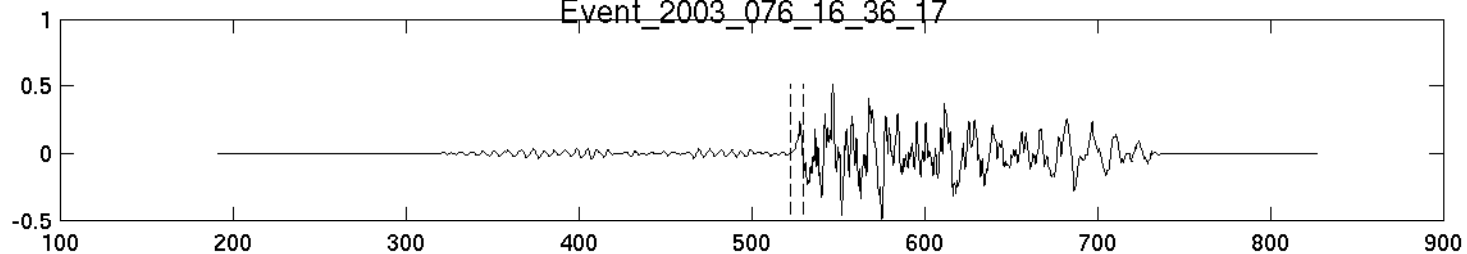


Sorted by  $t^*$ :Event\_2003\_076\_16\_36\_17

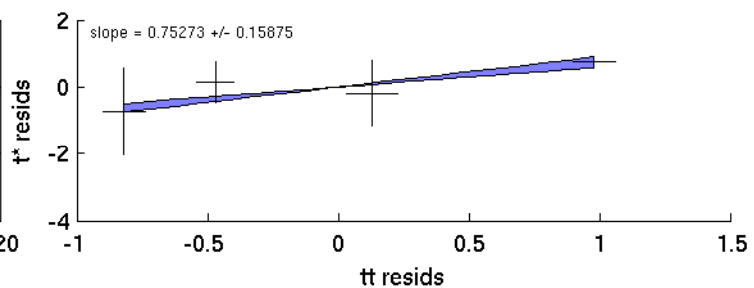
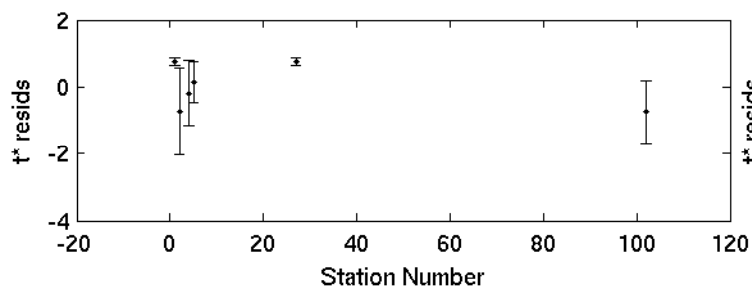


# Event\_2003\_076\_16\_36\_17

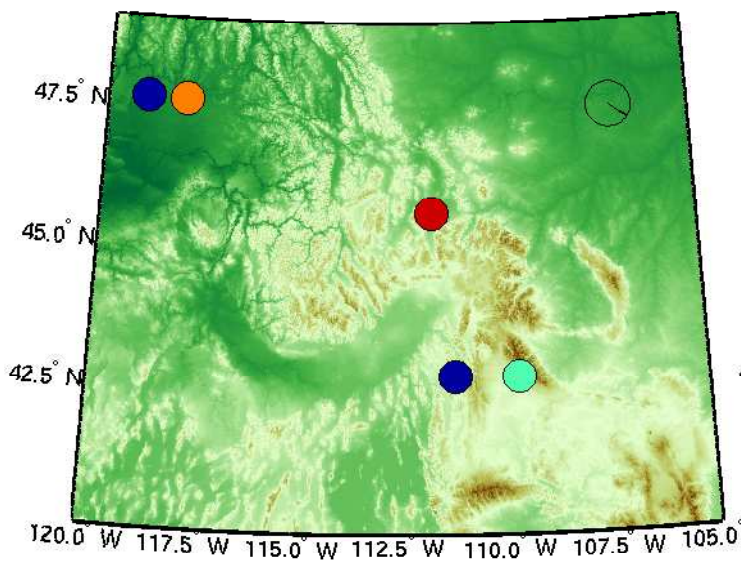
Stack



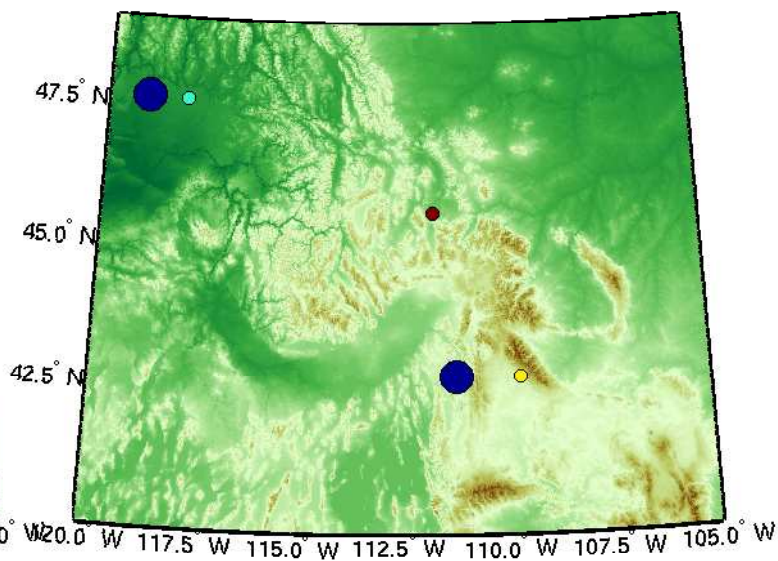
Baz = 306.5312  
Mean xcor value = 0.65  
Range of  $t^*$  values is 1.5167  
Median  $t^*$  err is 0.7755  
Slope = 0.75273 +/- 0.15875



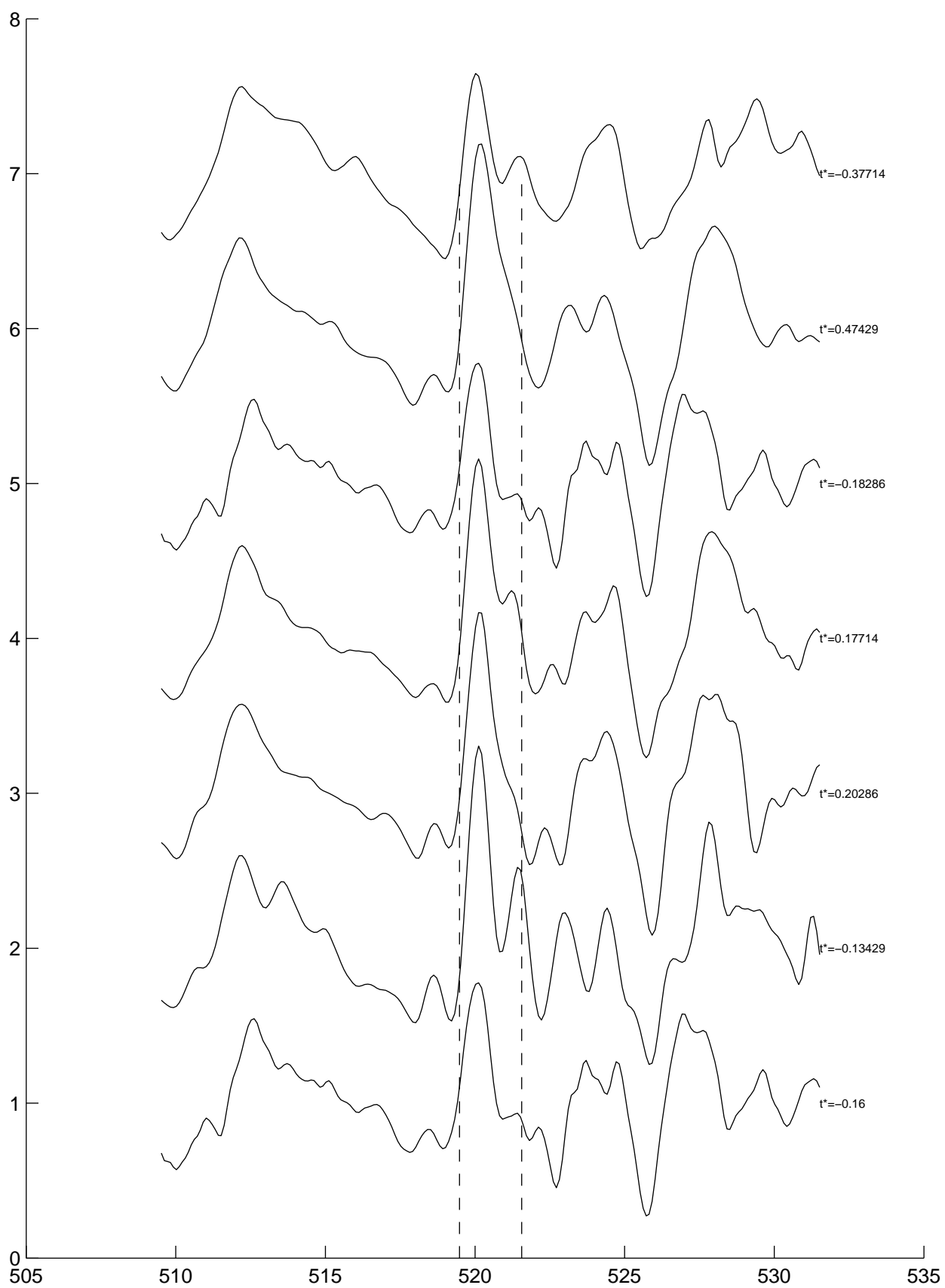
travel time residuals



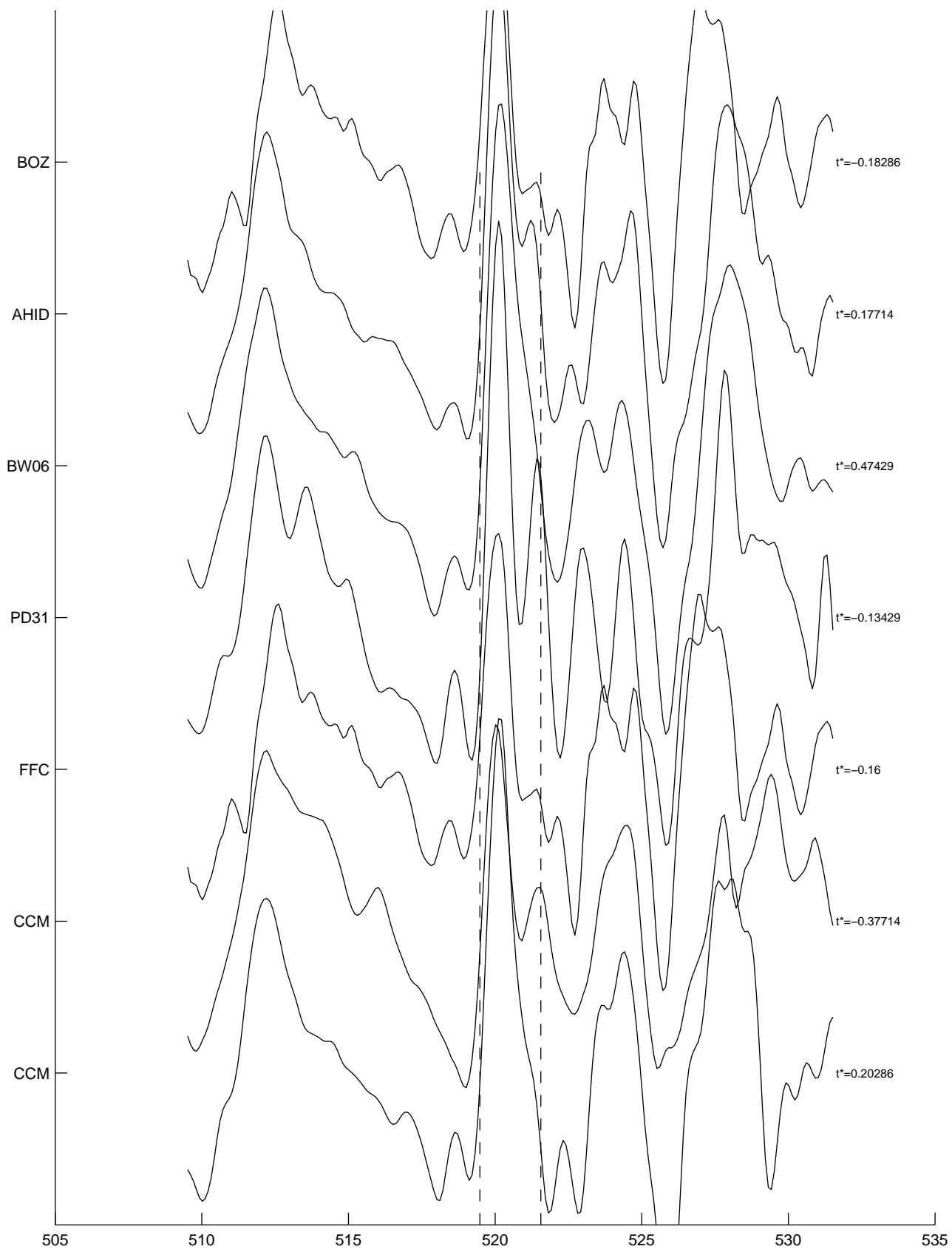
$t^*$  values



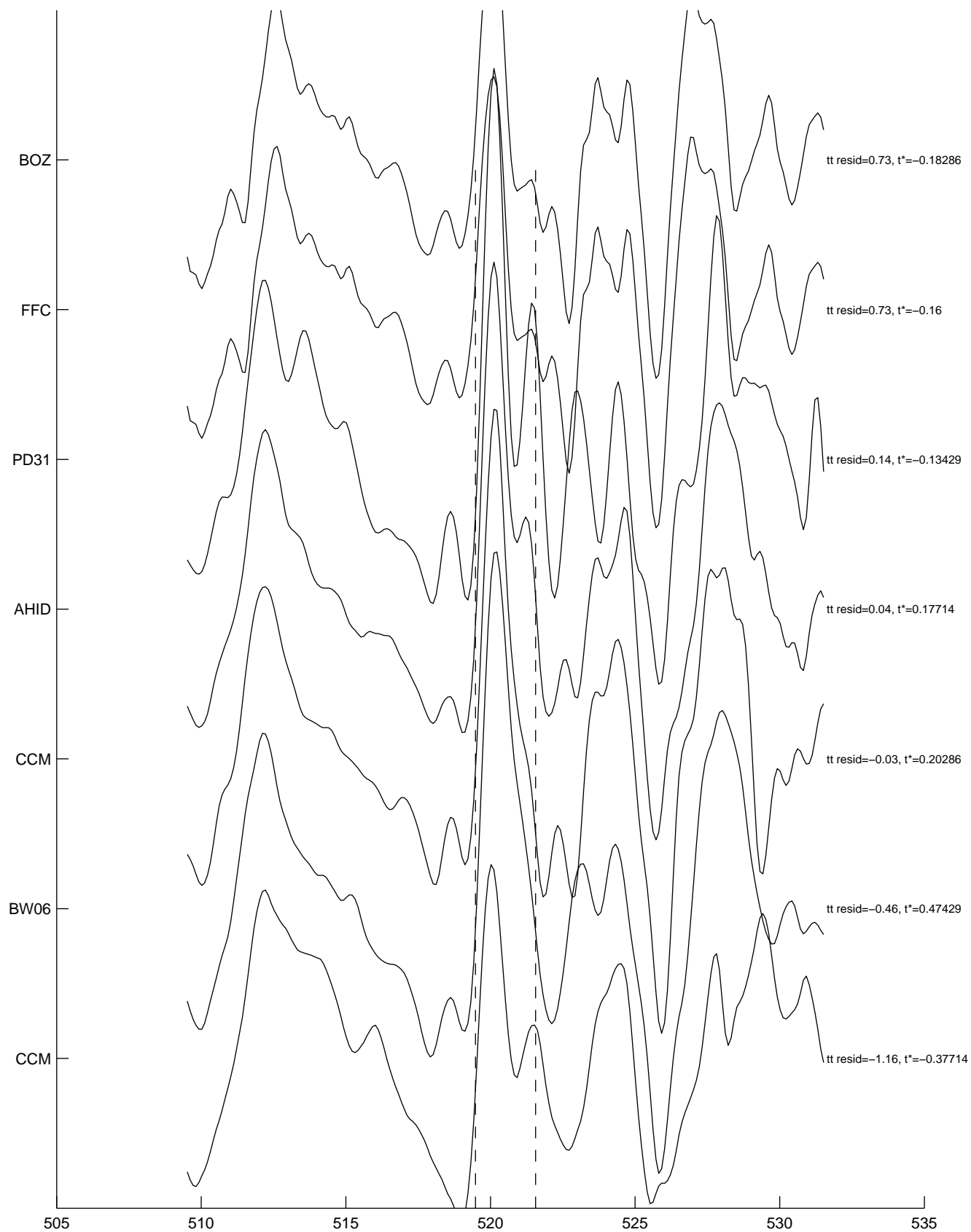
# Event\_2003\_134\_06\_03\_35



Sorted by Delta:Event\_2003\_134\_06\_03\_35

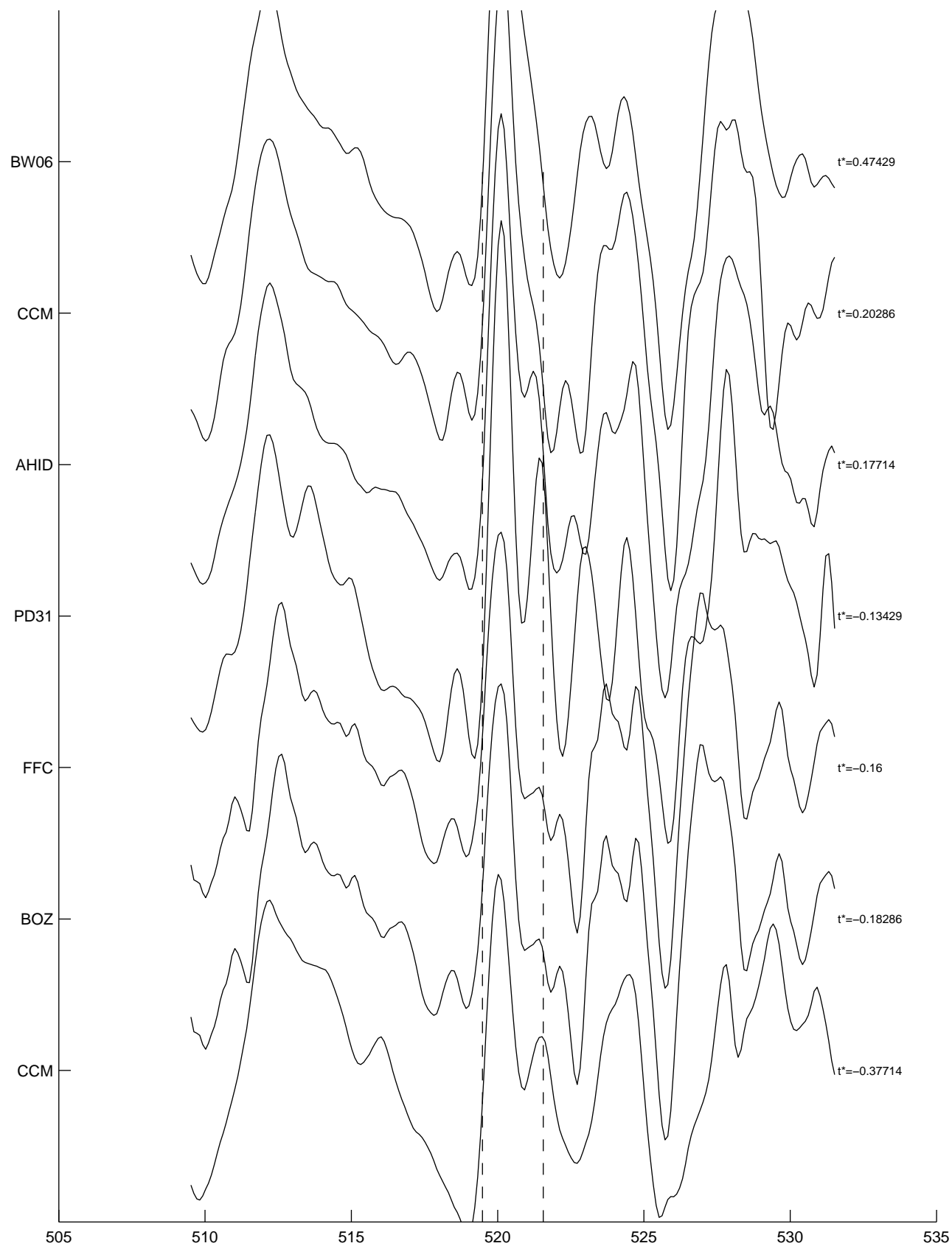


# Sorted by travel time: Event\_2003\_134\_06\_03\_35

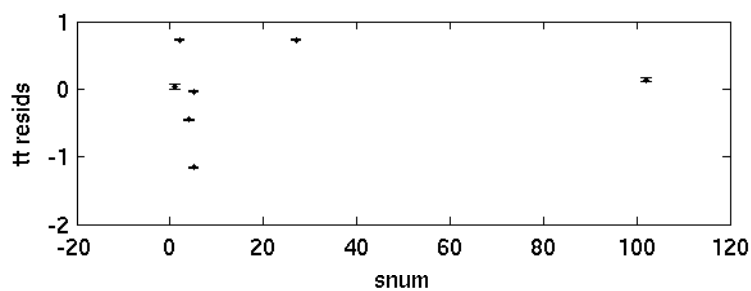
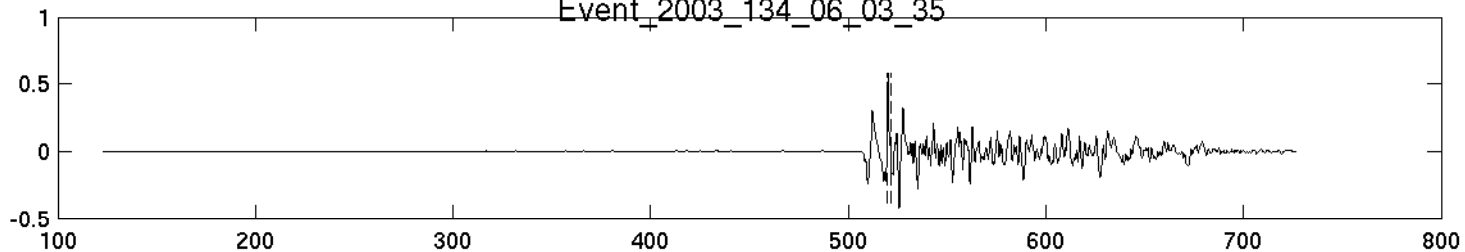




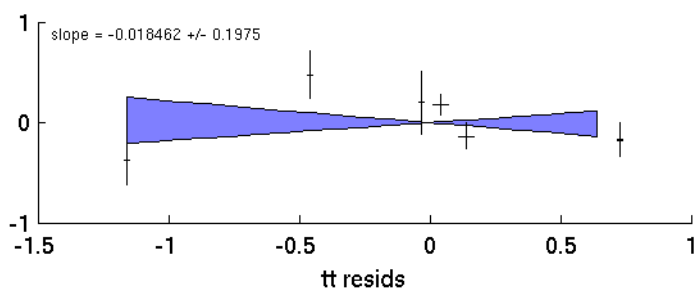
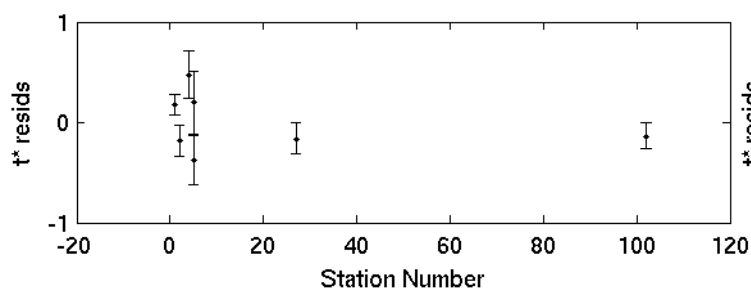
Sorted by t\*:Event\_2003\_134\_06\_03\_35



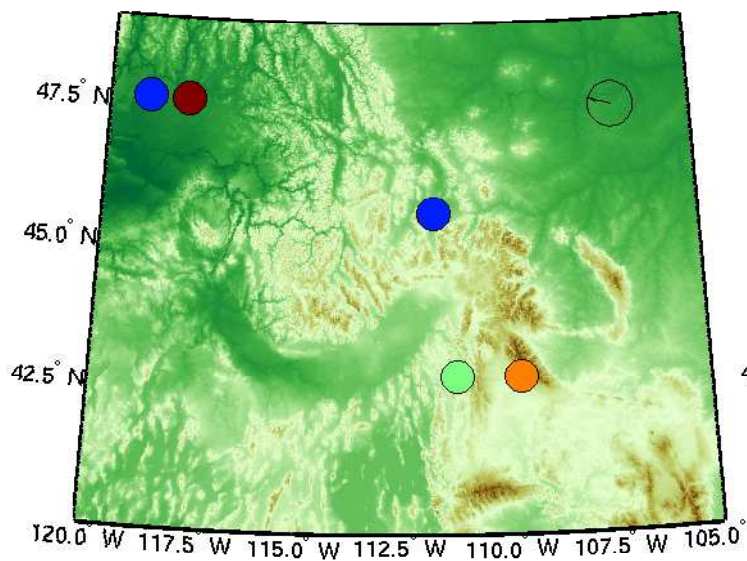
# Stack Event\_2003\_134\_06\_03\_35



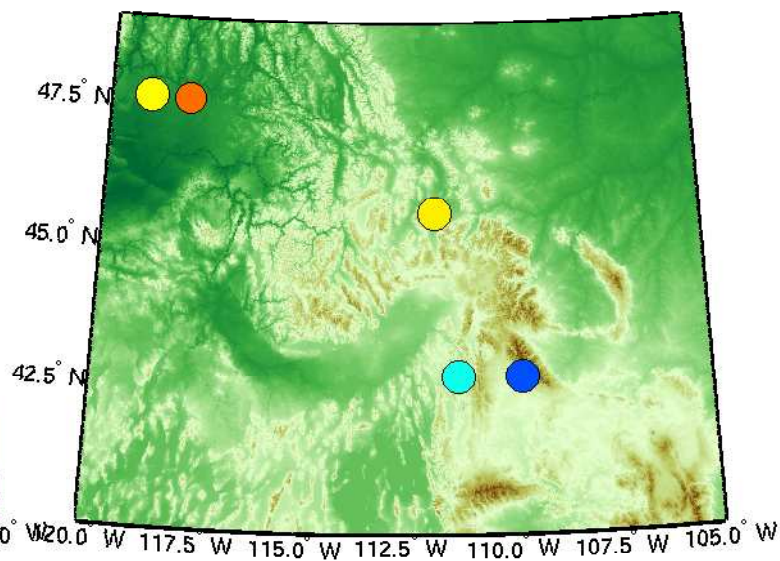
Baz = 107.7055  
Mean xcor value = 0.78  
Range of  $t^*$  values is 0.85143  
Median  $t^*$  err is 0.16352  
Slope = -0.018462 +/- 0.1975



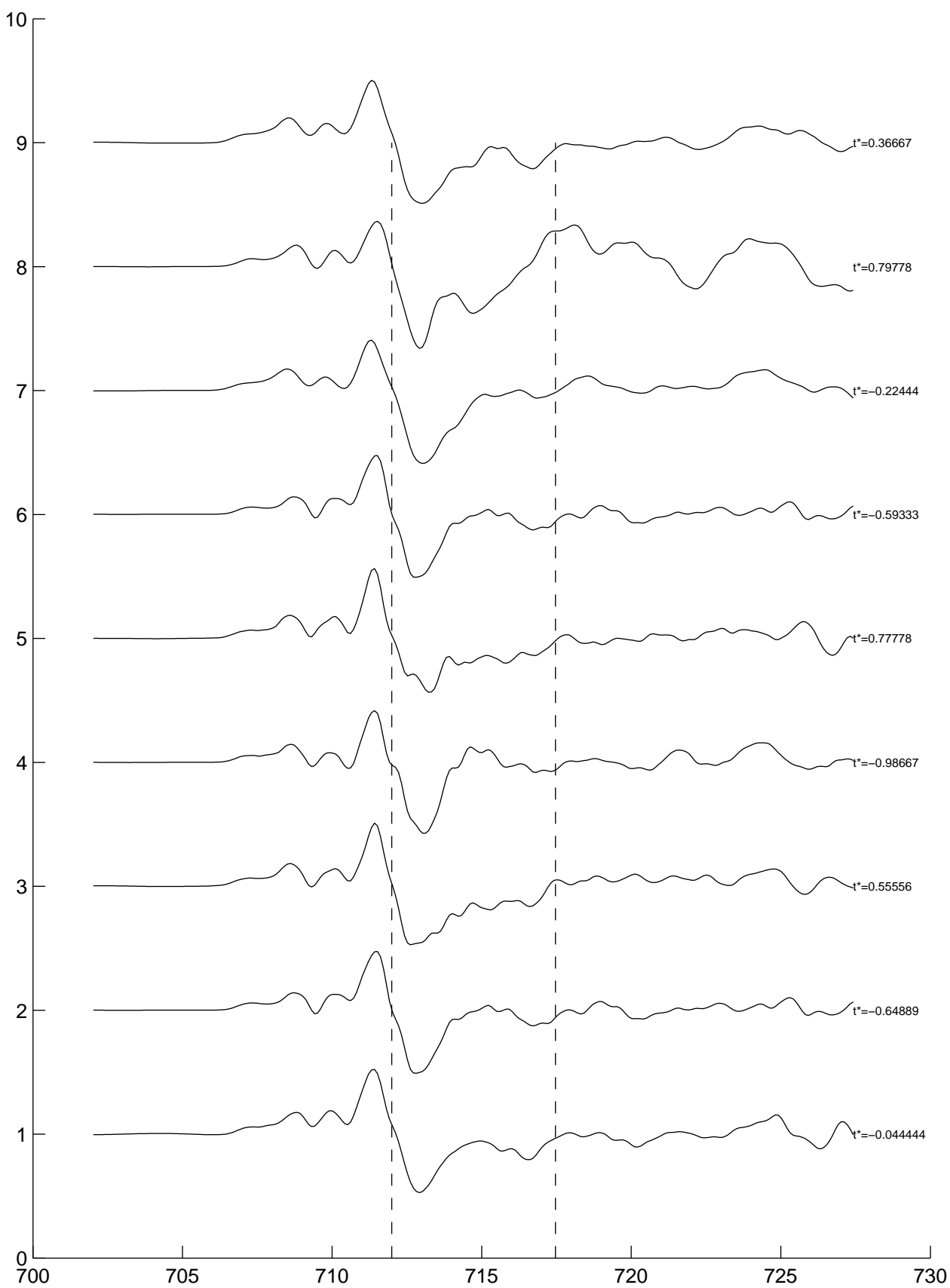
travel time residuals



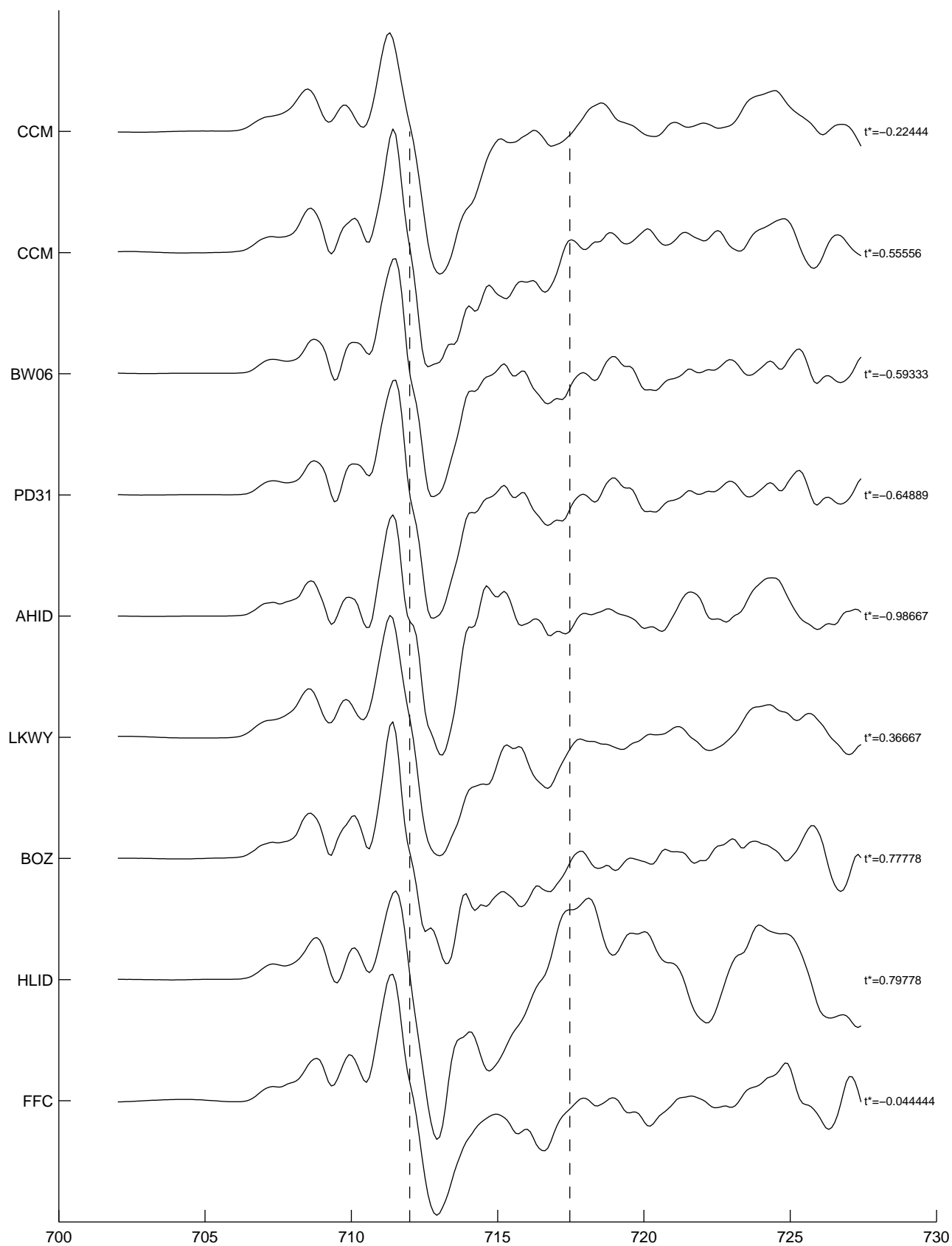
$t^*$  values



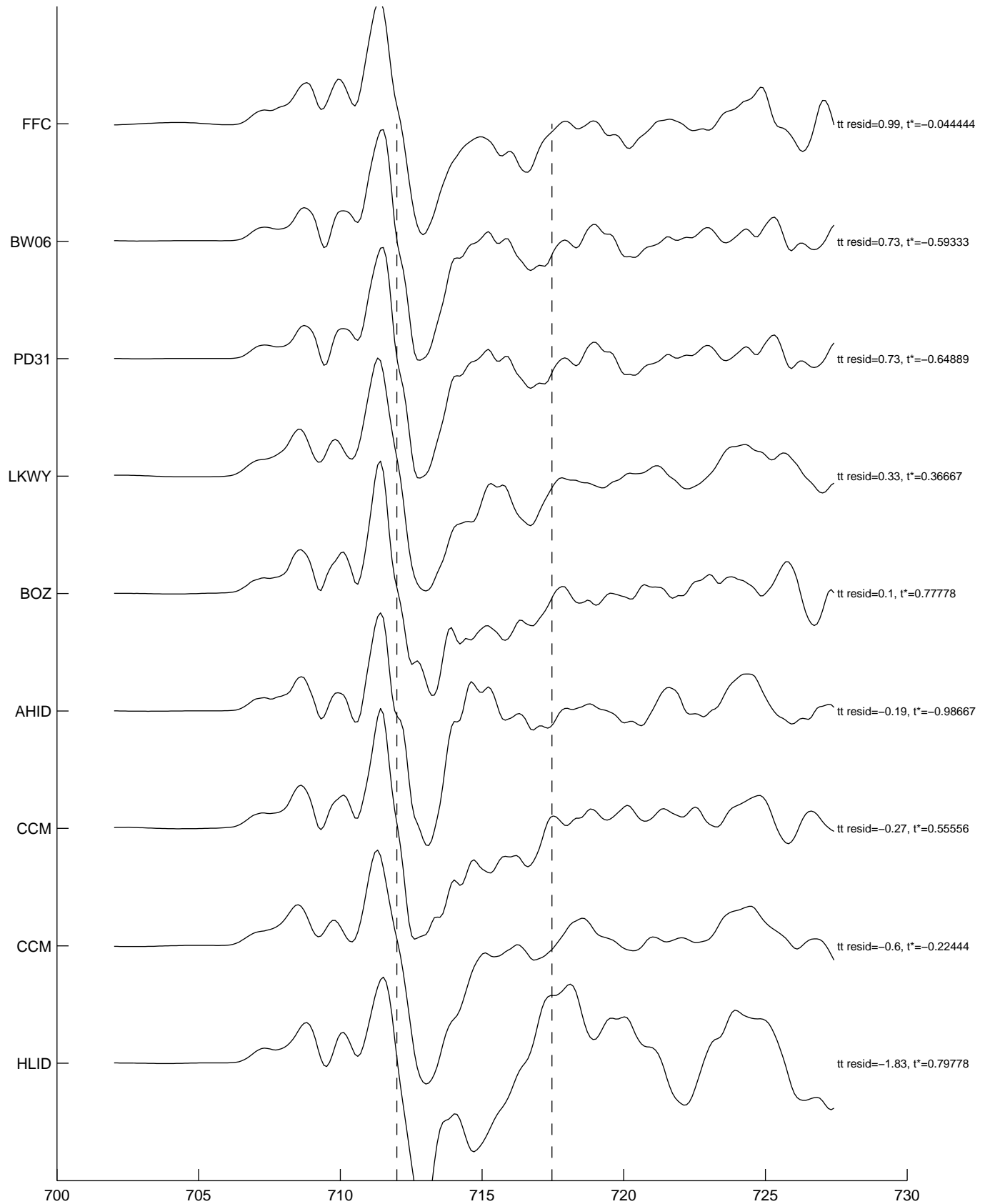
# Event\_2003\_146\_09\_24\_33



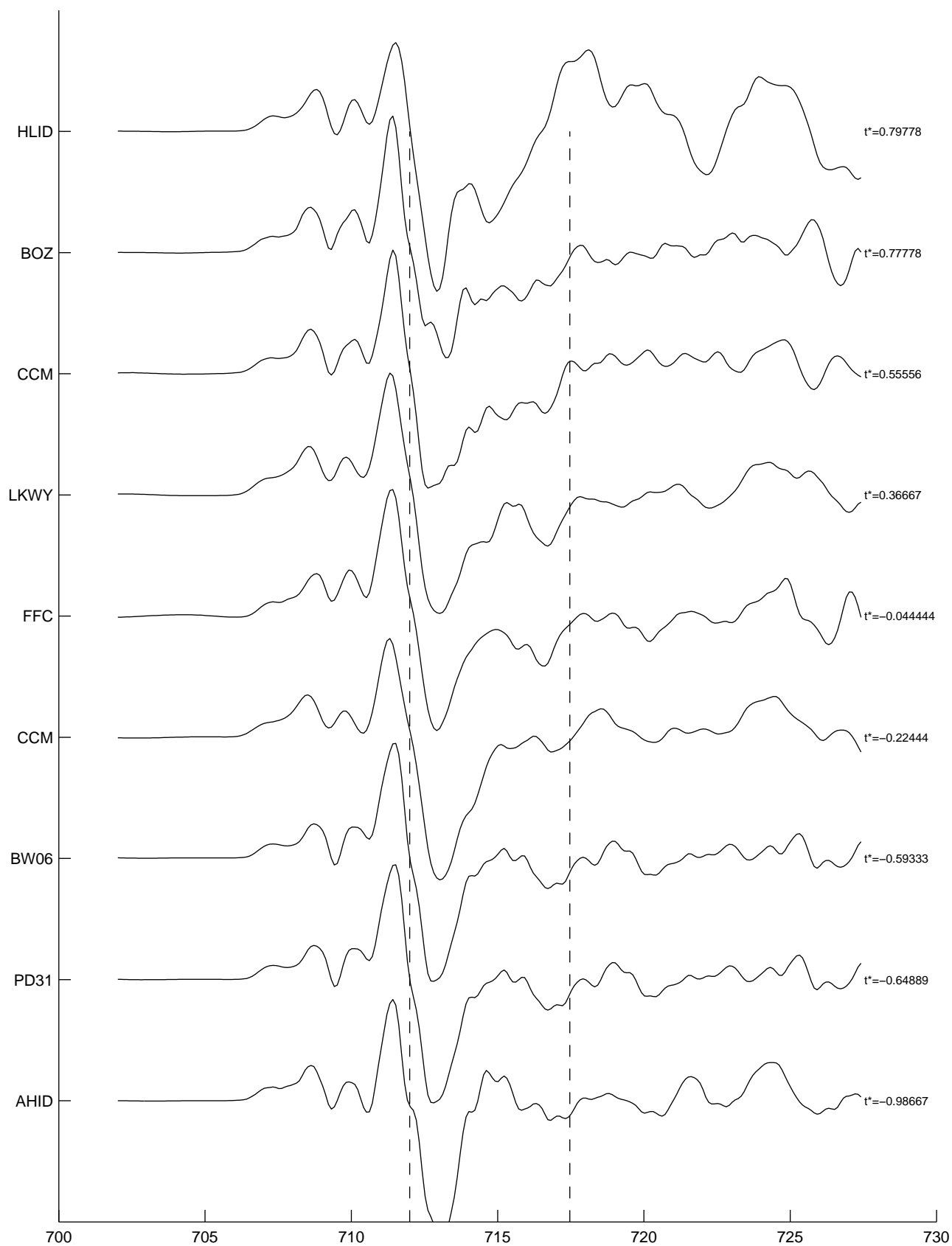
# Sorted by Delta:Event\_2003\_146\_09\_24\_33



# Sorted by travel time:Event\_2003\_146\_09\_24\_33

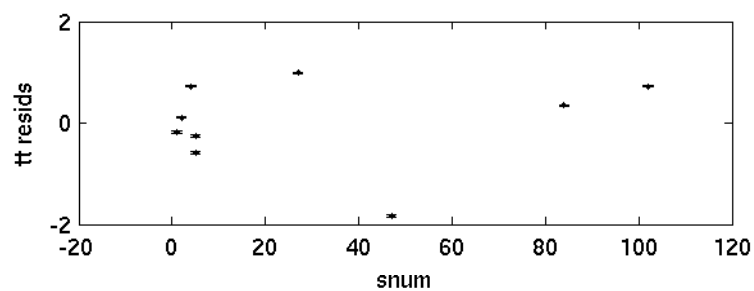
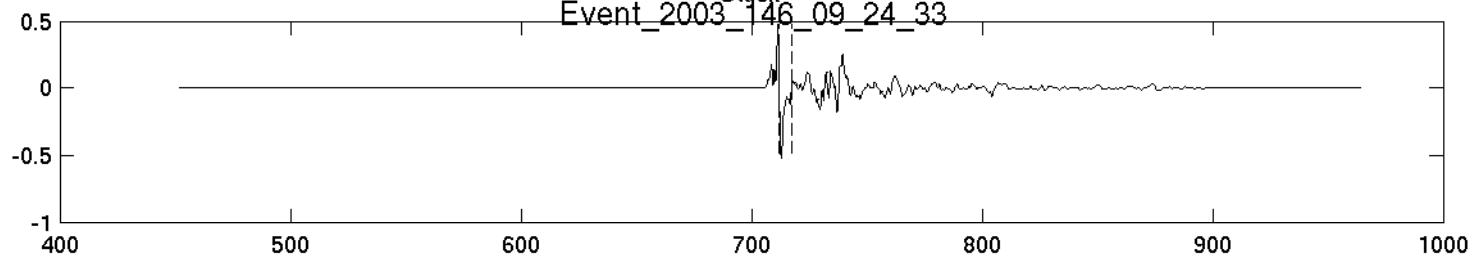


Sorted by  $t^*$ :Event\_2003\_146\_09\_24\_33

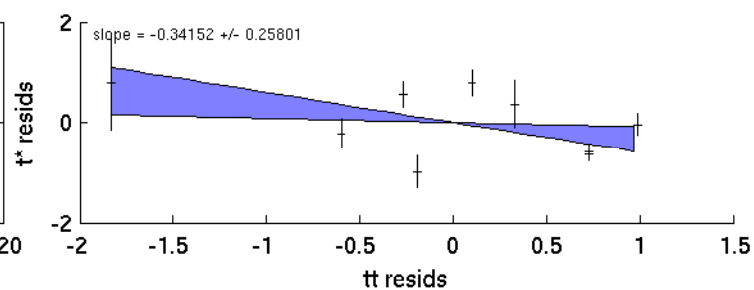
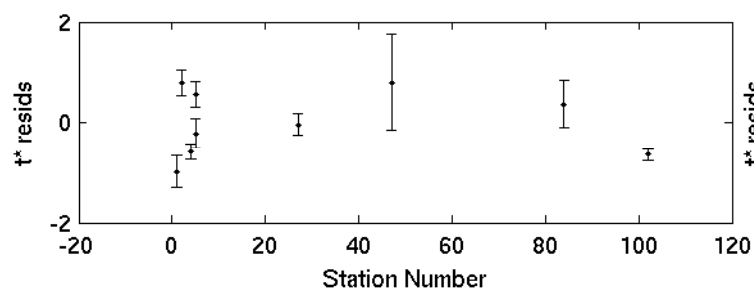


Event\_2003\_146\_09\_24\_33

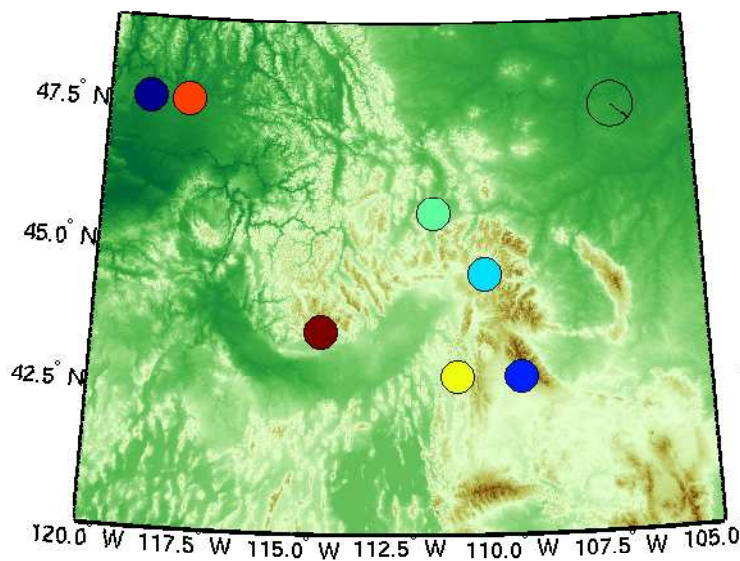
Stack



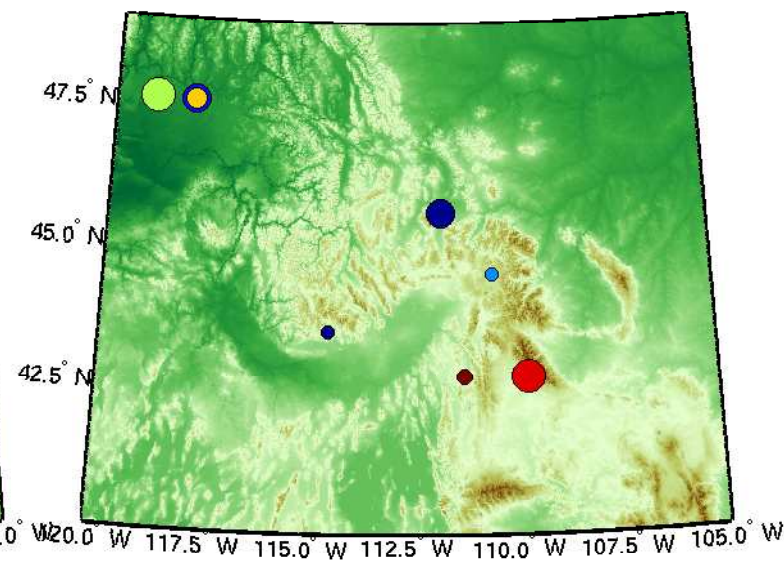
Baz = 312.045  
Mean xcor value = 0.81667  
Range of  $t^*$  values is 1.7844  
Median  $t^*$  err is 0.25623  
Slope =  $-0.34152 \pm 0.25801$



travel time residuals

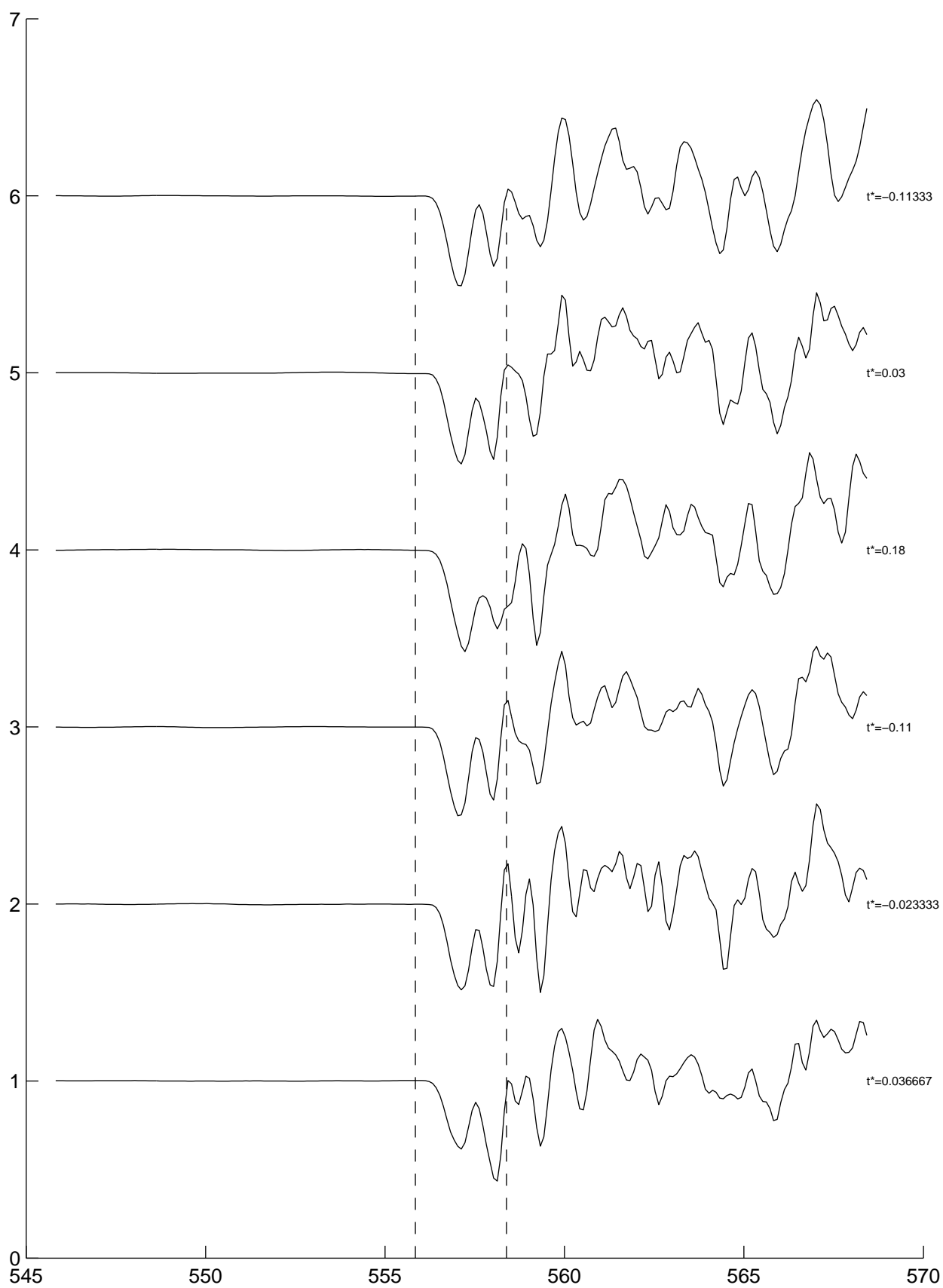


$t^*$  values

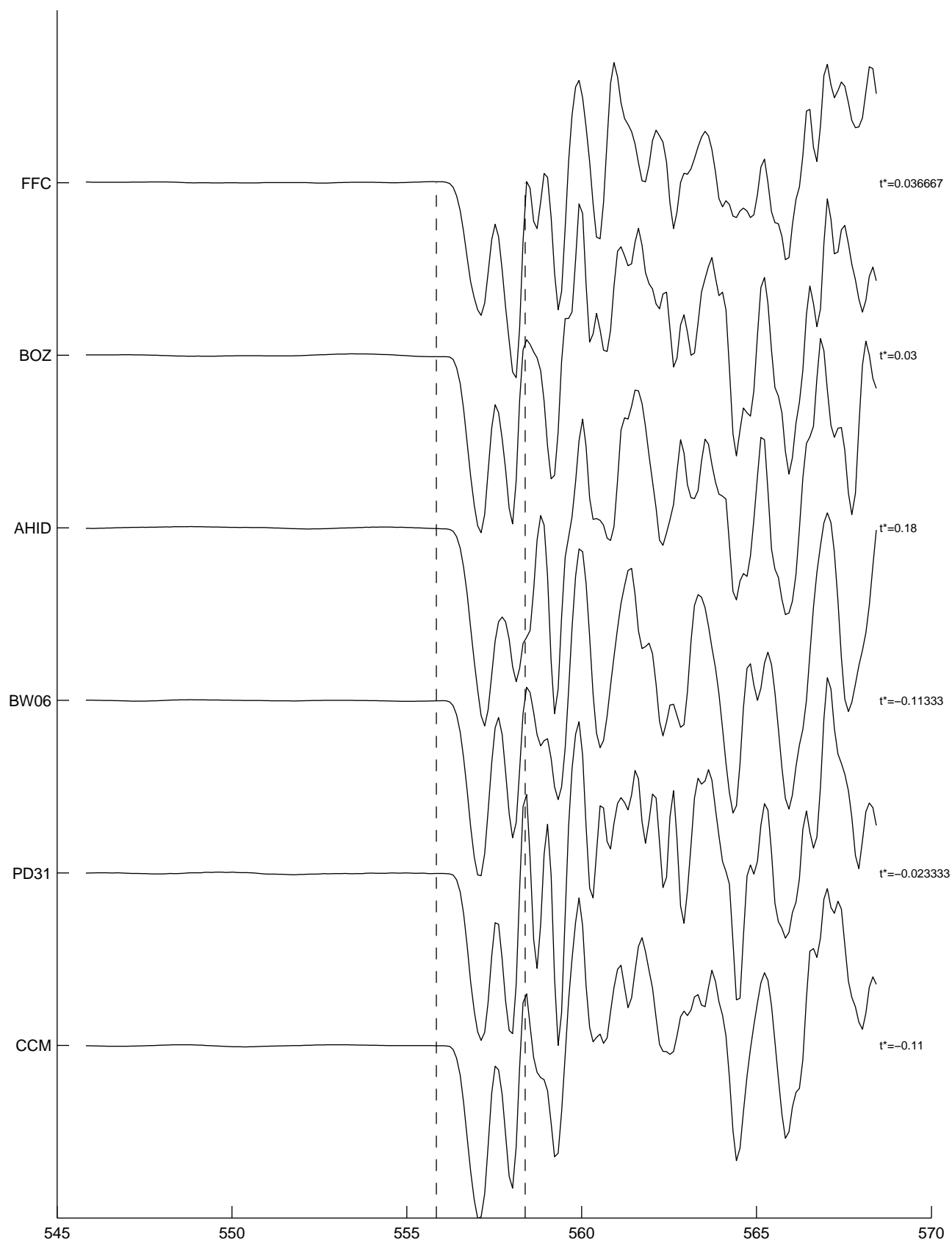




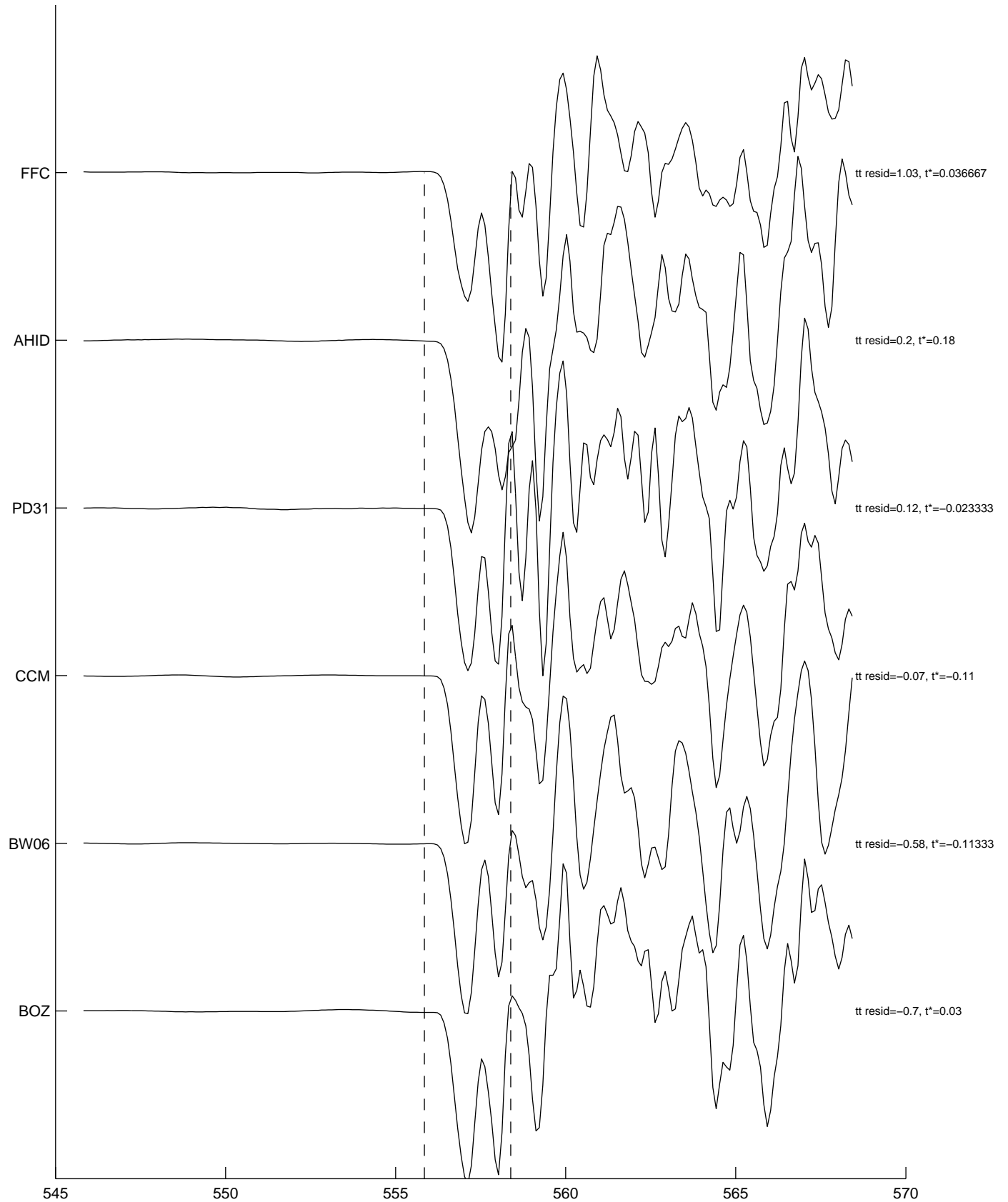
# Event\_2003\_171\_06\_19\_38



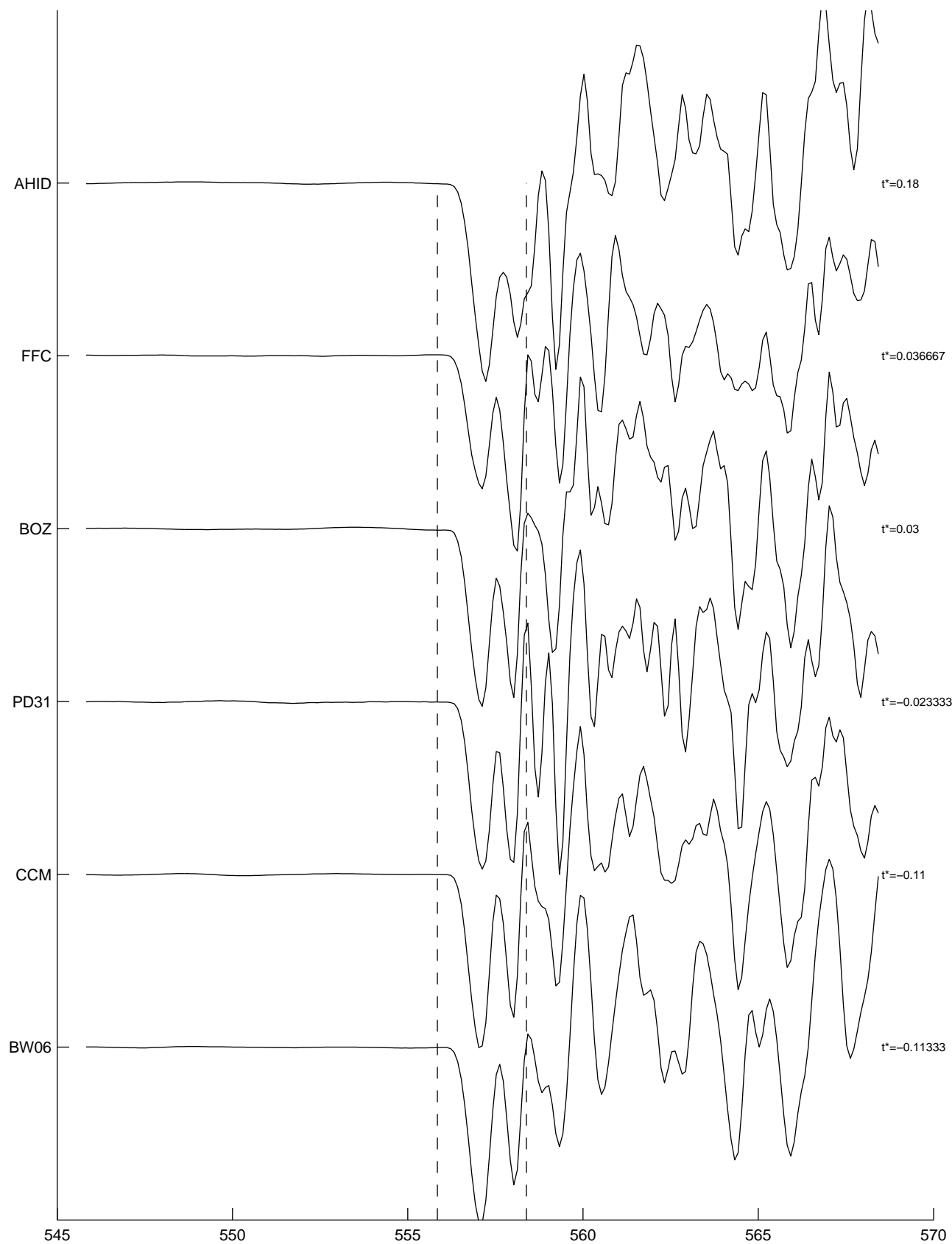
# Sorted by Delta:Event\_2003\_171\_06\_19\_38



# Sorted by travel time: Event\_2003\_171\_06\_19\_38

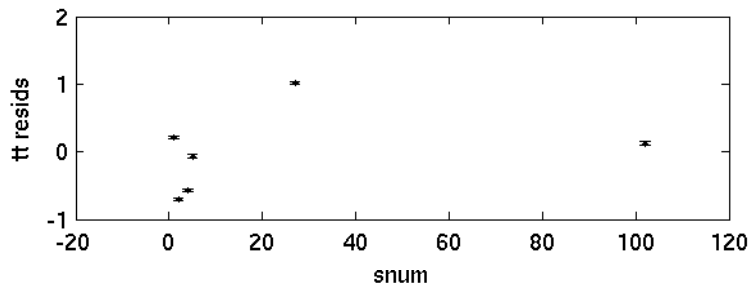
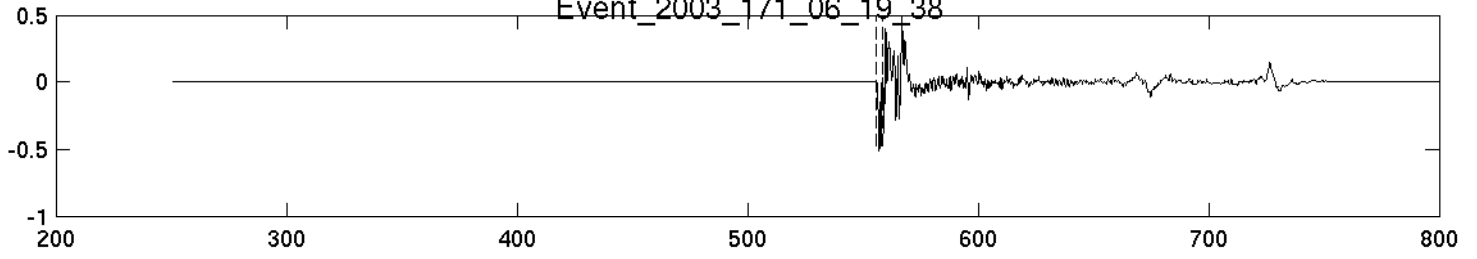


Sorted by t\*:Event\_2003\_171\_06\_19\_38

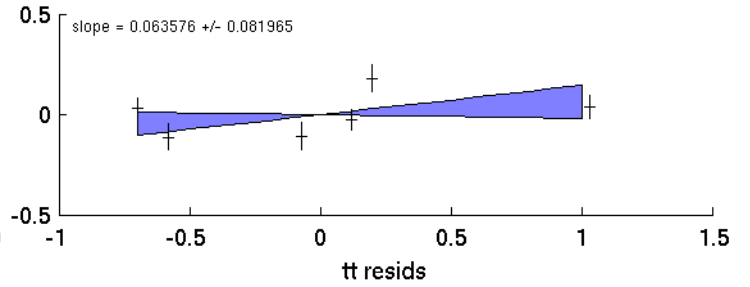
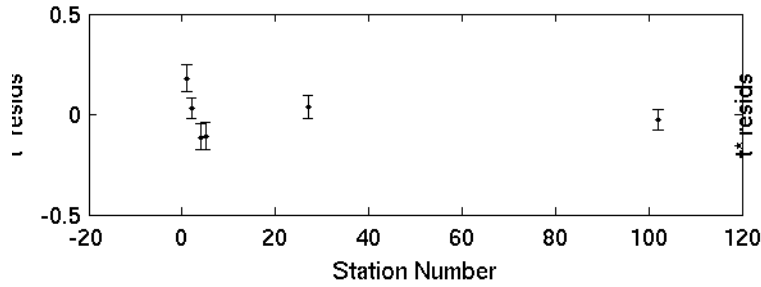


Event\_2003\_171\_06\_19\_38

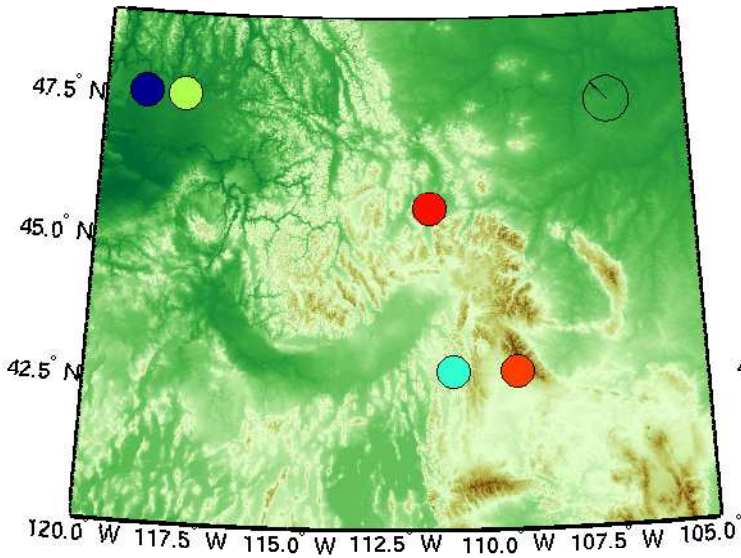
Stack



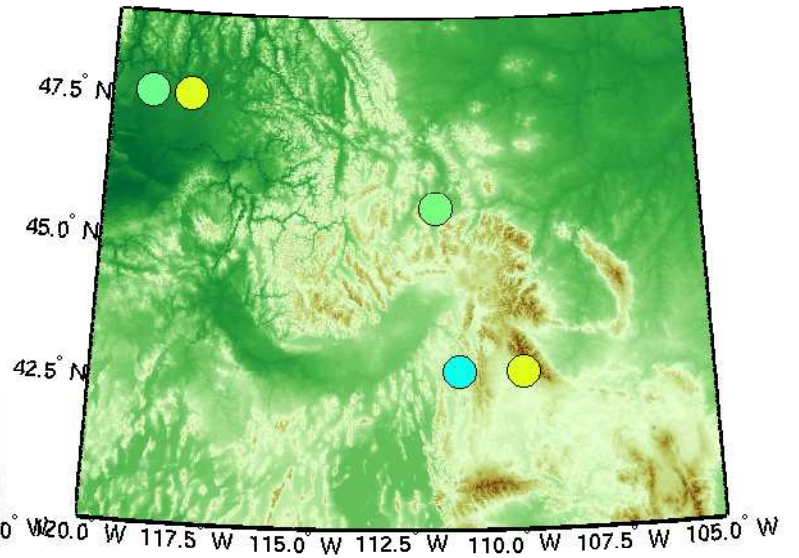
Baz = 139.7379  
Mean xcor value = 0.675  
Range of t\* values is 0.29333  
Median t\* err is 0.062909  
Slope = 0.063576 +/- 0.081965



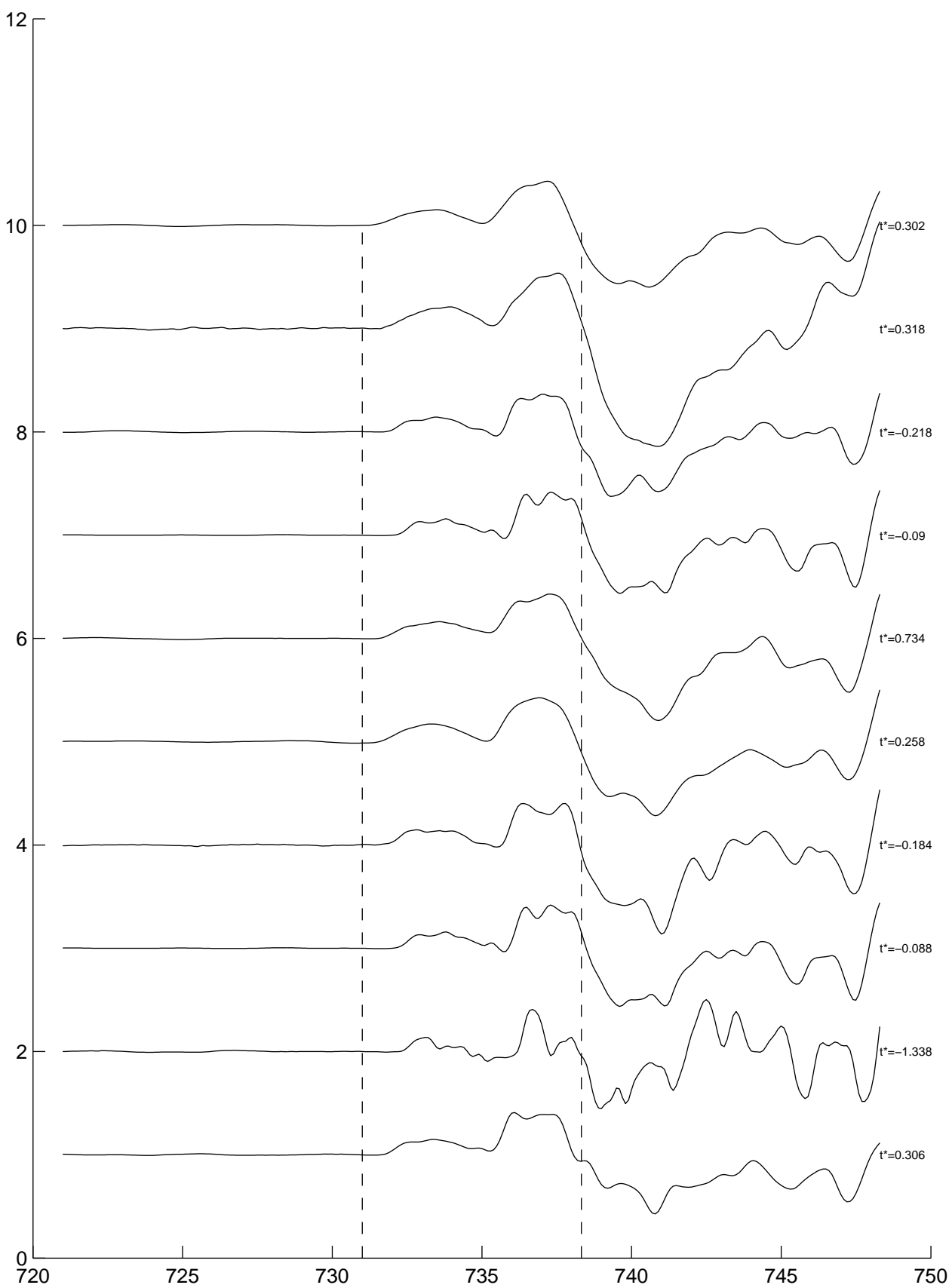
travel time residuals



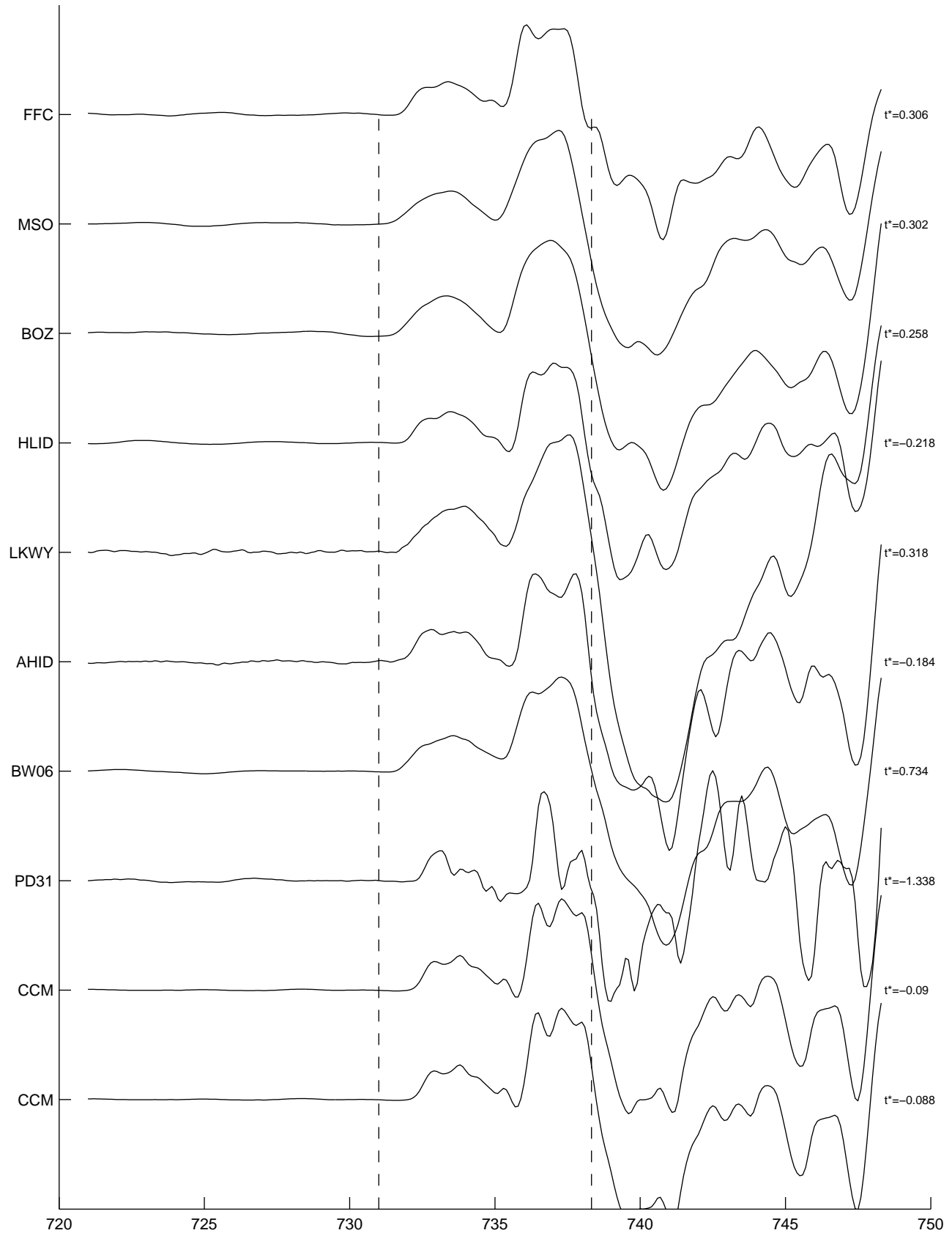
t\* values



# Event\_2003\_171\_13\_30\_41

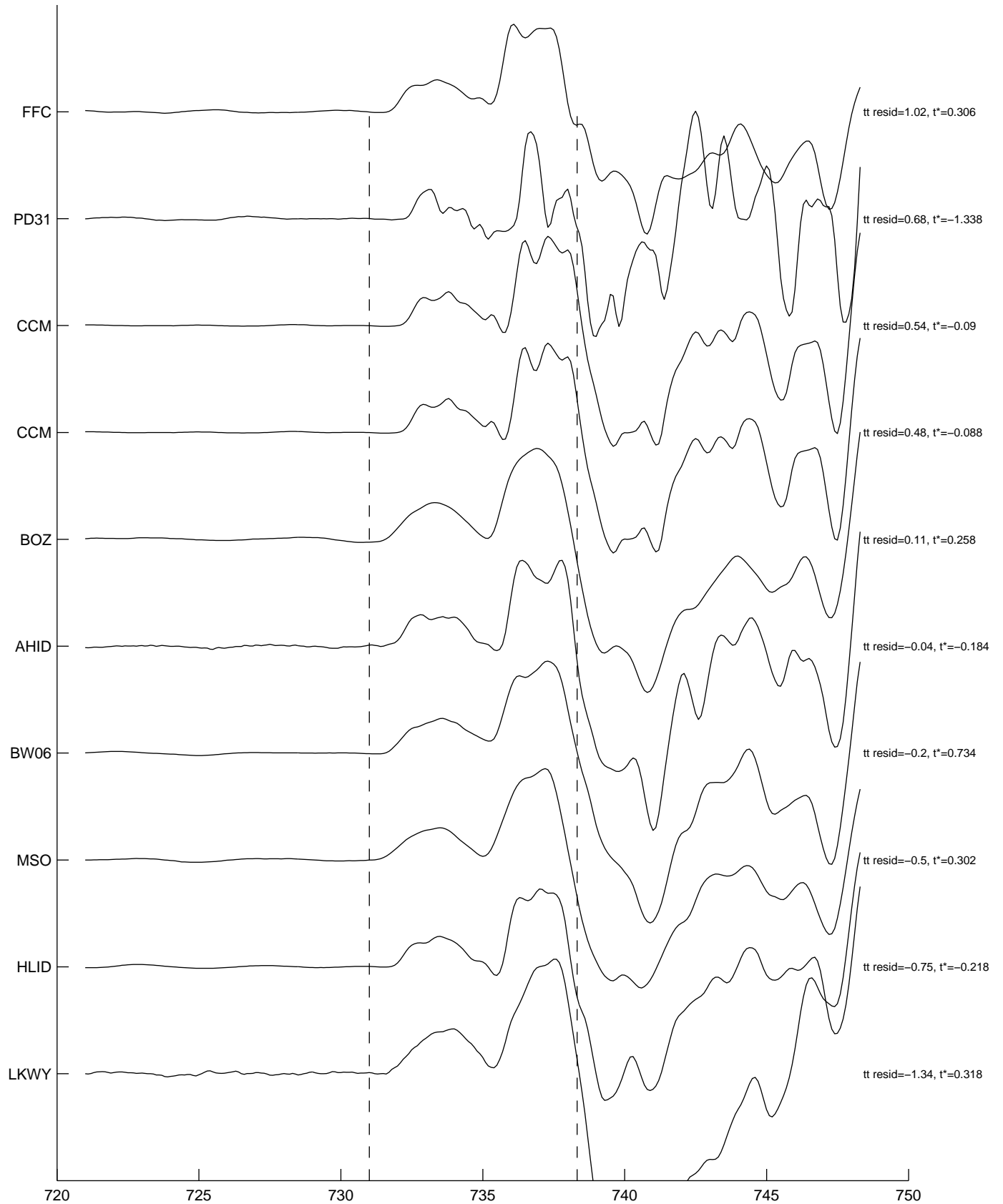


# Sorted by Delta:Event\_2003\_171\_13\_30\_41

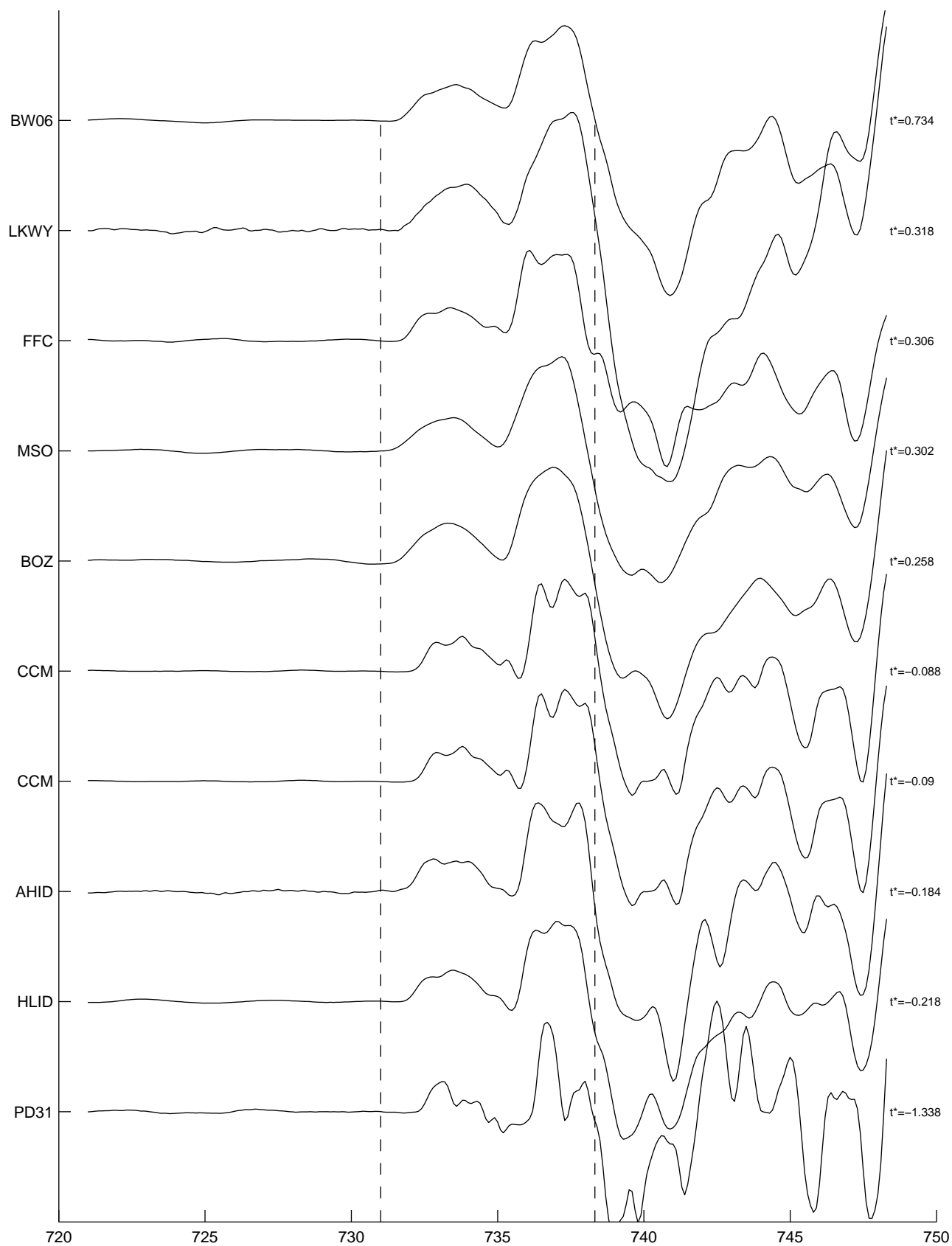




# Sorted by travel time:Event\_2003\_171\_13\_30\_41

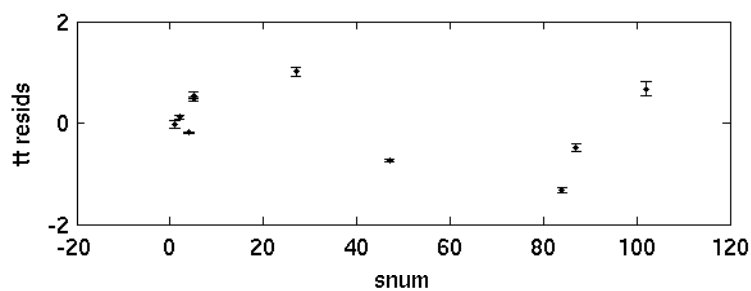
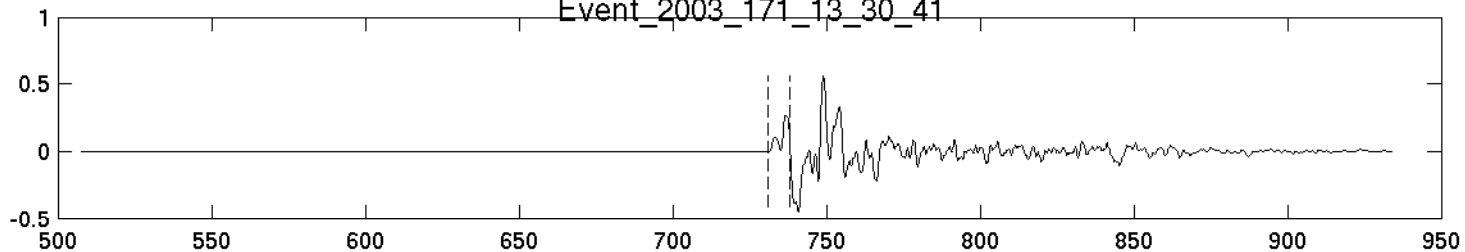


Sorted by  $t^*$ :Event\_2003\_171\_13\_30\_41

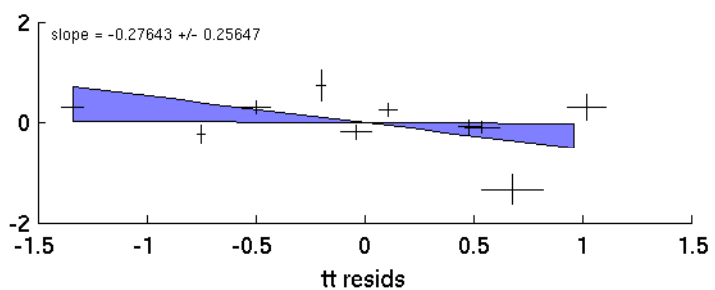
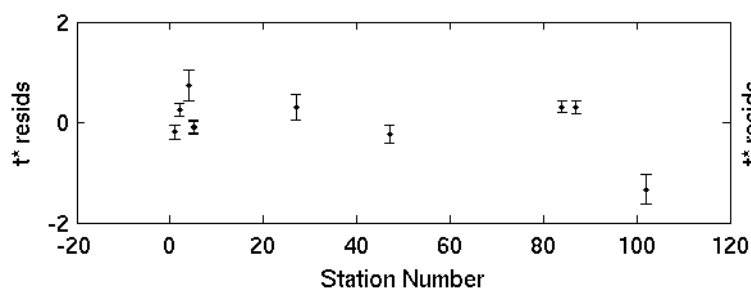


Event\_2003\_171\_13\_30\_41

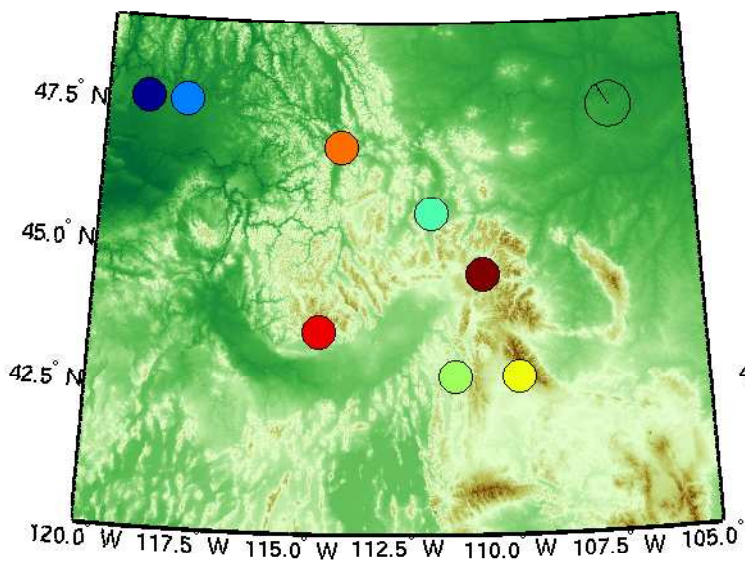
Stack



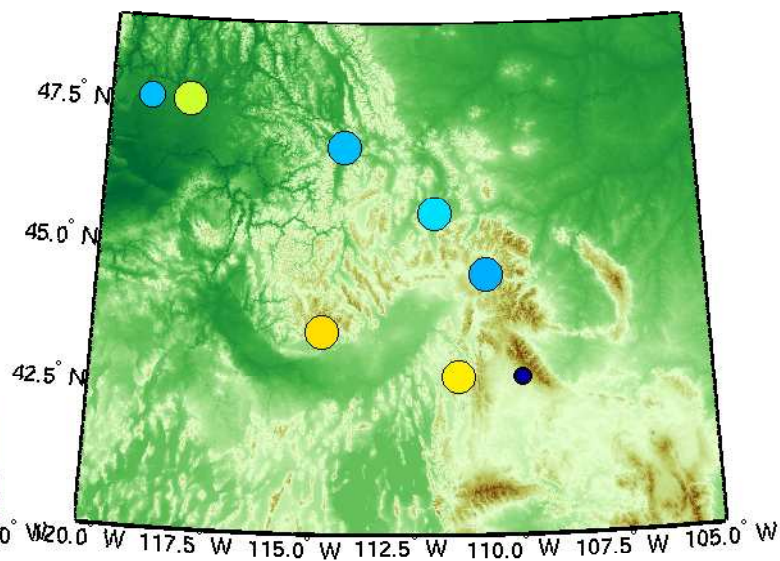
Baz = 150.227  
Mean xcor value = 0.83  
Range of  $t^*$  values is 2.072  
Median  $t^*$  err is 0.13854  
Slope = -0.27643 +/- 0.25647



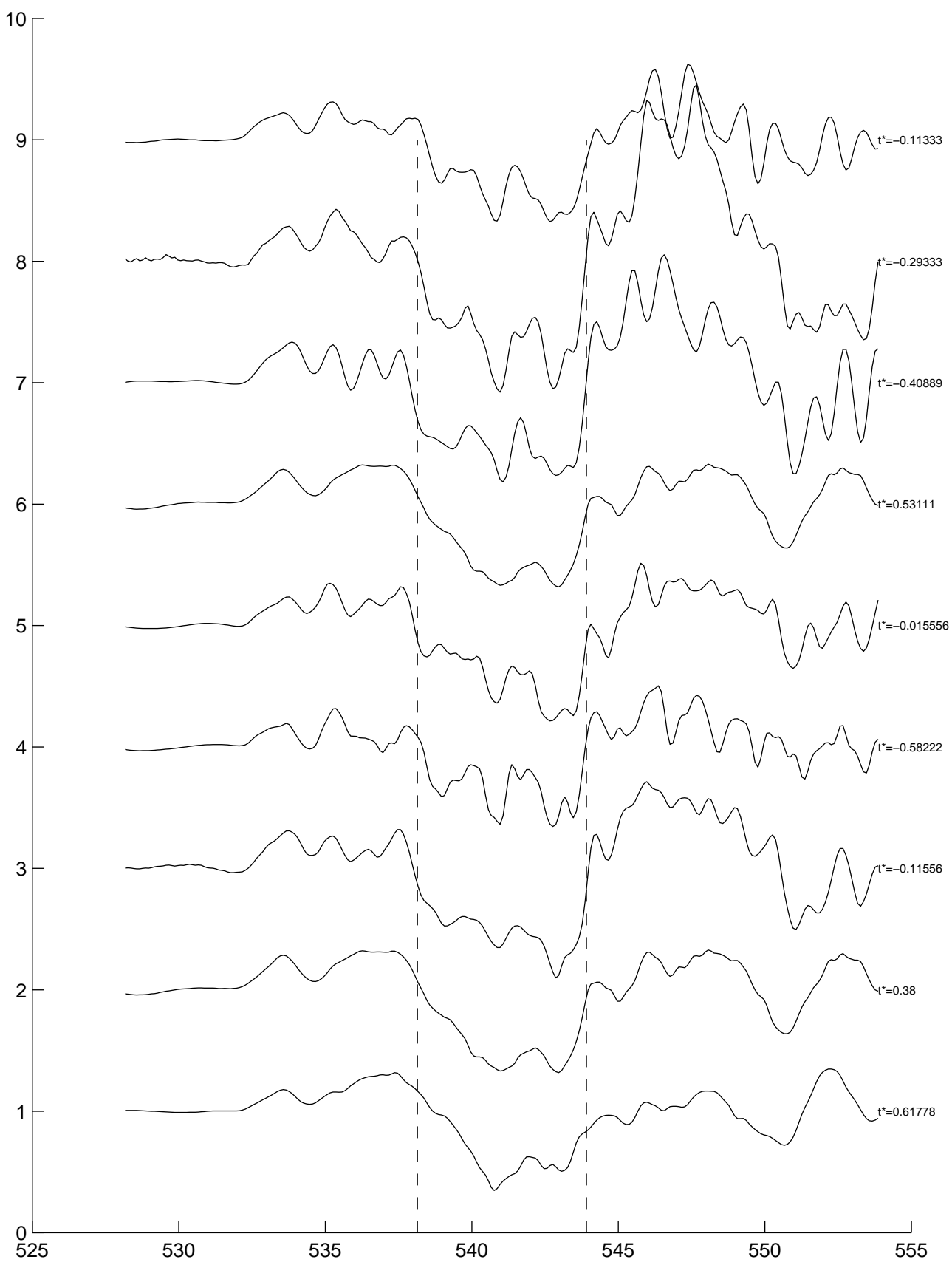
travel time residuals



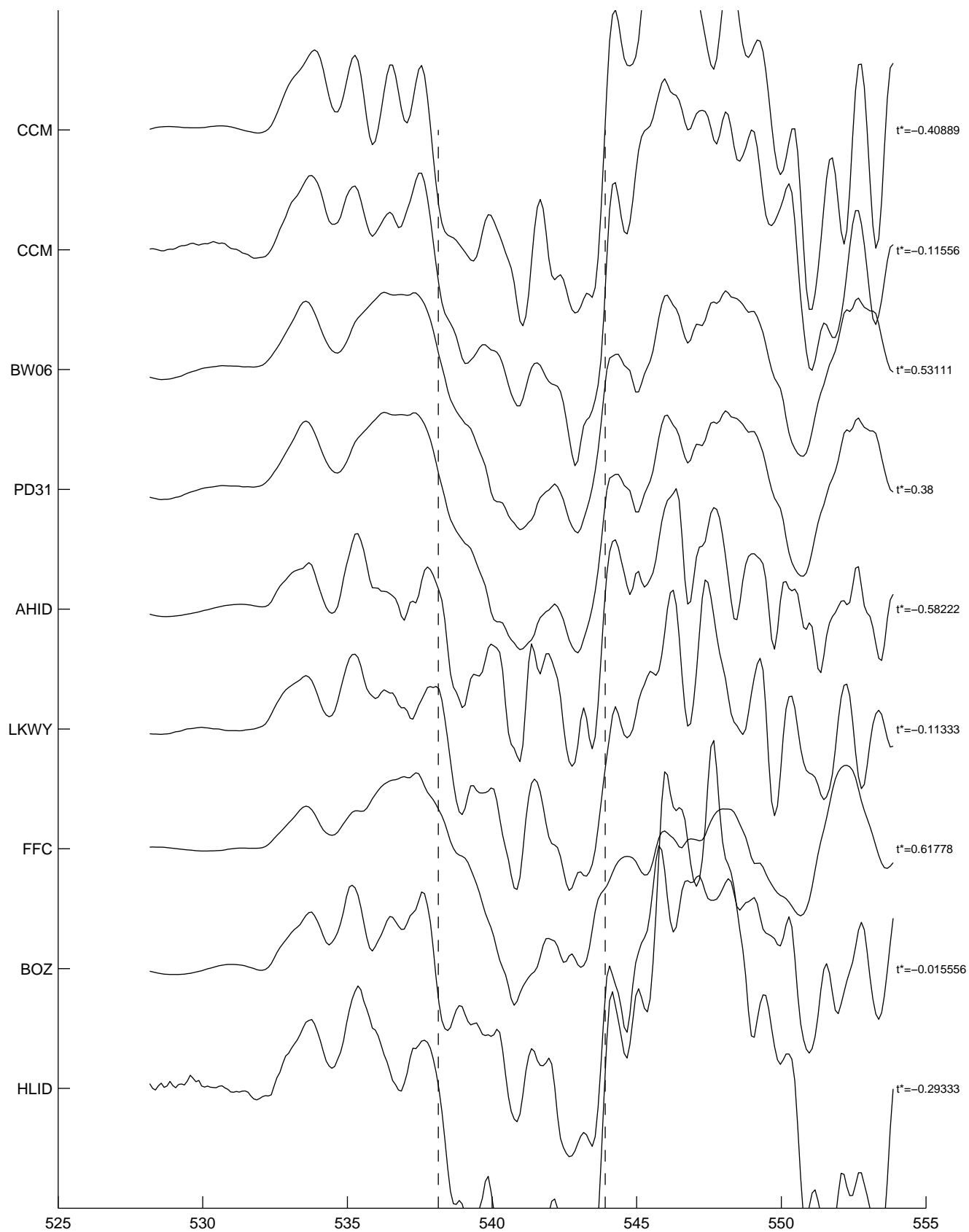
$t^*$  values



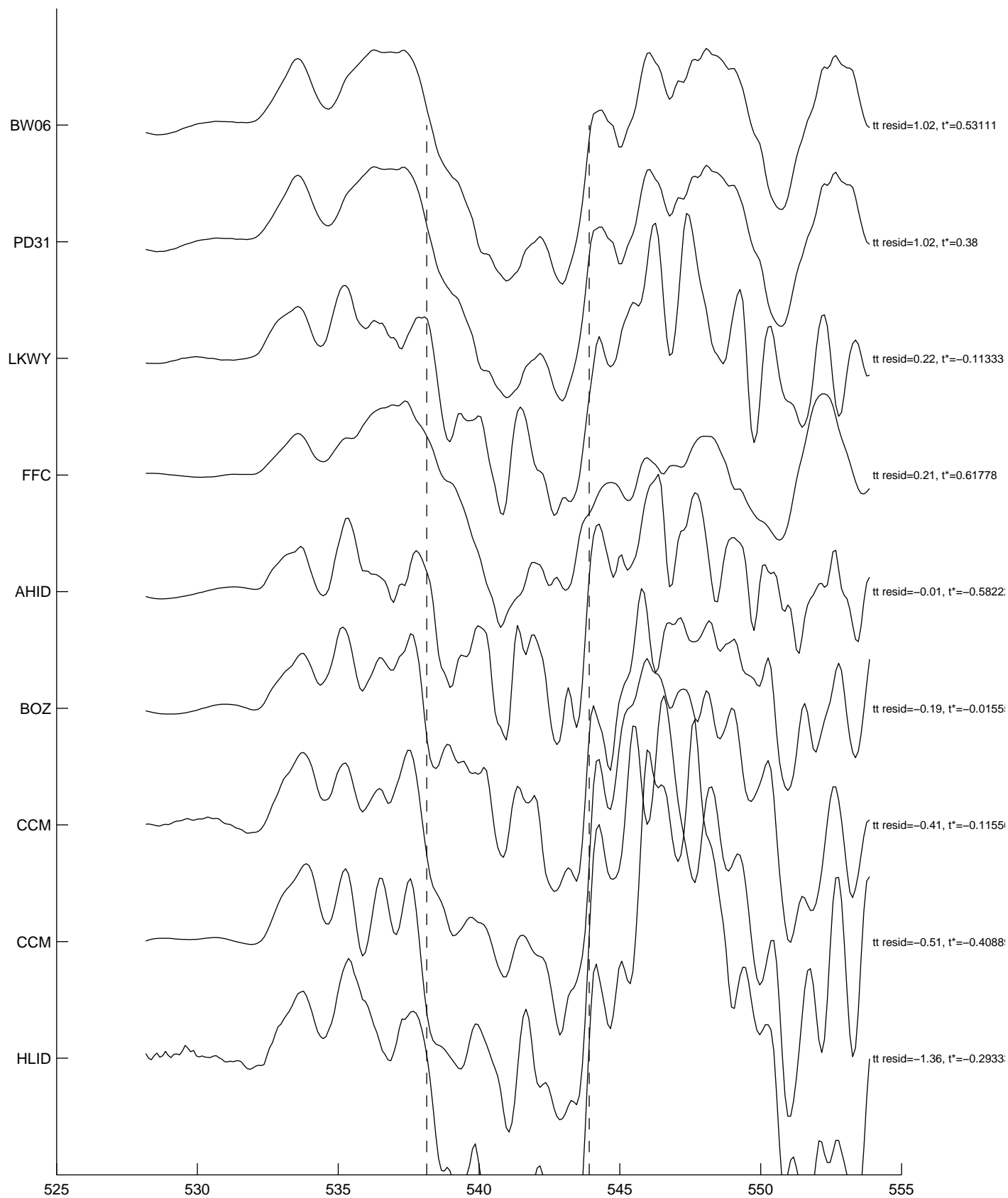
# Event\_2003\_174\_12\_12\_34



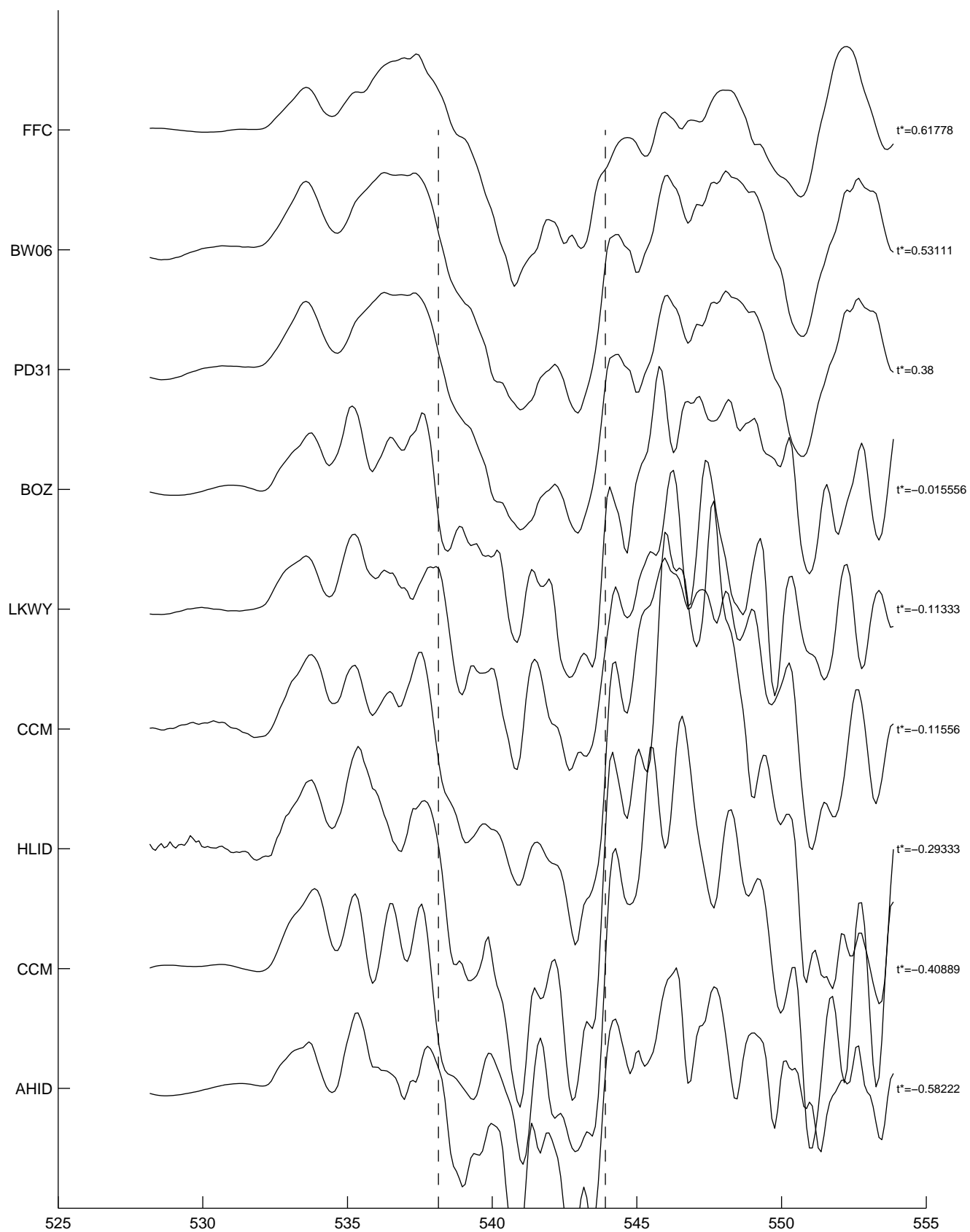
# Sorted by Delta:Event\_2003\_174\_12\_12\_34



# Sorted by travel time:Event\_2003\_174\_12\_12\_34



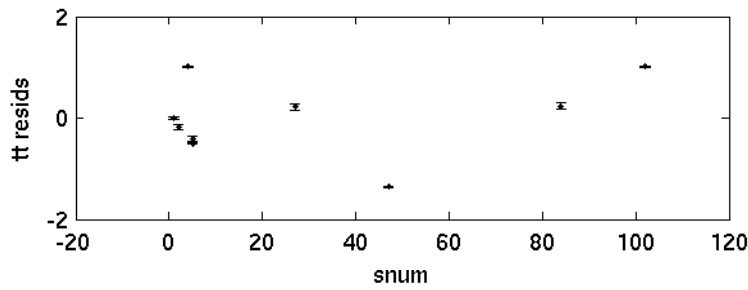
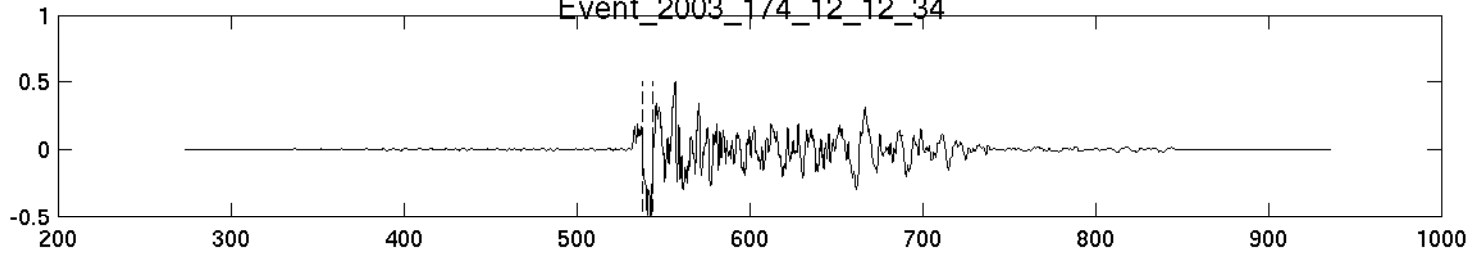
Sorted by  $t^*$ :Event\_2003\_174\_12\_12\_34



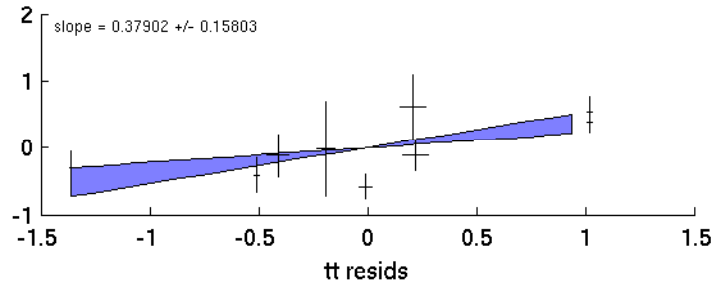
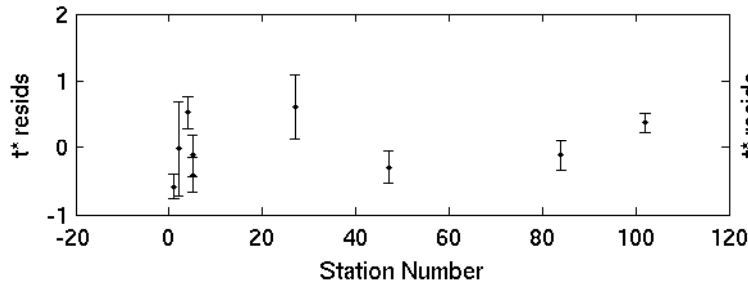


# Event\_2003\_174\_12\_12\_34

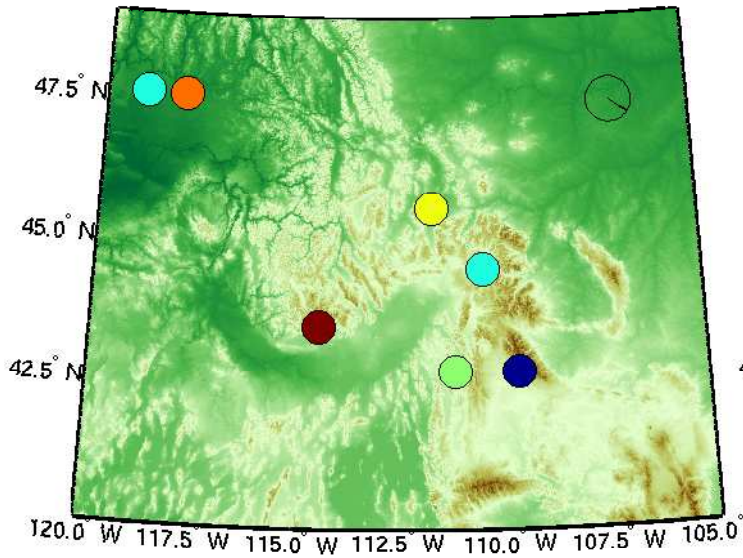
Stack



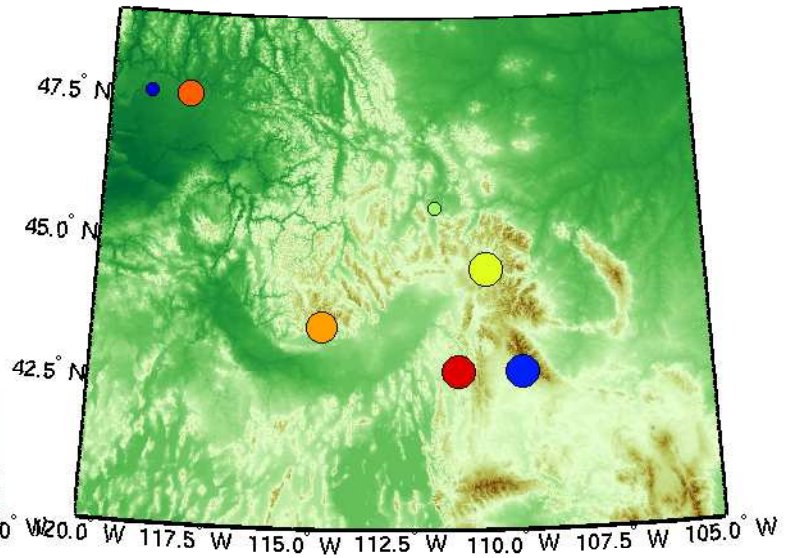
Baz = 307.127  
Mean xcor value = 0.77444  
Range of  $t^*$  values is 1.2  
Median  $t^*$  err is 0.24661  
Slope = 0.37902 +/- 0.15803



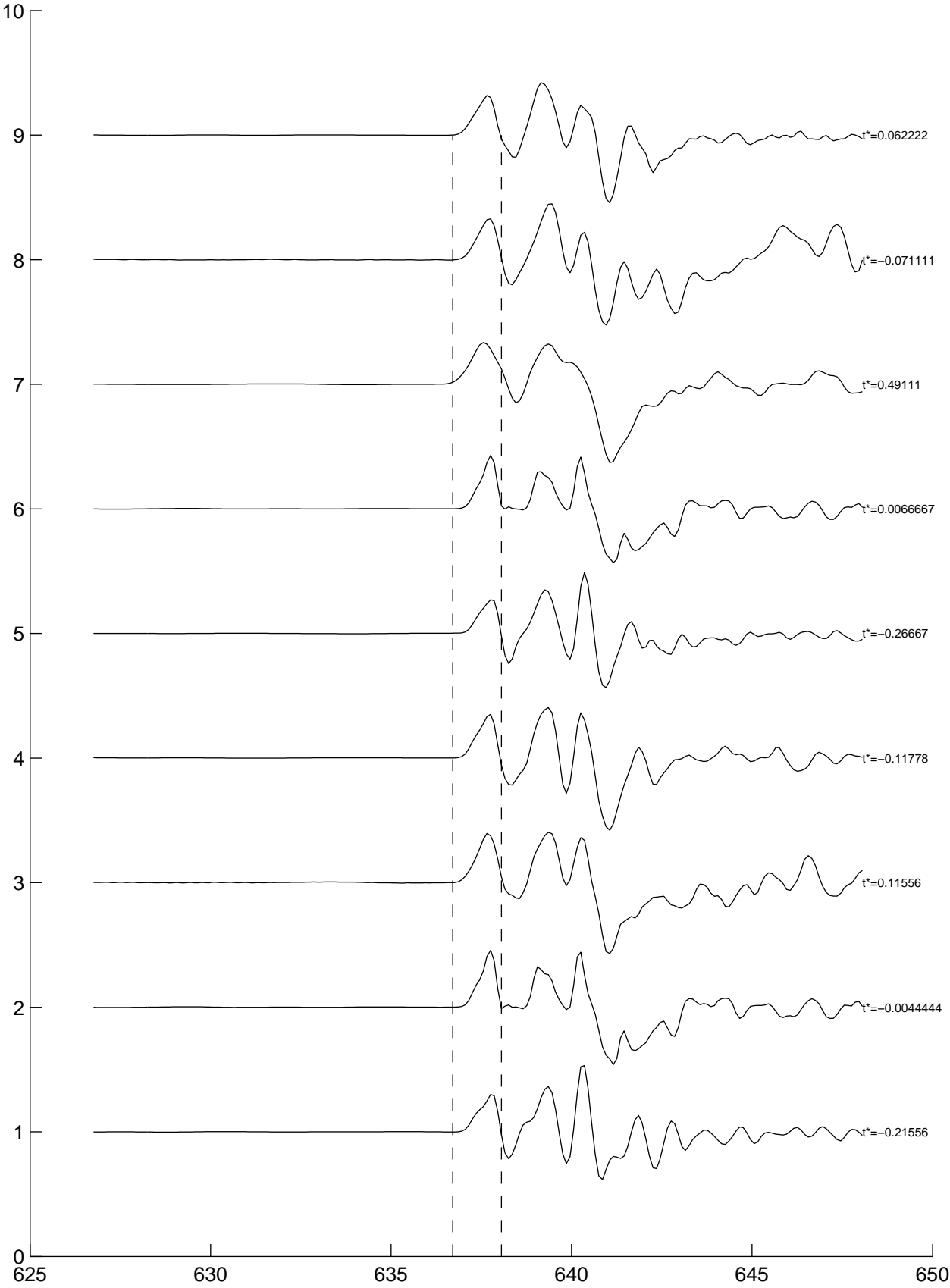
travel time residuals



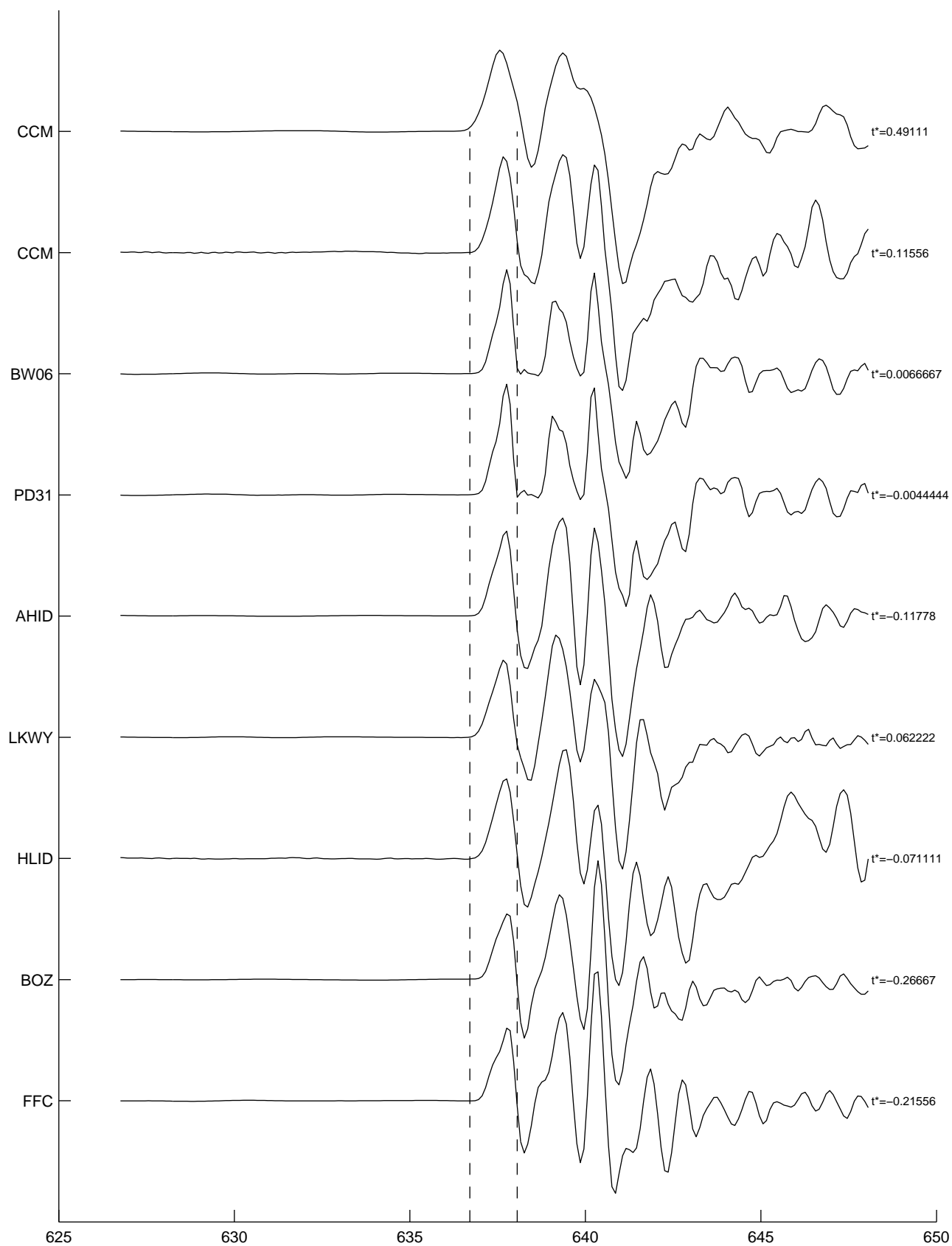
$t^*$  values



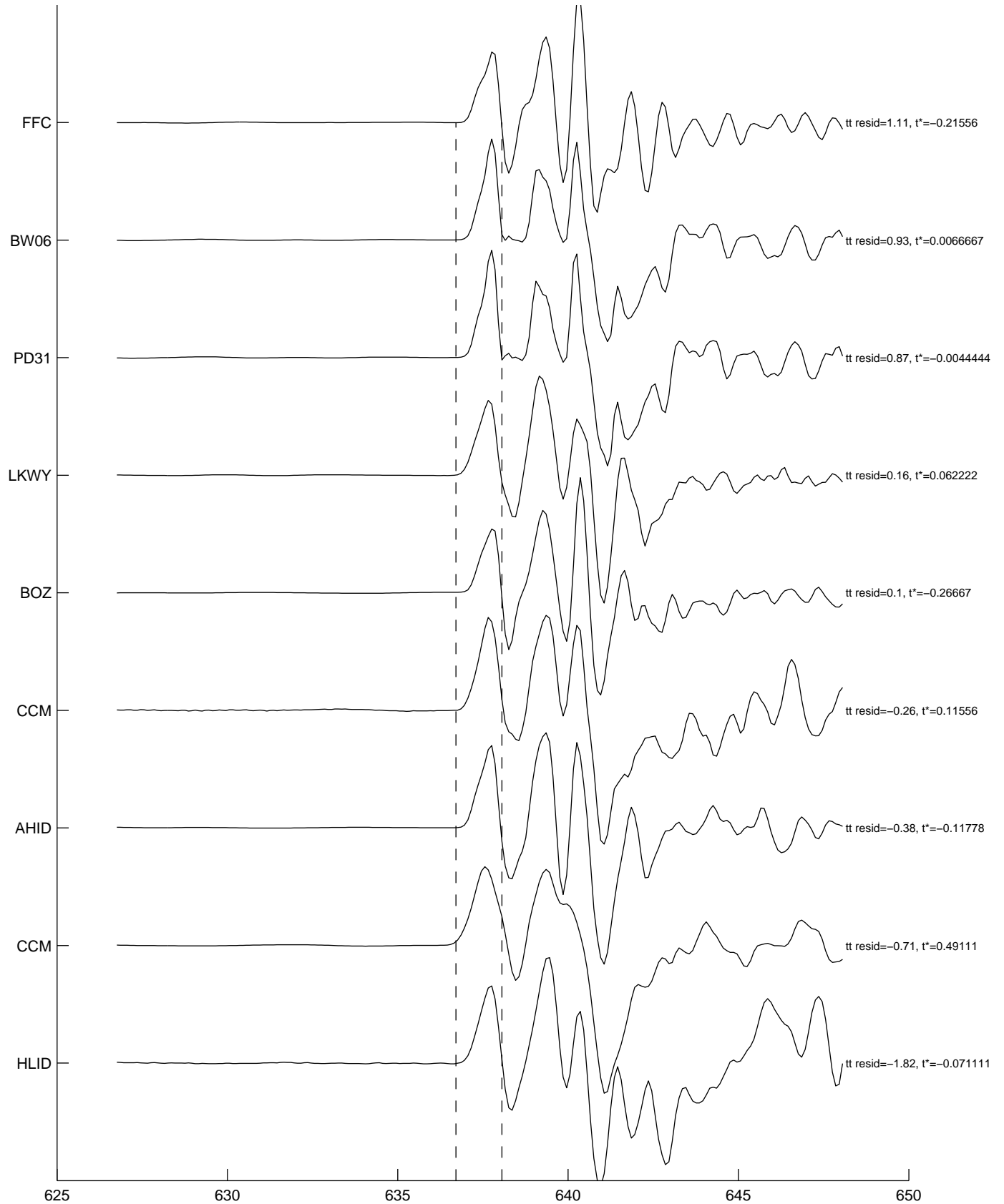
Event\_2003\_208\_06\_25\_31



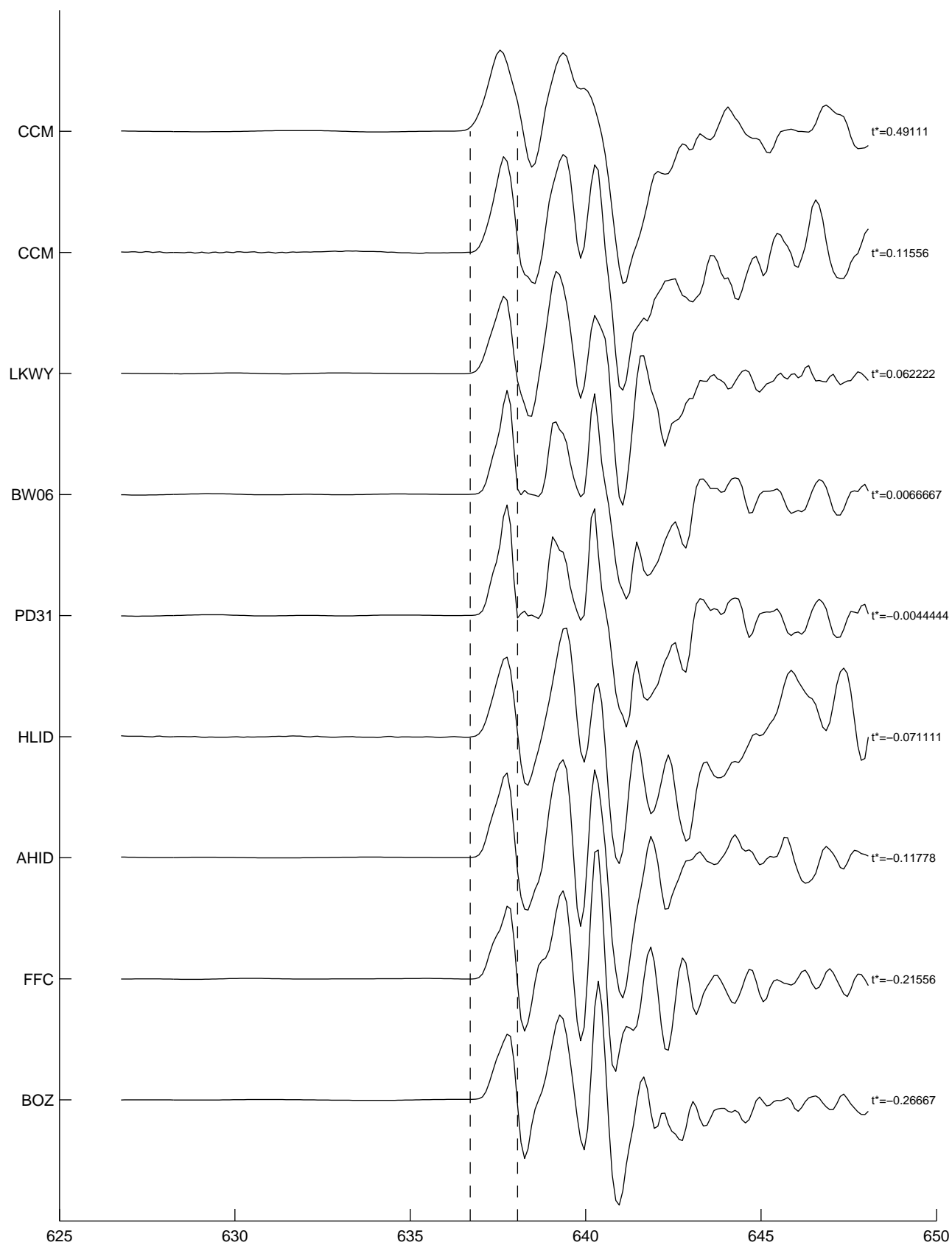
# Sorted by Delta:Event\_2003\_208\_06\_25\_31



# Sorted by travel time:Event\_2003\_208\_06\_25\_31

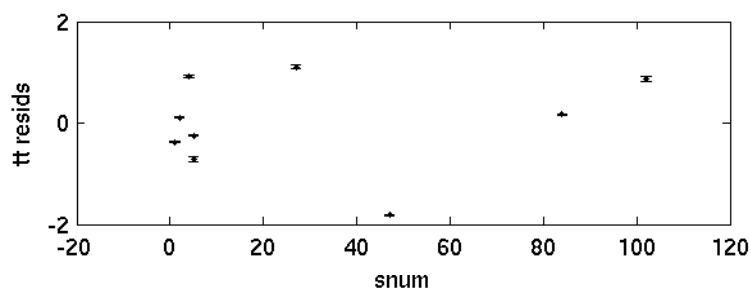
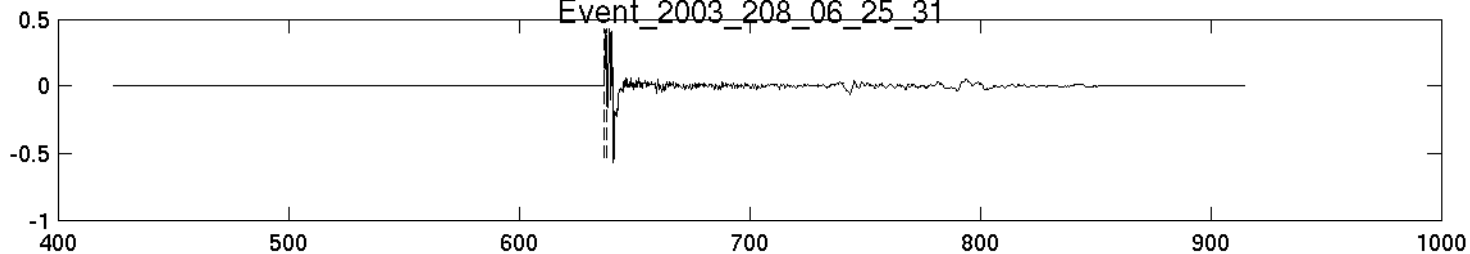


Sorted by t\*:Event\_2003\_208\_06\_25\_31

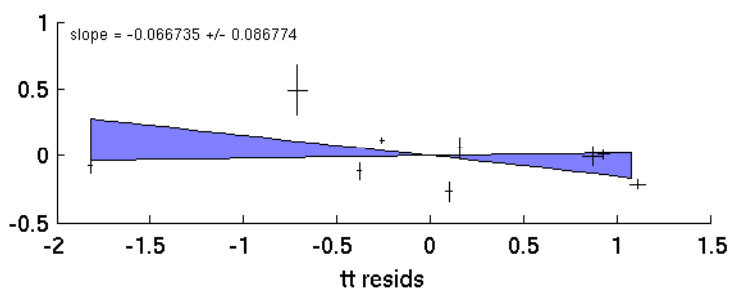
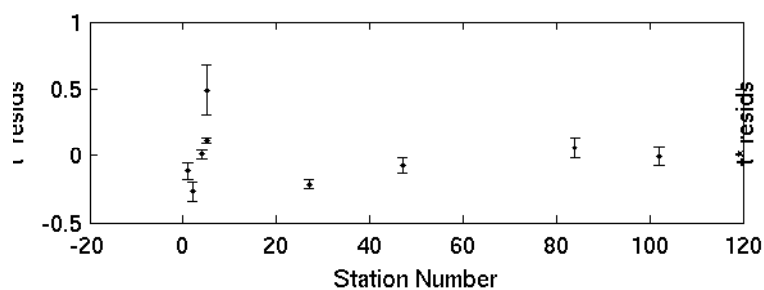


Event\_2003\_208\_06\_25\_31

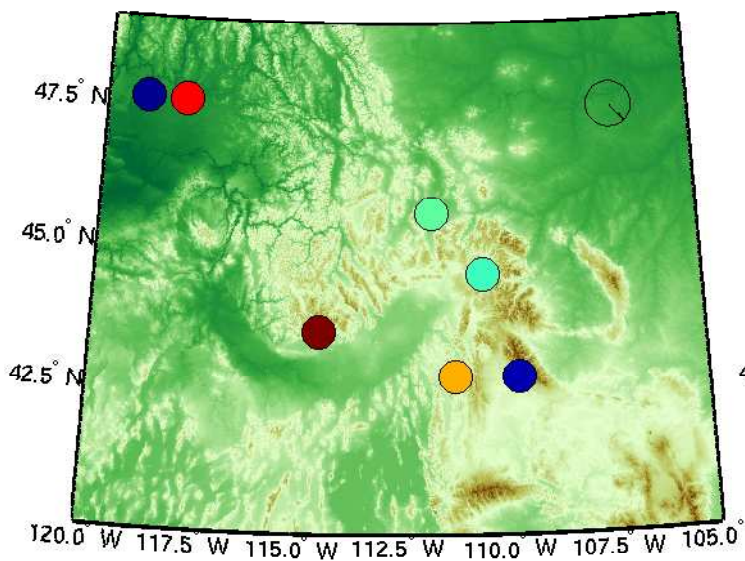
Stack



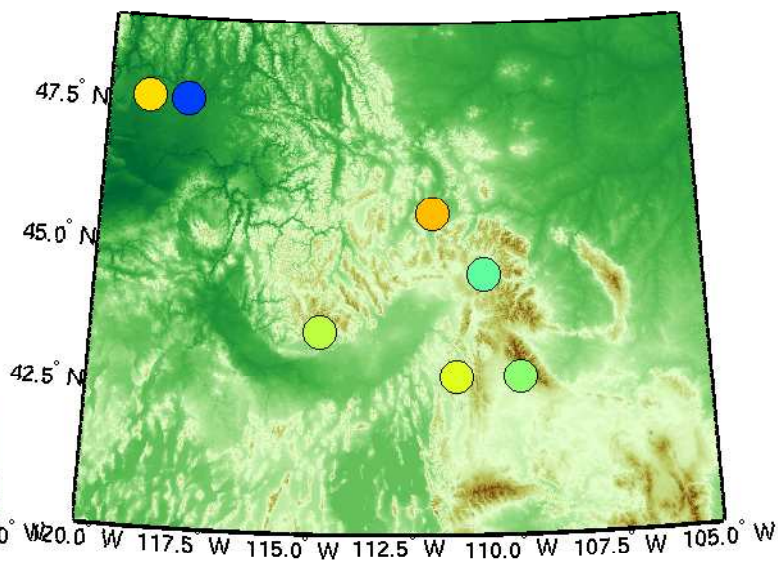
Baz = 319.2479  
Mean xcor value = 0.70333  
Range of  $t^*$  values is 0.75778  
Median  $t^*$  err is 0.058288  
Slope =  $-0.066735 \pm 0.086774$



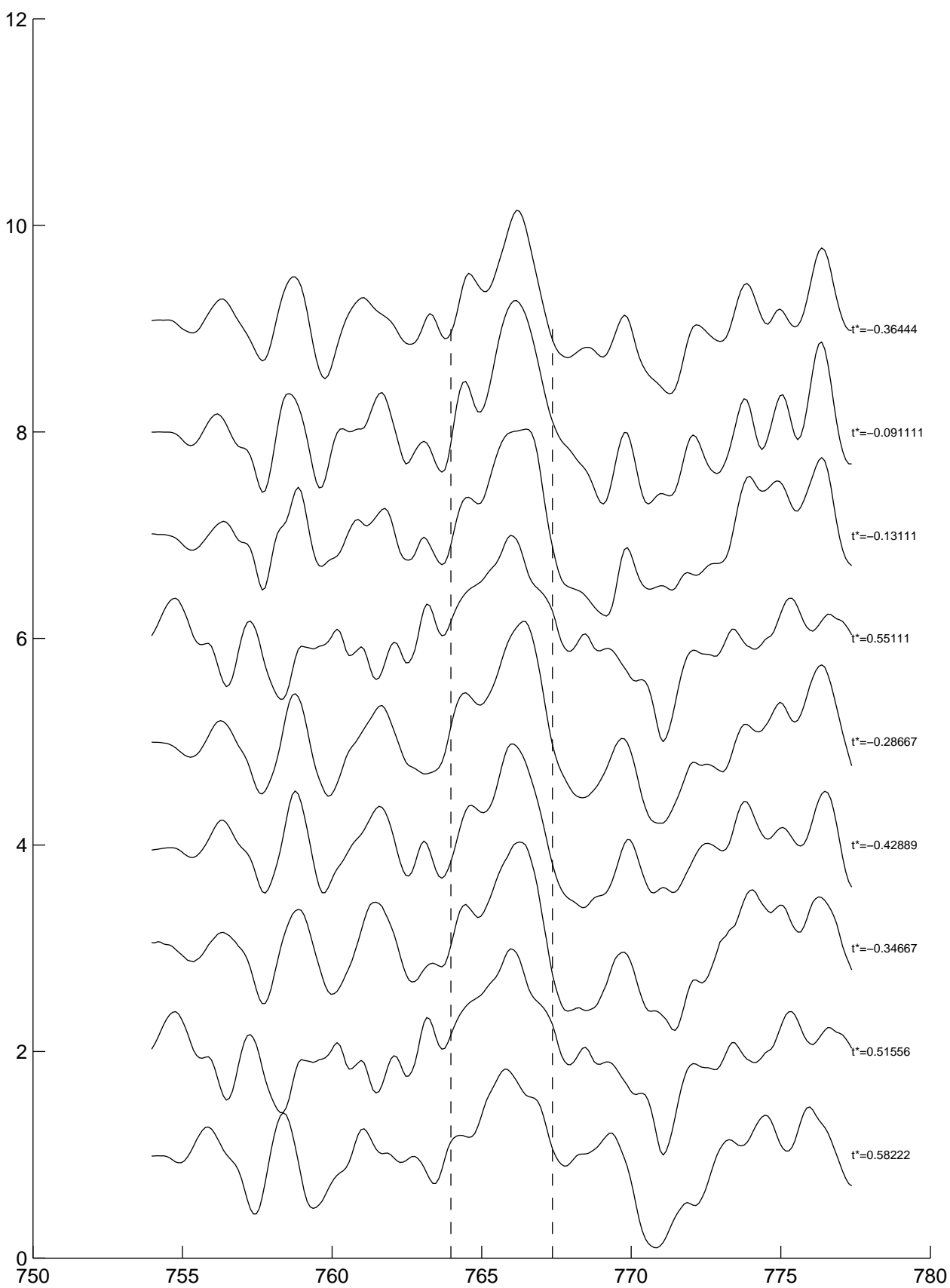
travel time residuals



$t^*$  values

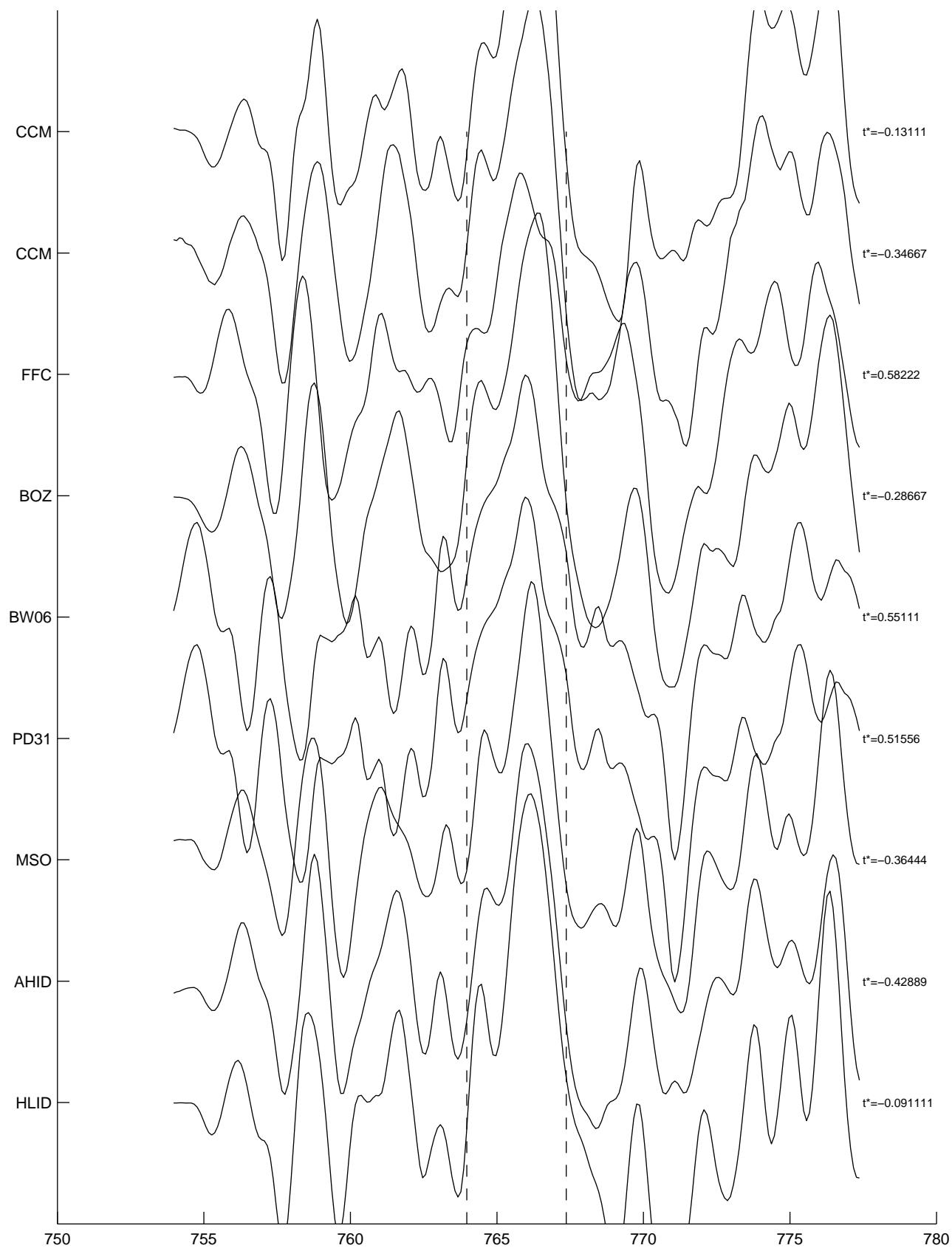


# Event\_2003\_245\_18\_28\_00

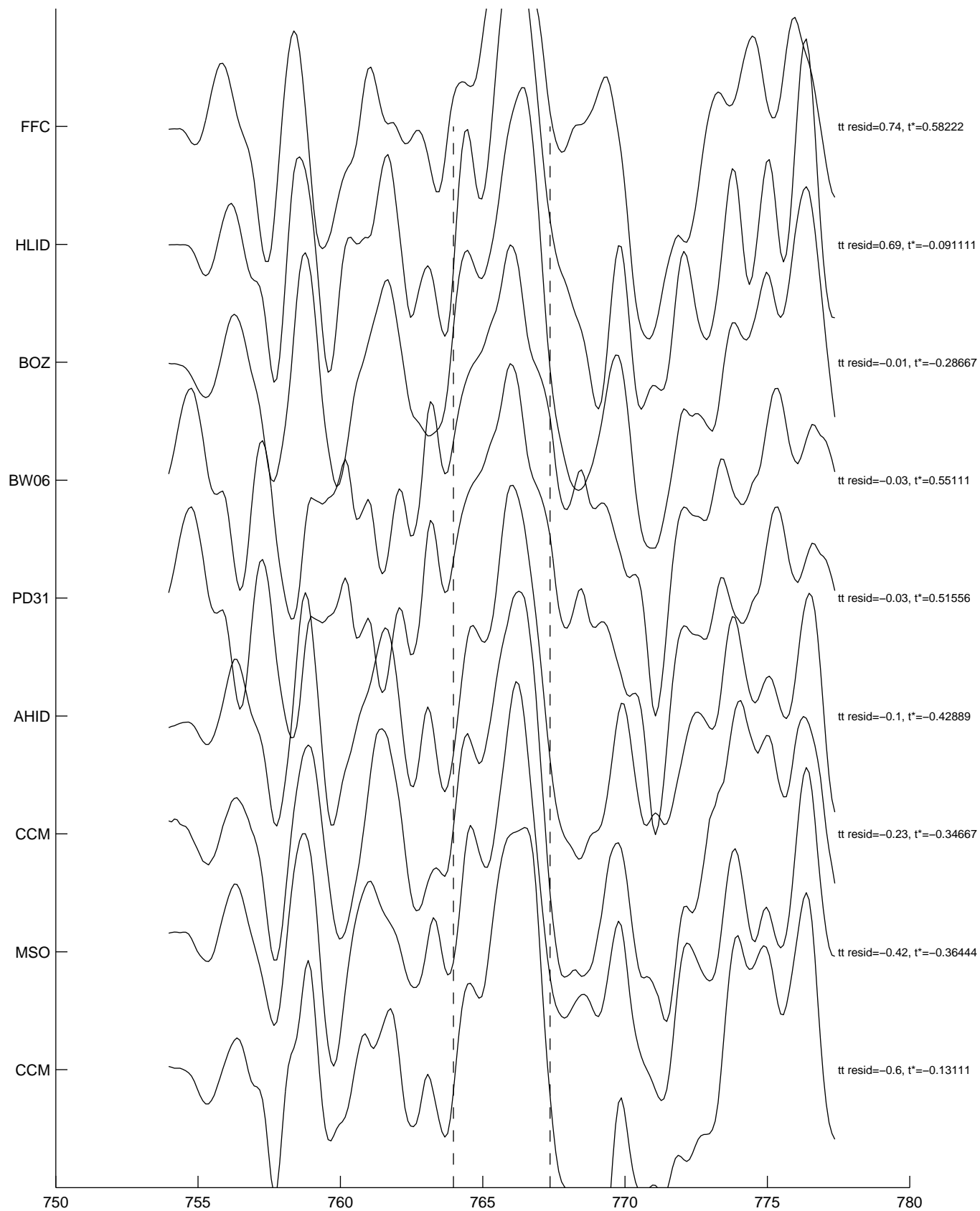




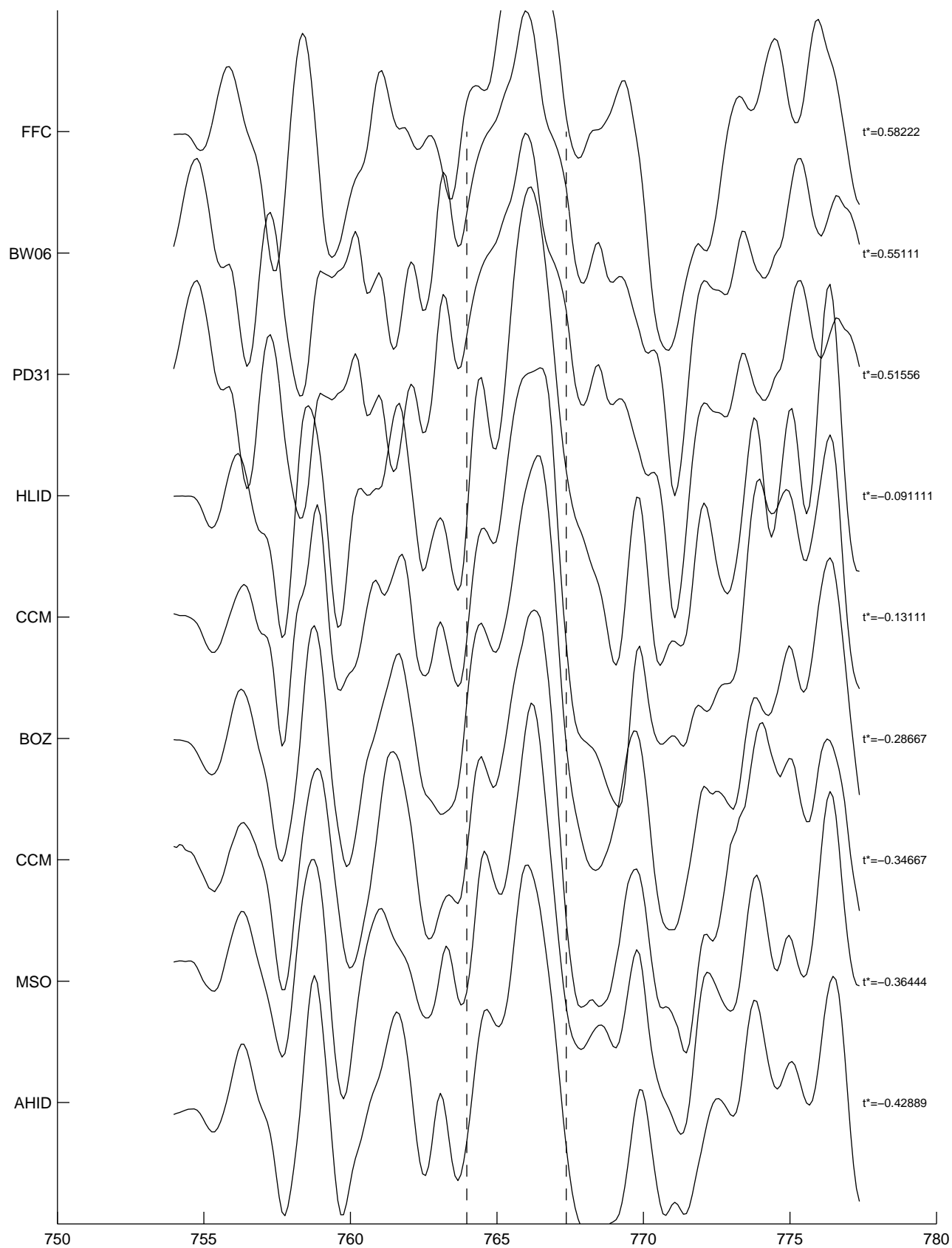
# Sorted by Delta:Event\_2003\_245\_18\_28\_00



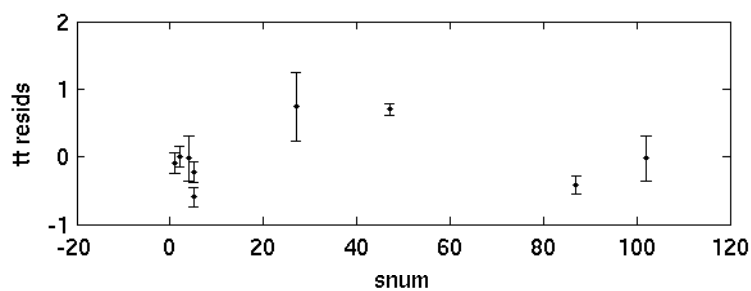
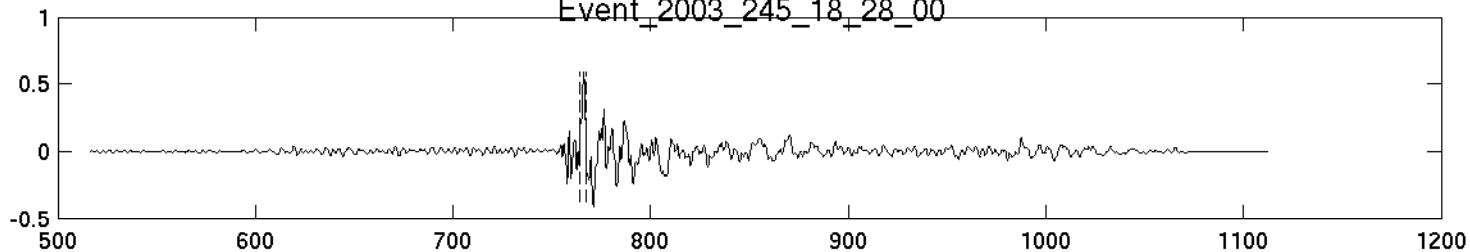
# Sorted by travel time: Event\_2003\_245\_18\_28\_00



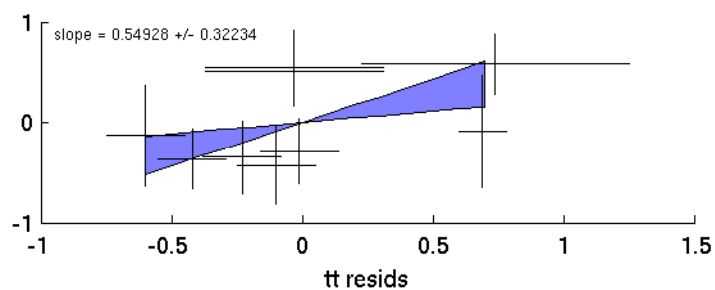
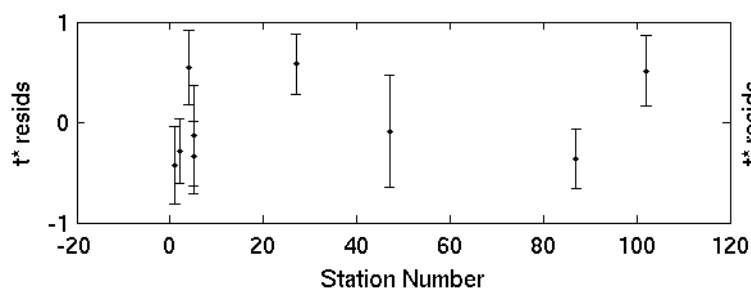
Sorted by  $t^*$ :Event\_2003\_245\_18\_28\_00



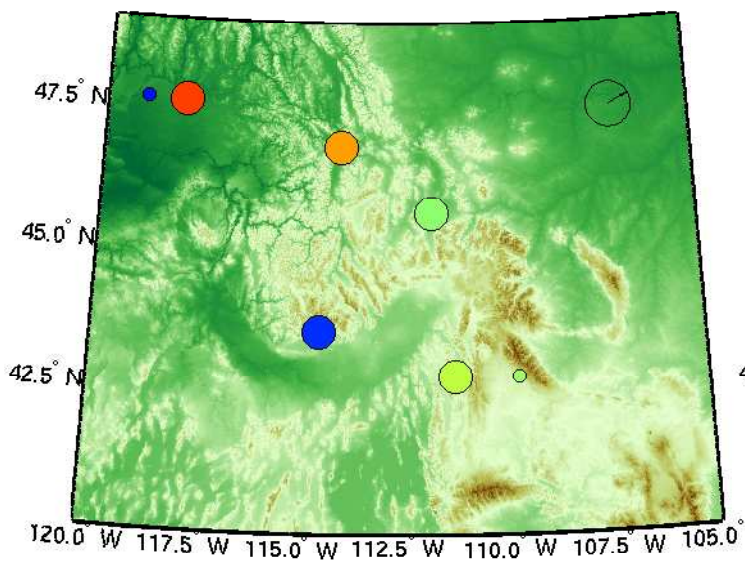
Stack  
Event\_2003\_245\_18\_28\_00



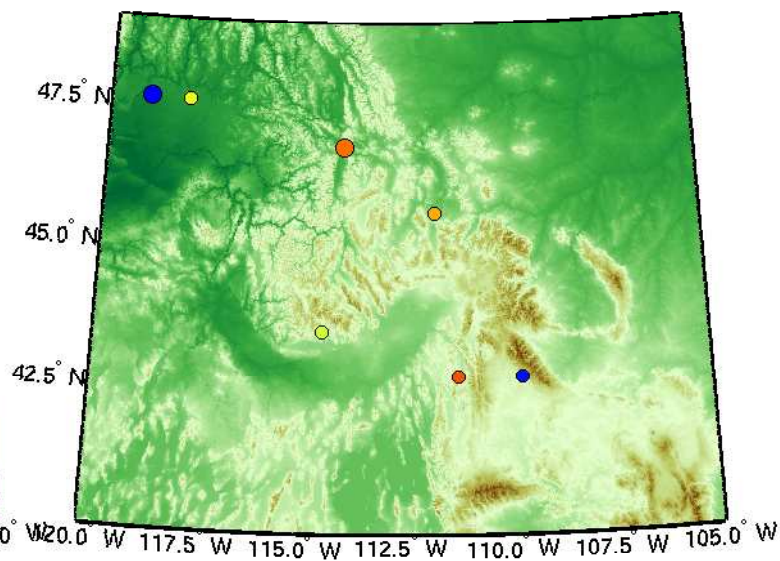
Baz = 242.6299  
Mean xcor value = 0.76667  
Range of  $t^*$  values is 1.0111  
Median  $t^*$  err is 0.36119  
Slope = 0.54928 +/- 0.32234



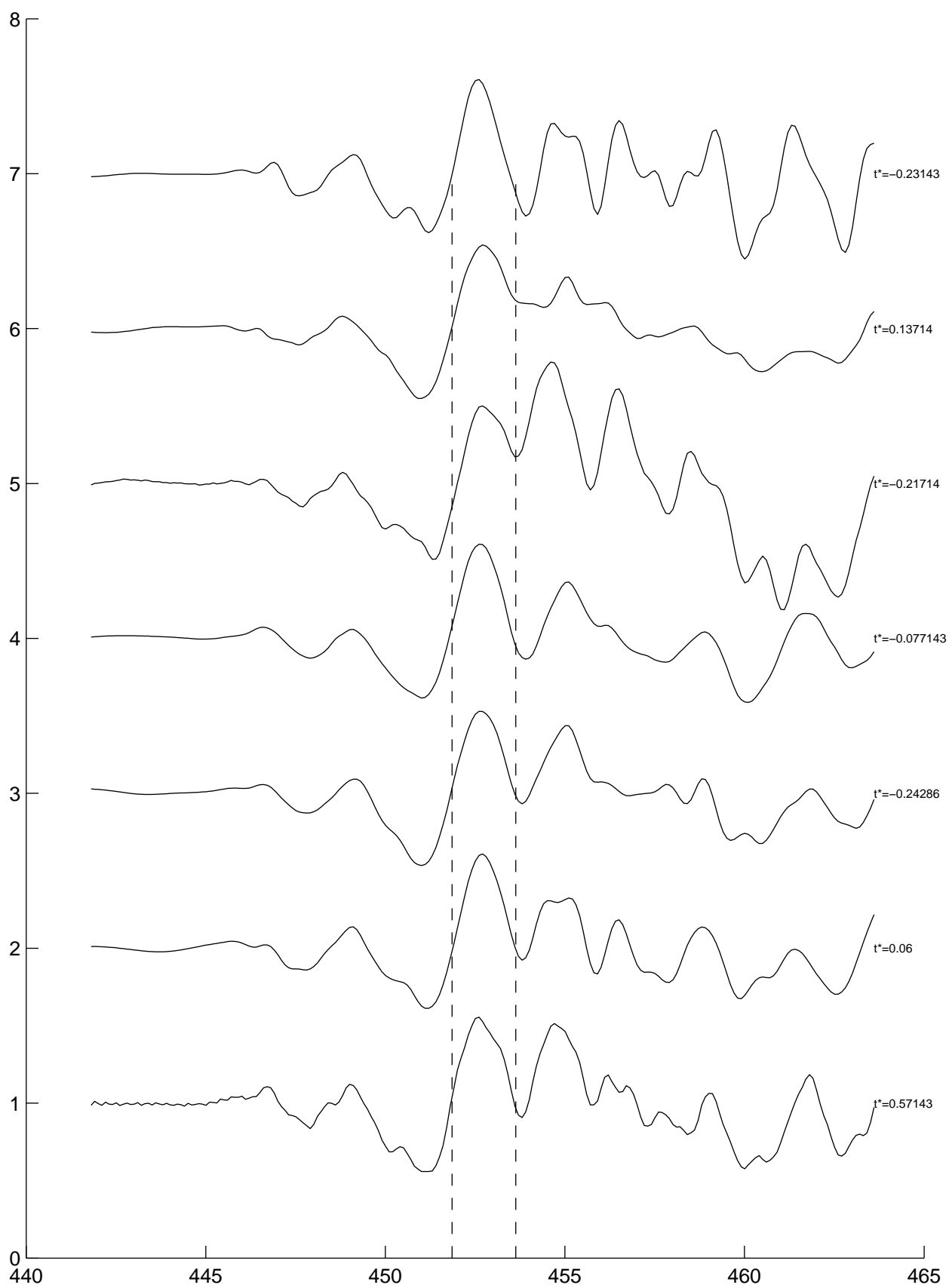
travel time residuals



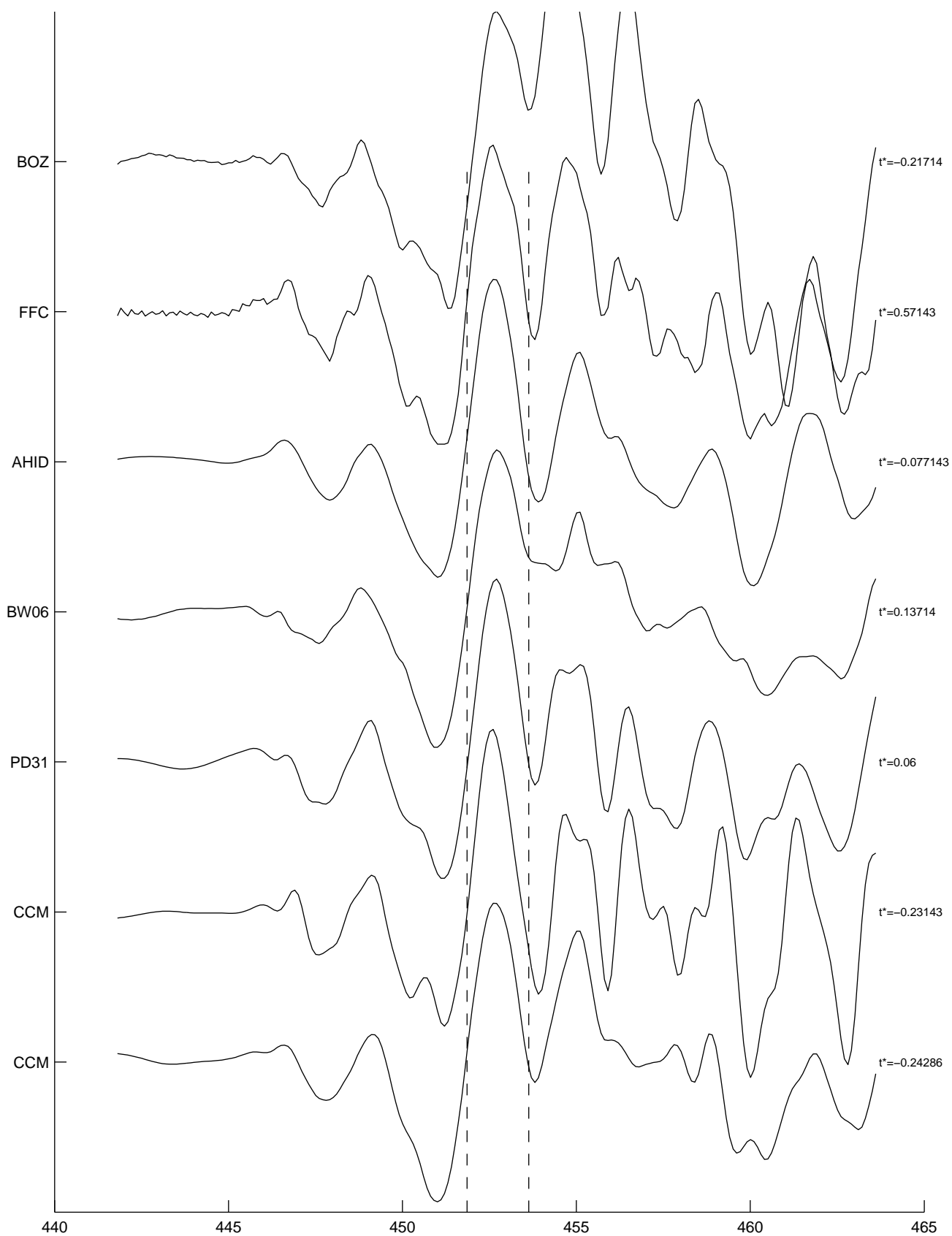
$t^*$  values



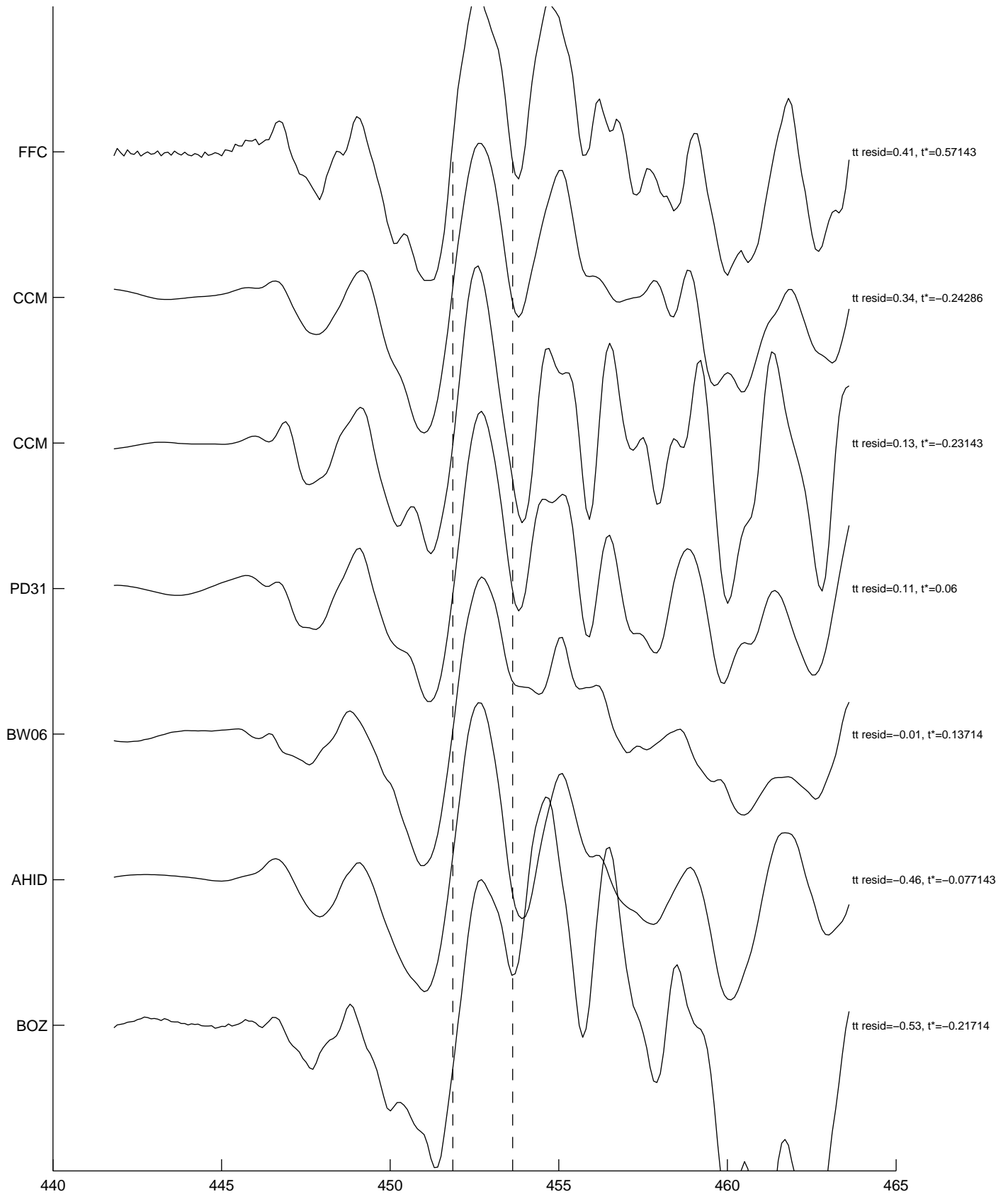
# Event\_2003\_265\_04\_45\_36



Sorted by Delta:Event\_2003\_265\_04\_45\_36

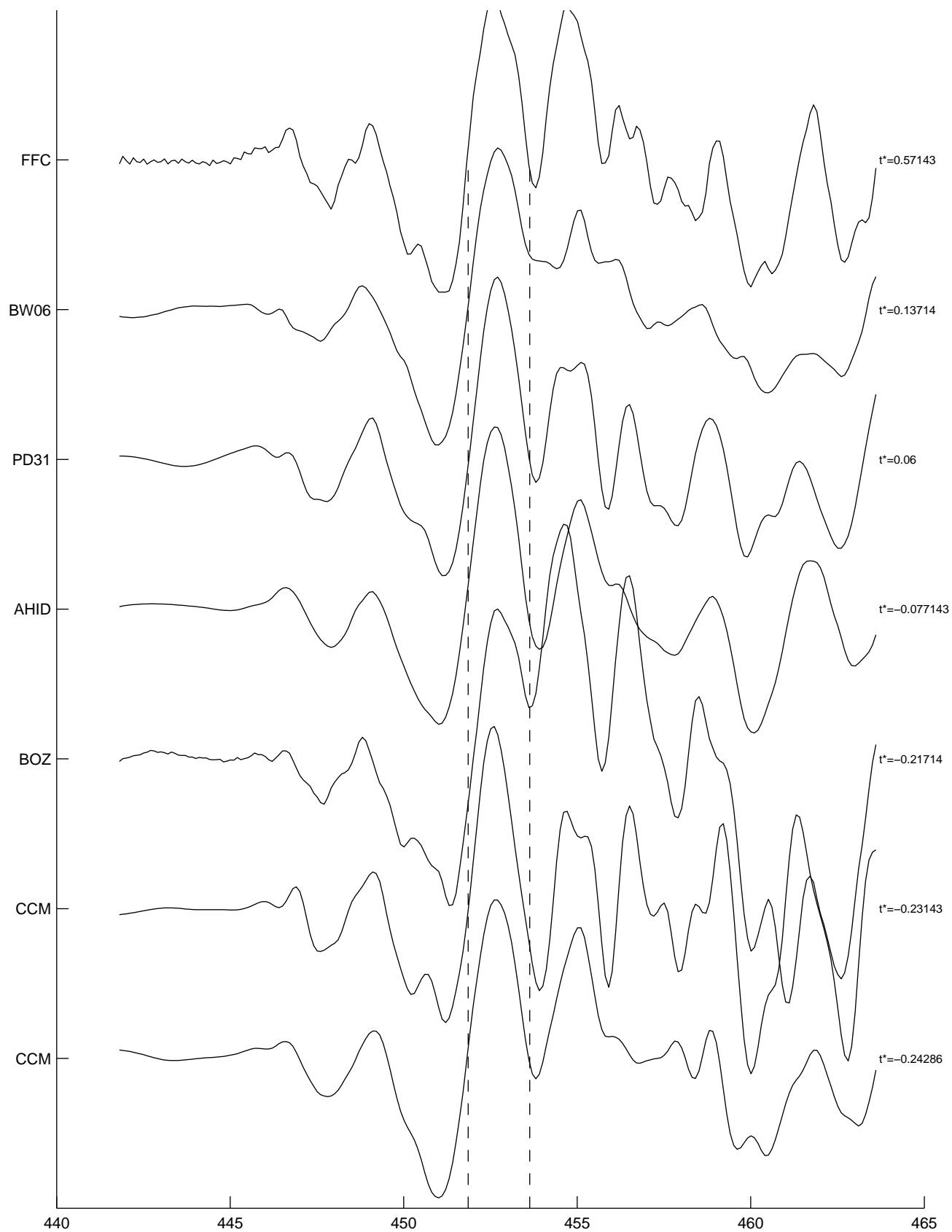


# Sorted by travel time: Event\_2003\_265\_04\_45\_36



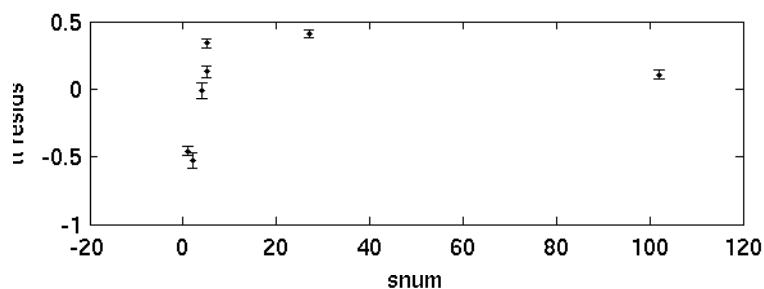
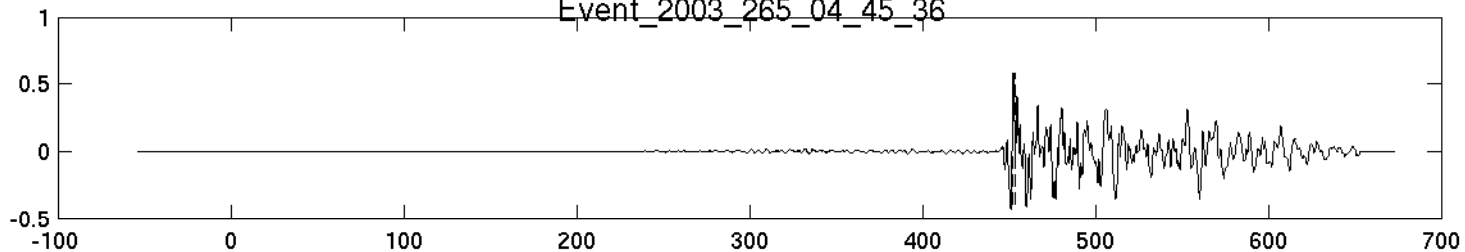


Sorted by t\*:Event\_2003\_265\_04\_45\_36

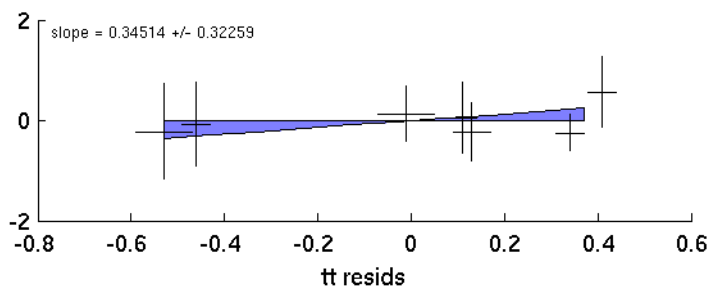
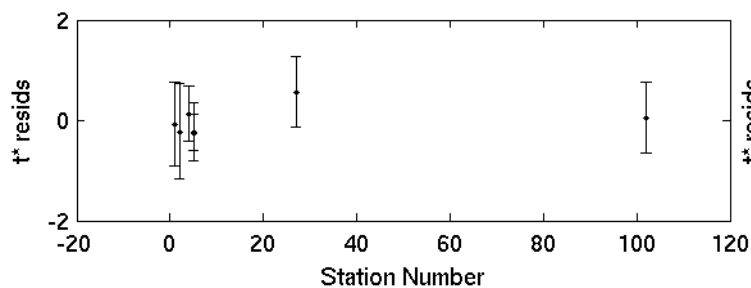


# Event\_2003\_265\_04\_45\_36

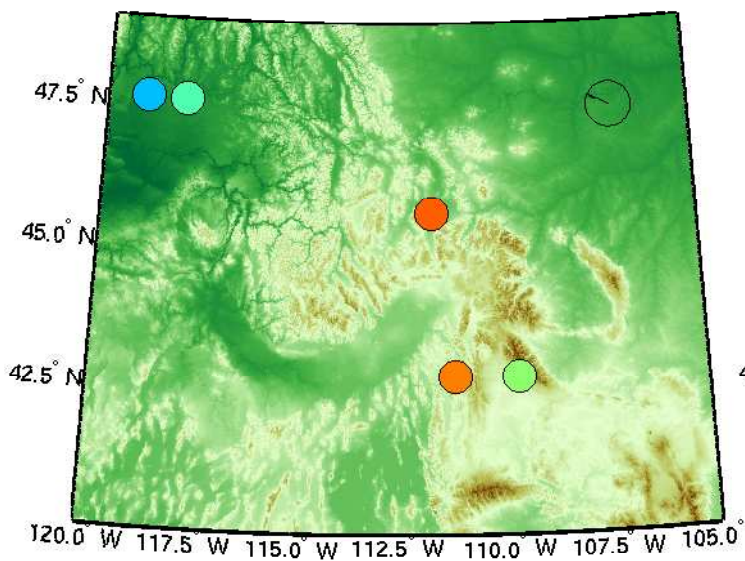
Stack



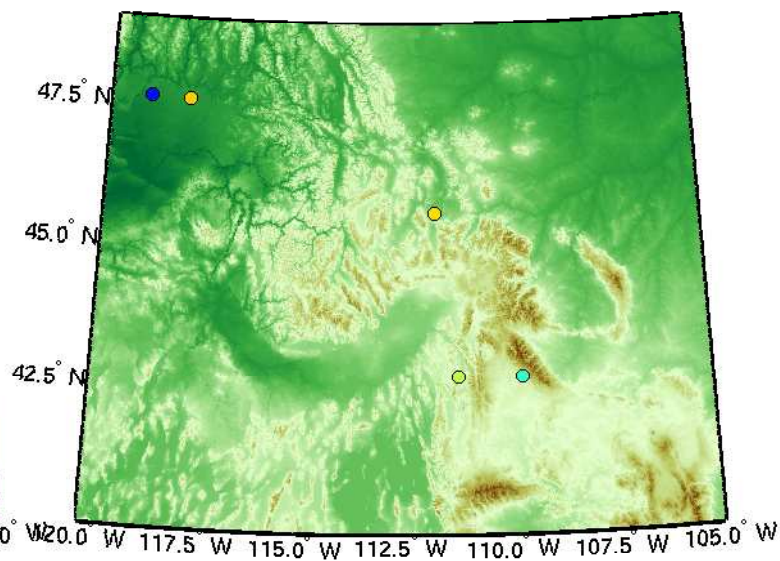
Baz = 117.4156  
Mean xcor value = 0.66429  
Range of  $t^*$  values is 0.81429  
Median  $t^*$  err is 0.70879  
Slope = 0.34514 +/- 0.32259



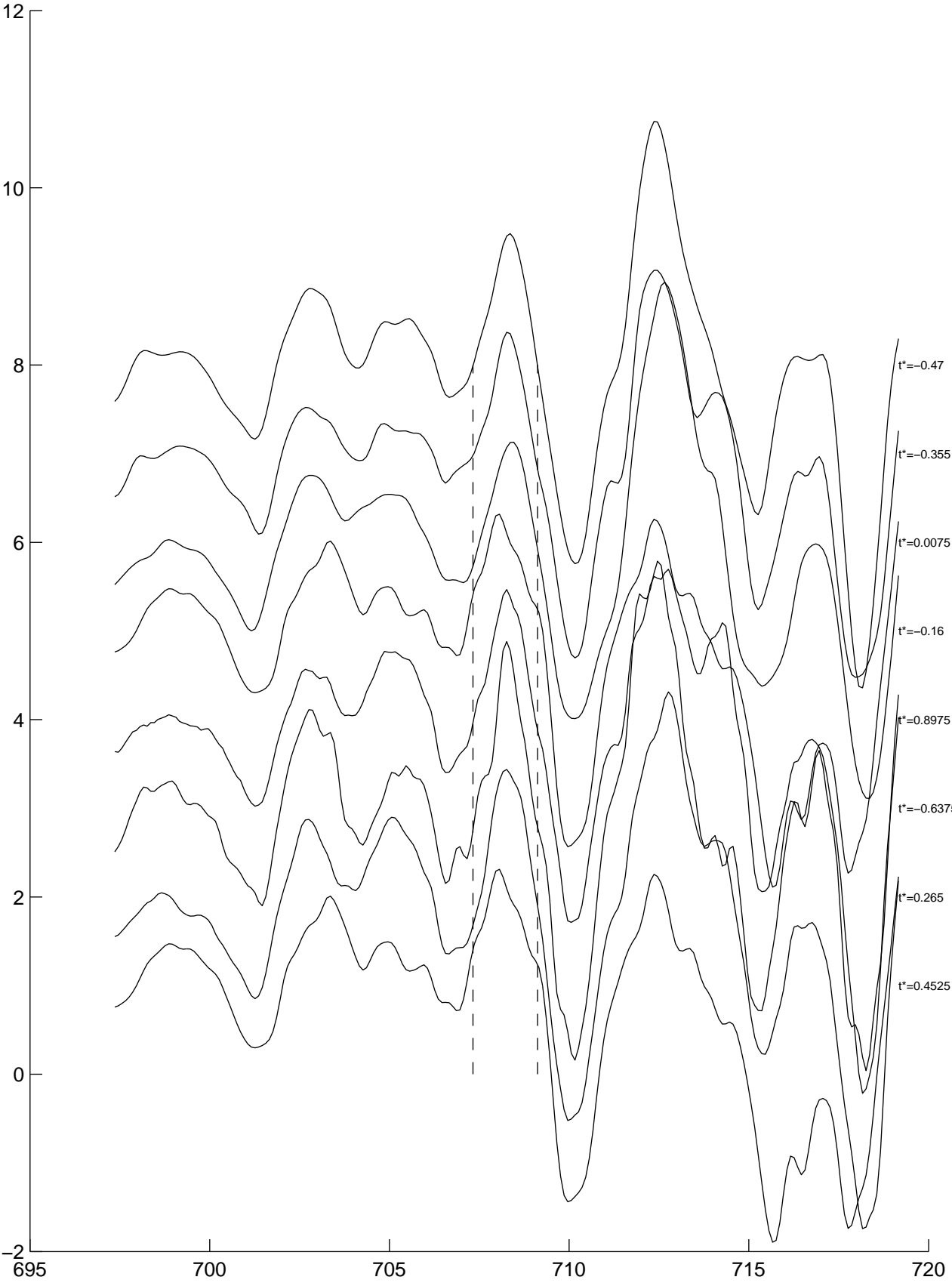
travel time residuals



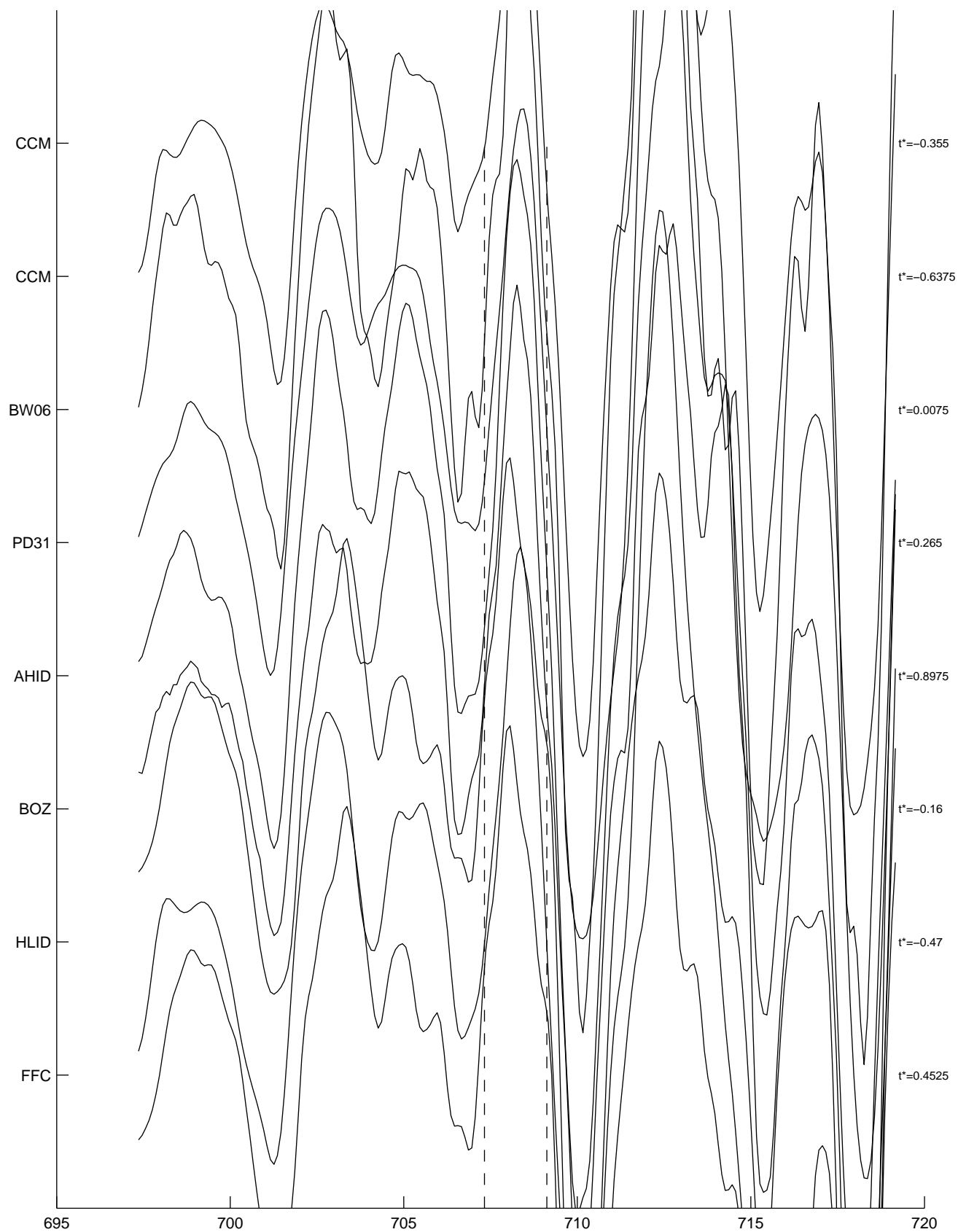
$t^*$  values



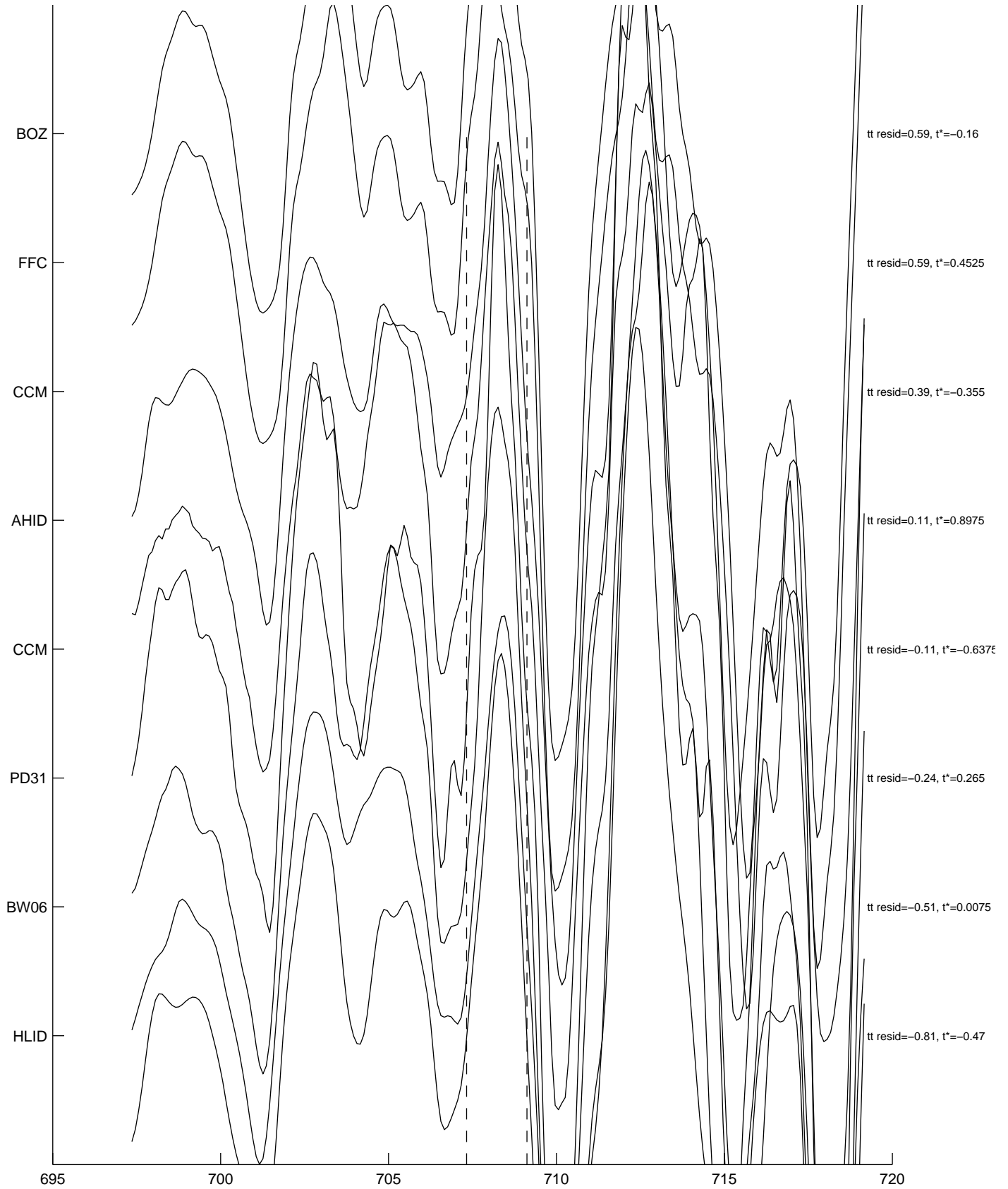
Event\_2003\_268\_19\_50\_06



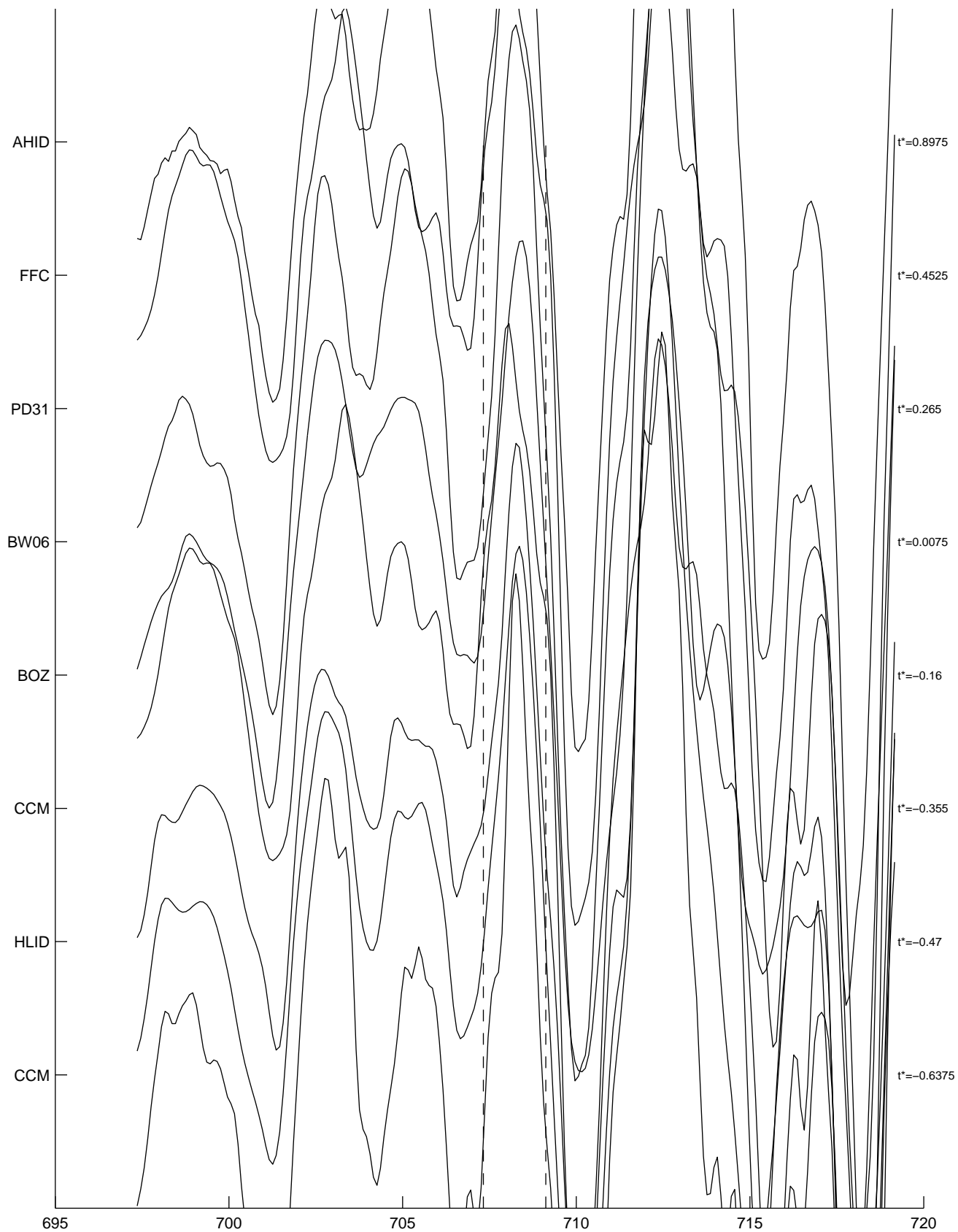
# Sorted by Delta:Event\_2003\_268\_19\_50\_06



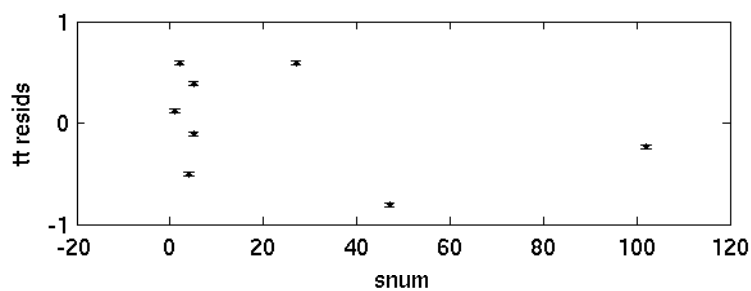
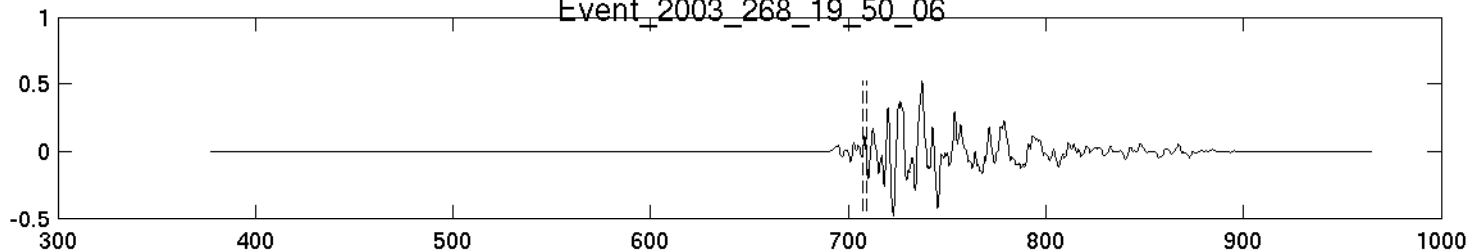
# Sorted by travel time:Event\_2003\_268\_19\_50\_06



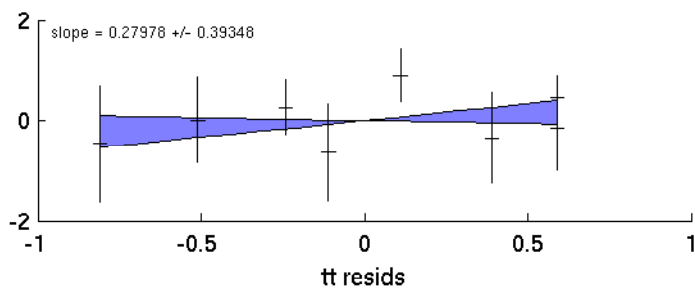
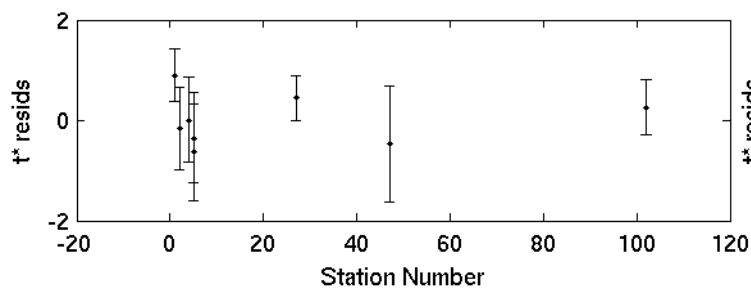
Sorted by  $t^*$ :Event\_2003\_268\_19\_50\_06



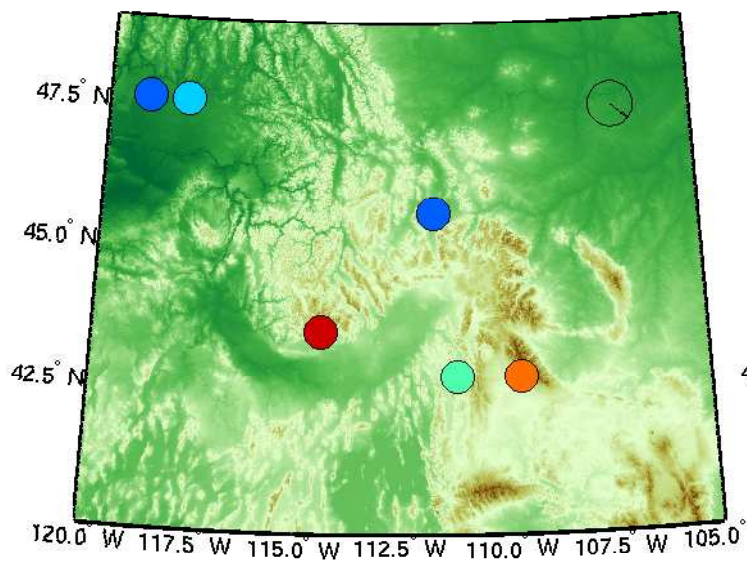
# Stack Event\_2003\_268\_19\_50\_06



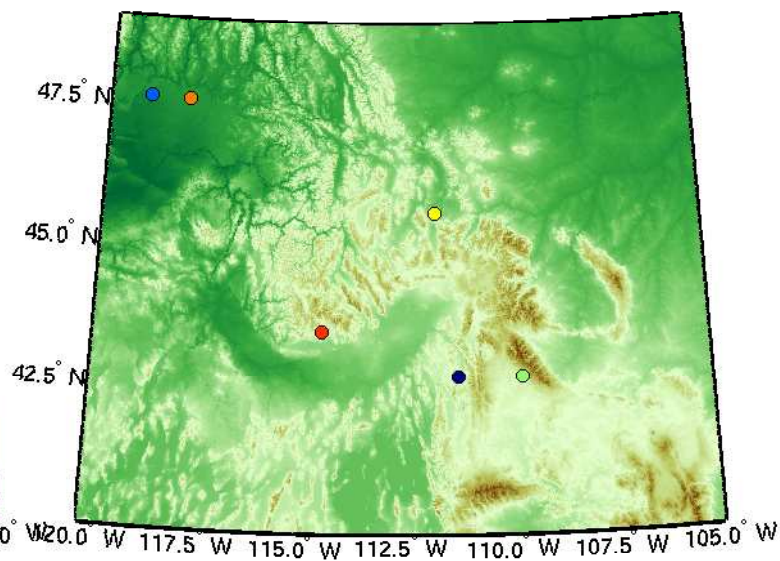
Baz = 312.6487  
Mean xcor value = 0.74375  
Range of t\* values is 1.535  
Median t\* err is 0.8458  
Slope = 0.27978 +/- 0.39348



travel time residuals

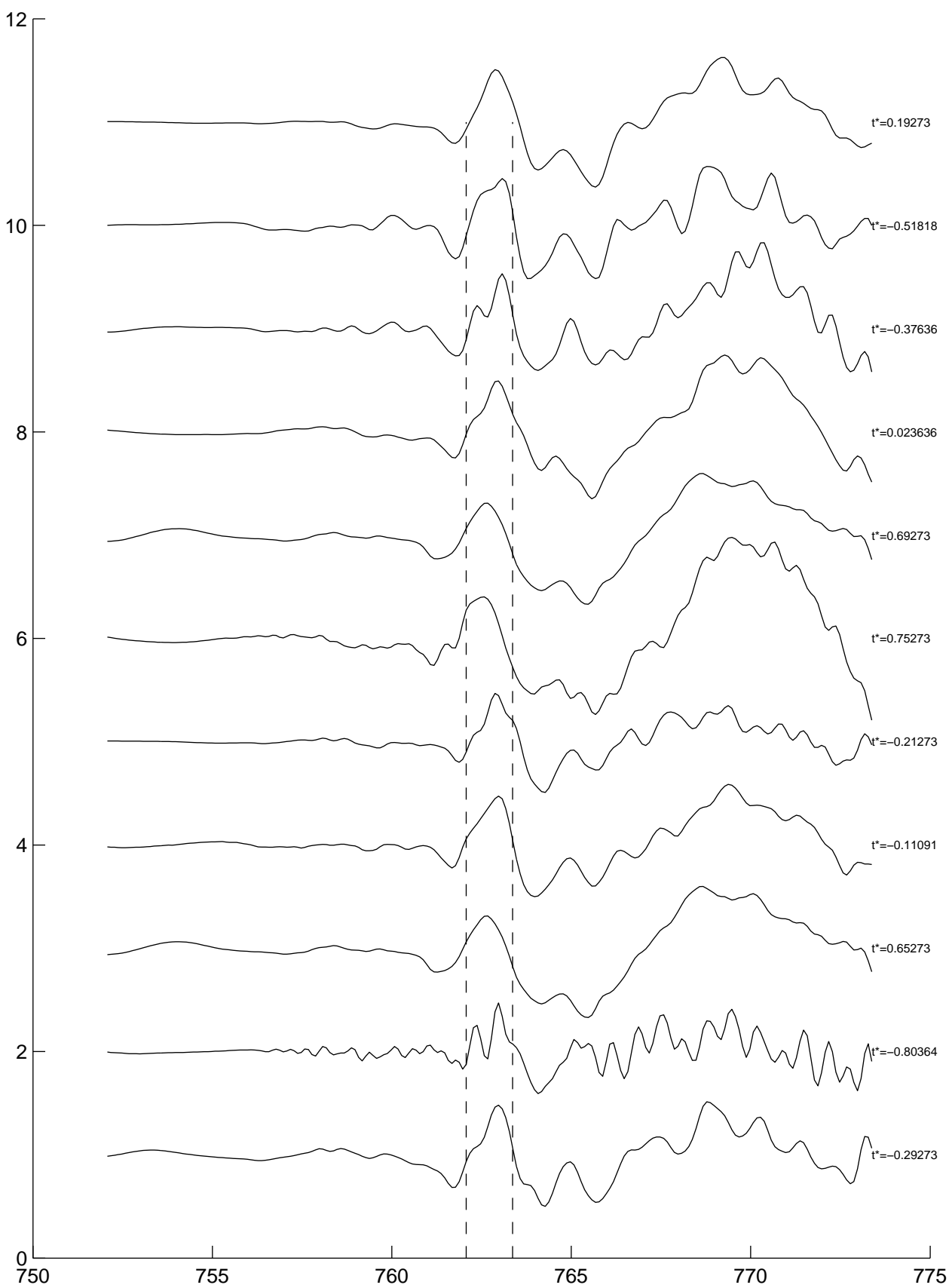


t\* values

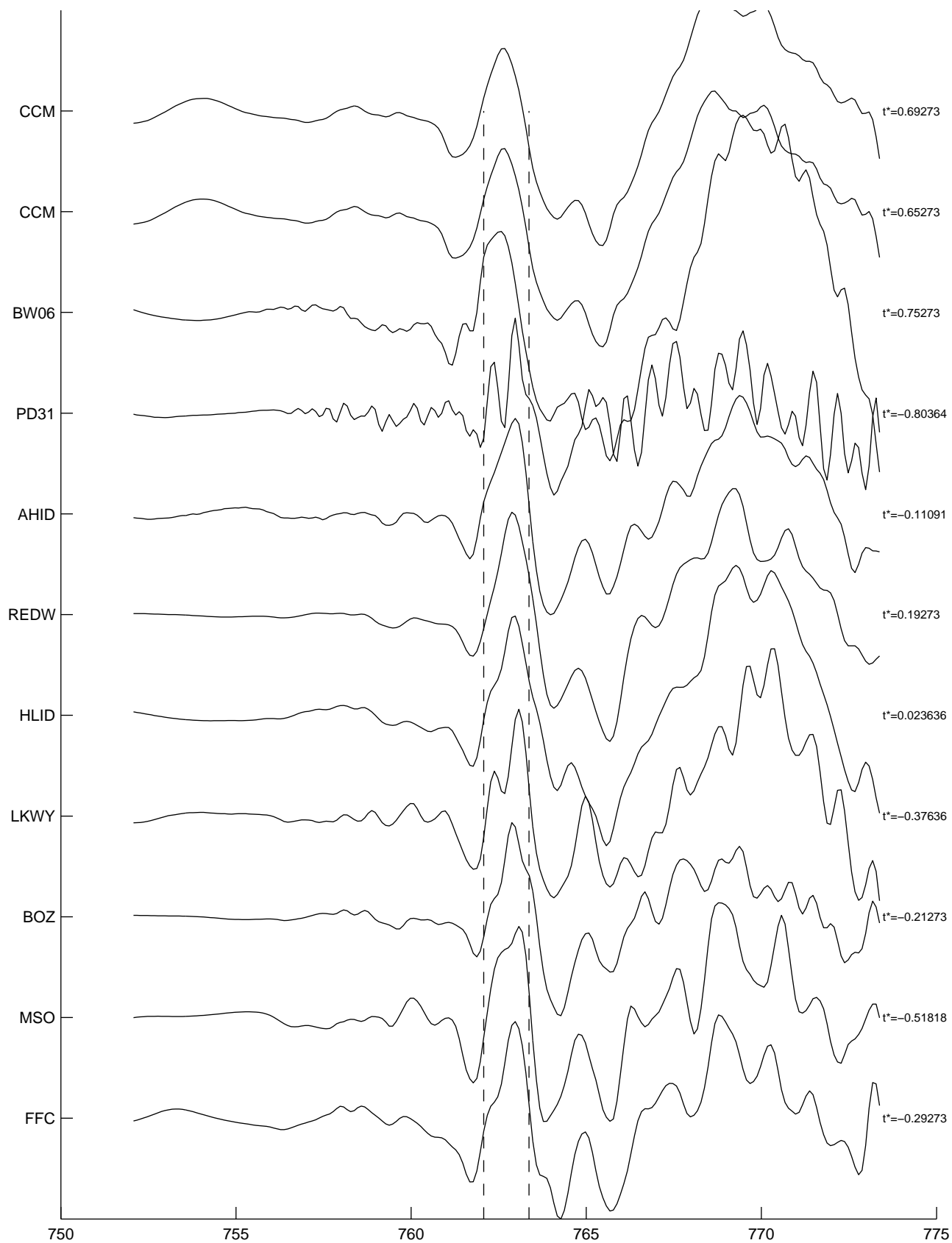




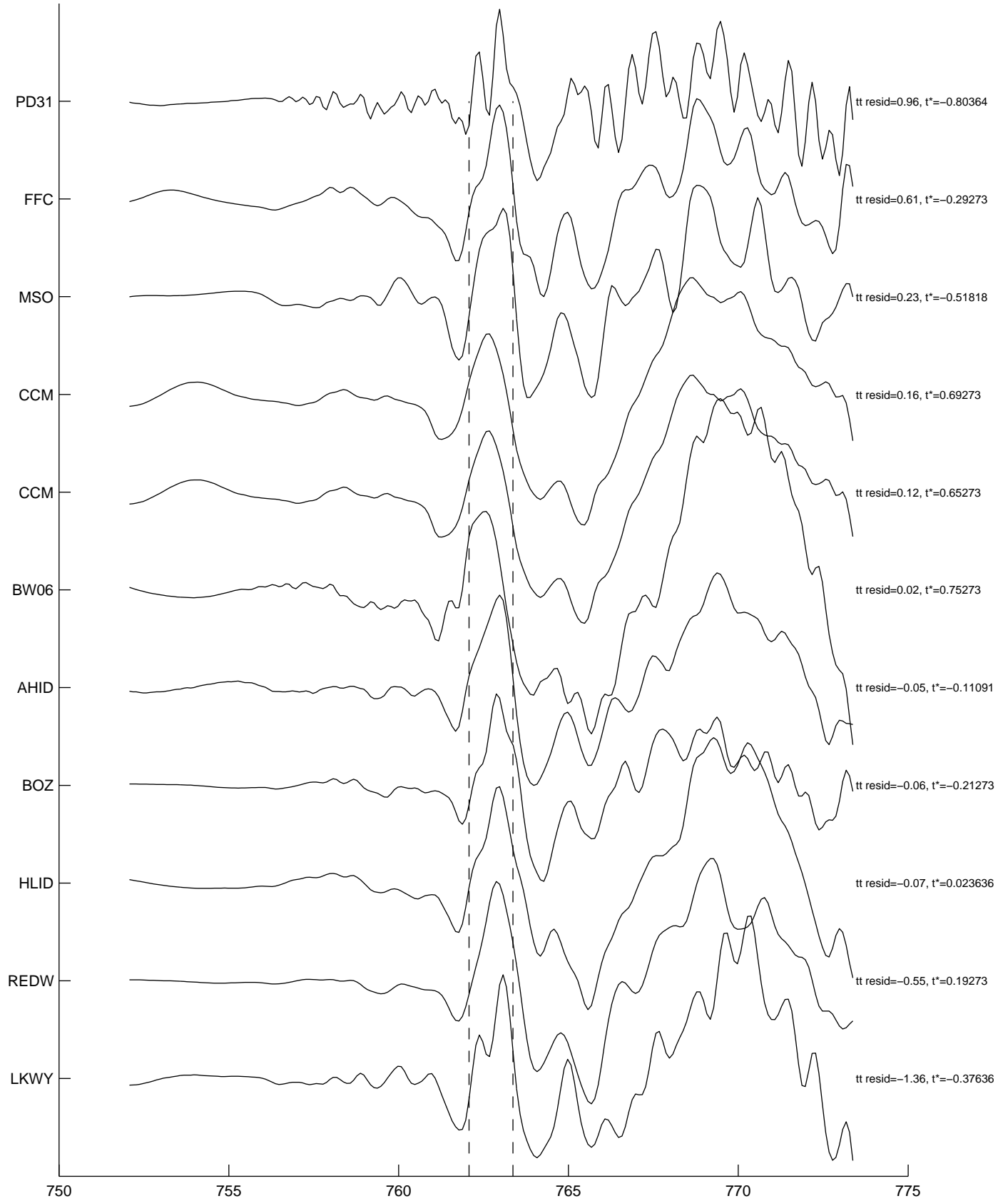
# Event\_2003\_270\_11\_33\_25



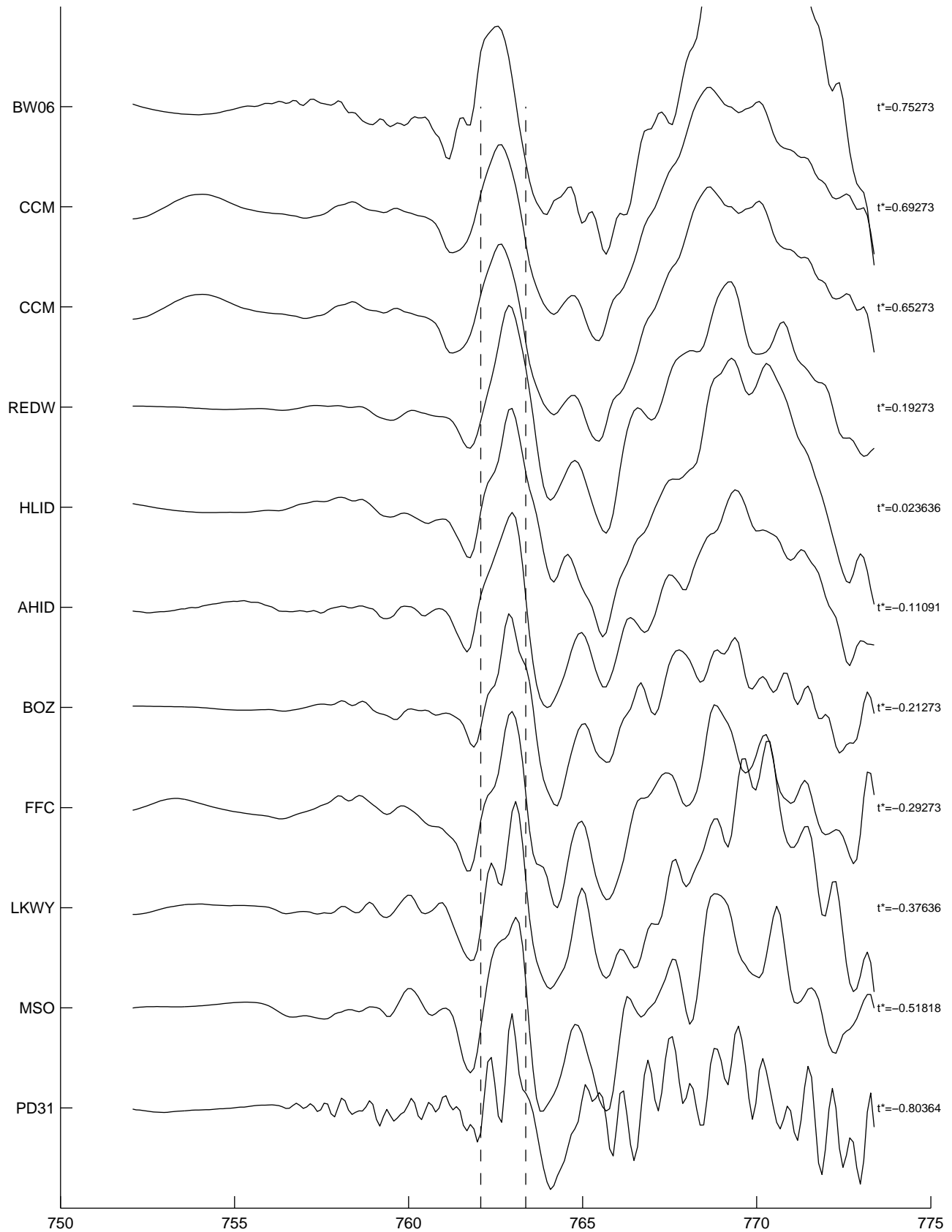
# Sorted by Delta:Event\_2003\_270\_11\_33\_25



# Sorted by travel time:Event\_2003\_270\_11\_33\_25

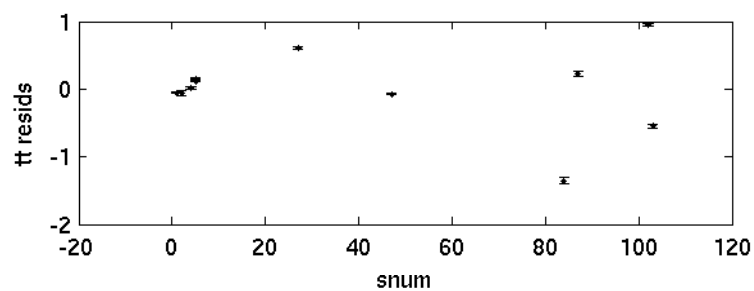
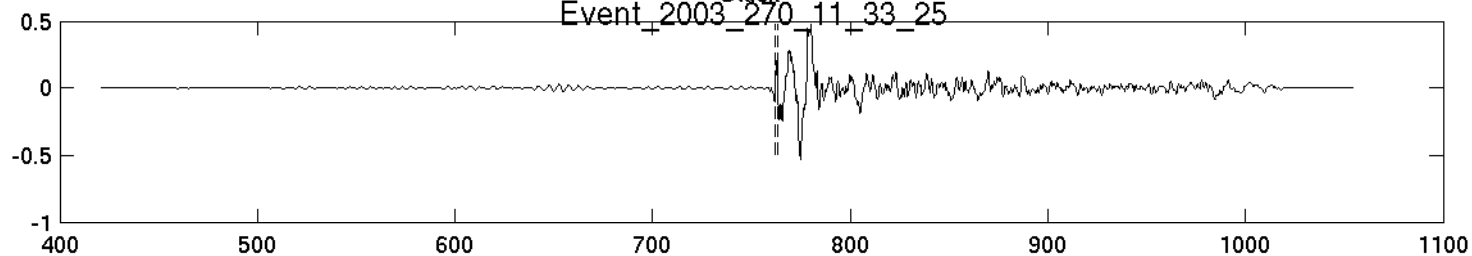


Sorted by  $t^*$ :Event\_2003\_270\_11\_33\_25

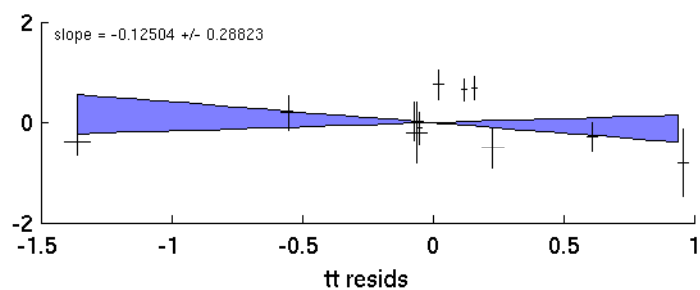
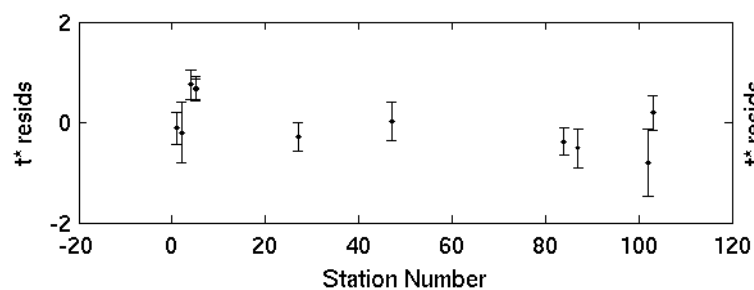


Event\_2003\_270\_11\_33\_25

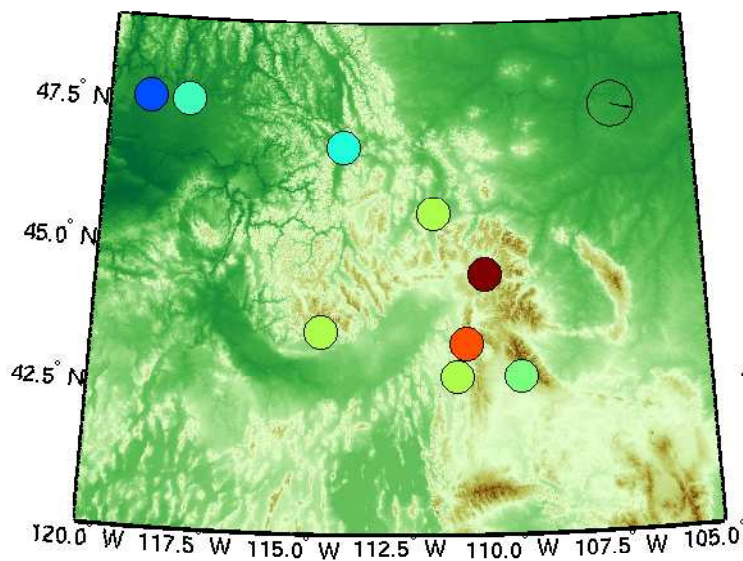
Stack



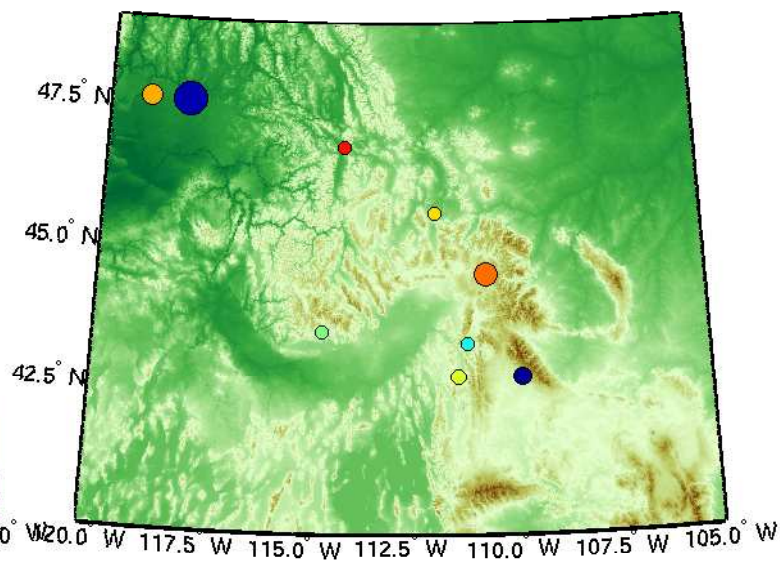
Baz = 285.1314  
Mean xcor value = 0.79273  
Range of  $t^*$  values is 1.5564  
Median  $t^*$  err is 0.3238  
Slope = -0.12504 +/- 0.28823



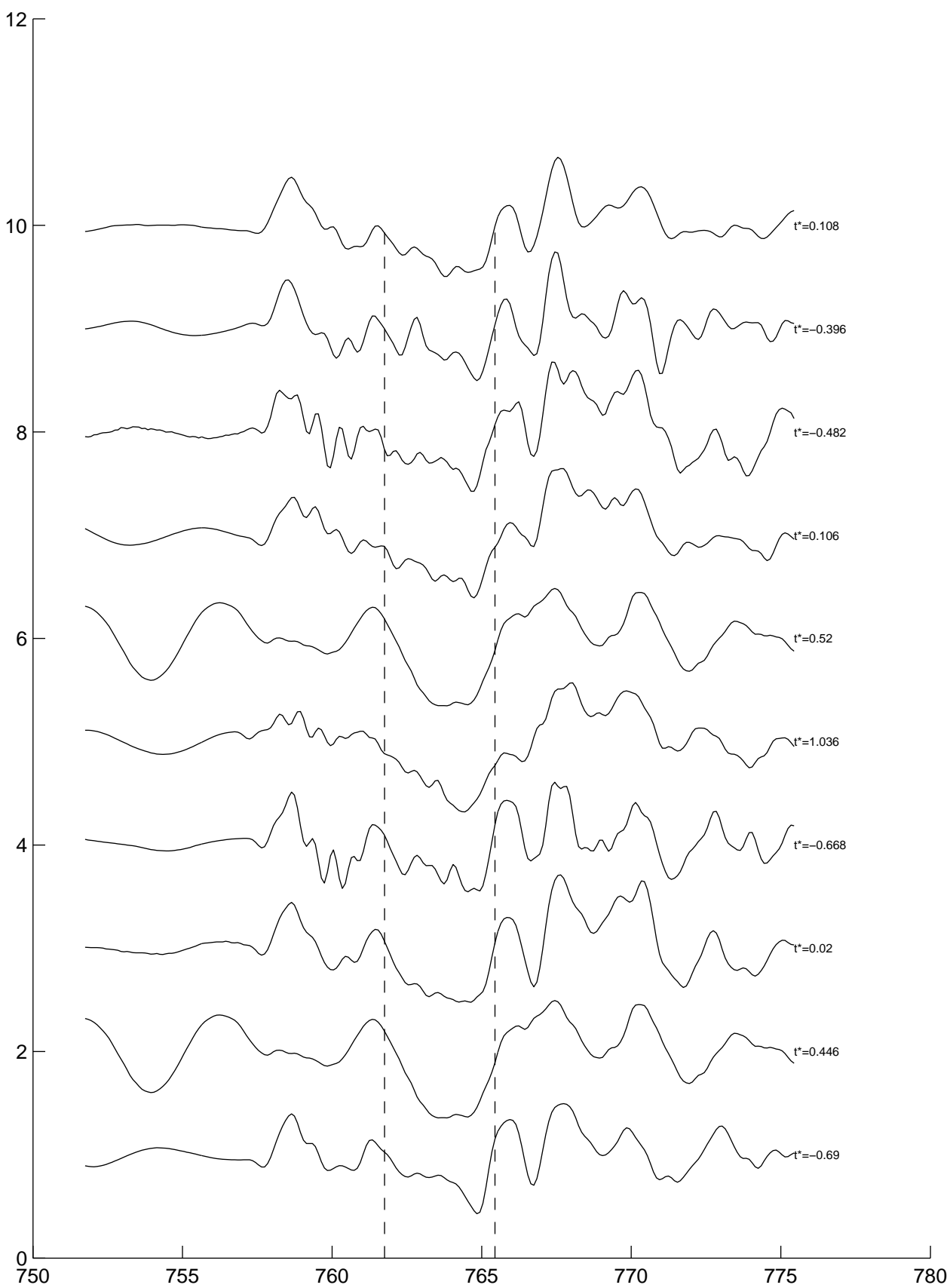
travel time residuals



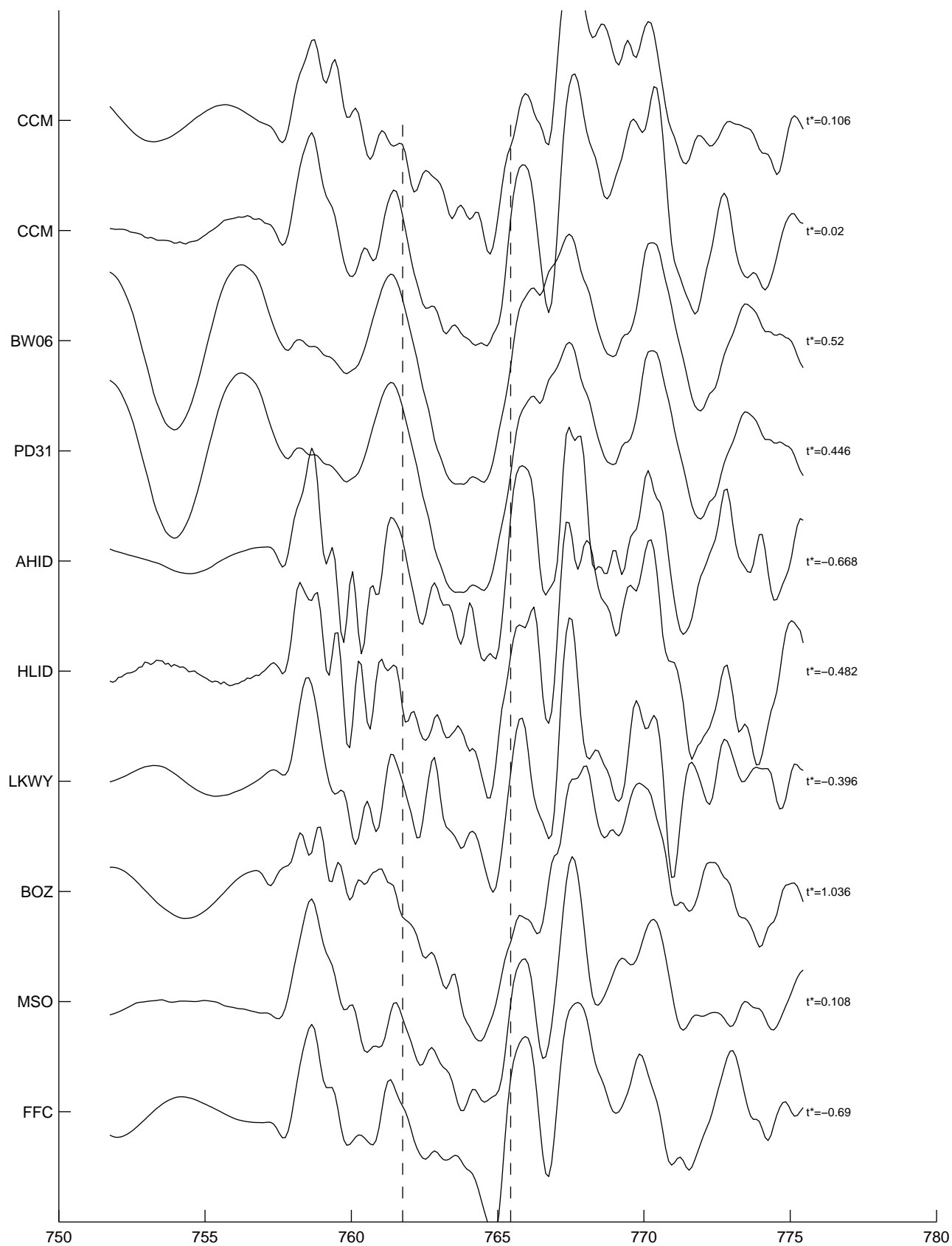
$t^*$  values



# Event\_2003\_270\_18\_52\_46

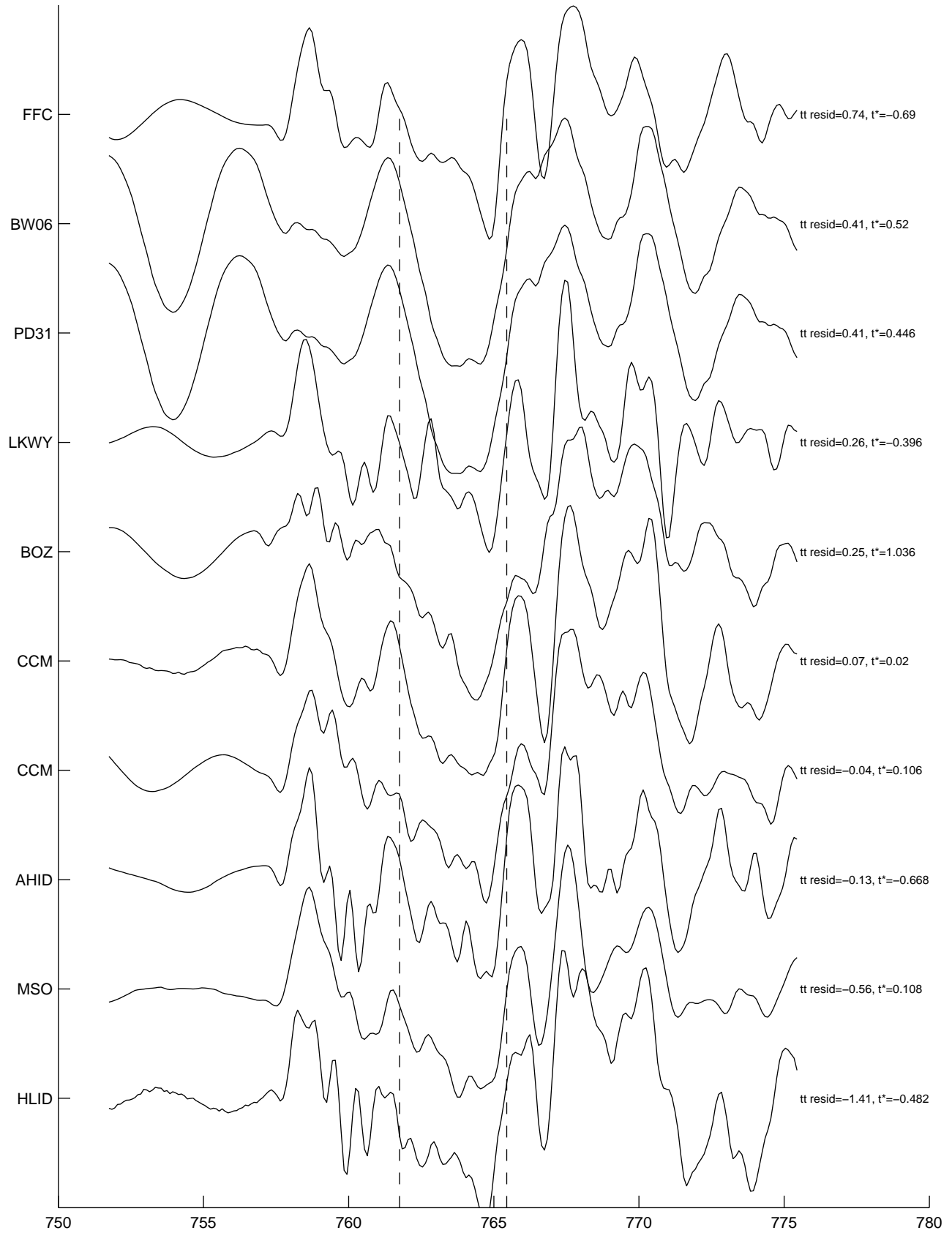


# Sorted by Delta:Event\_2003\_270\_18\_52\_46

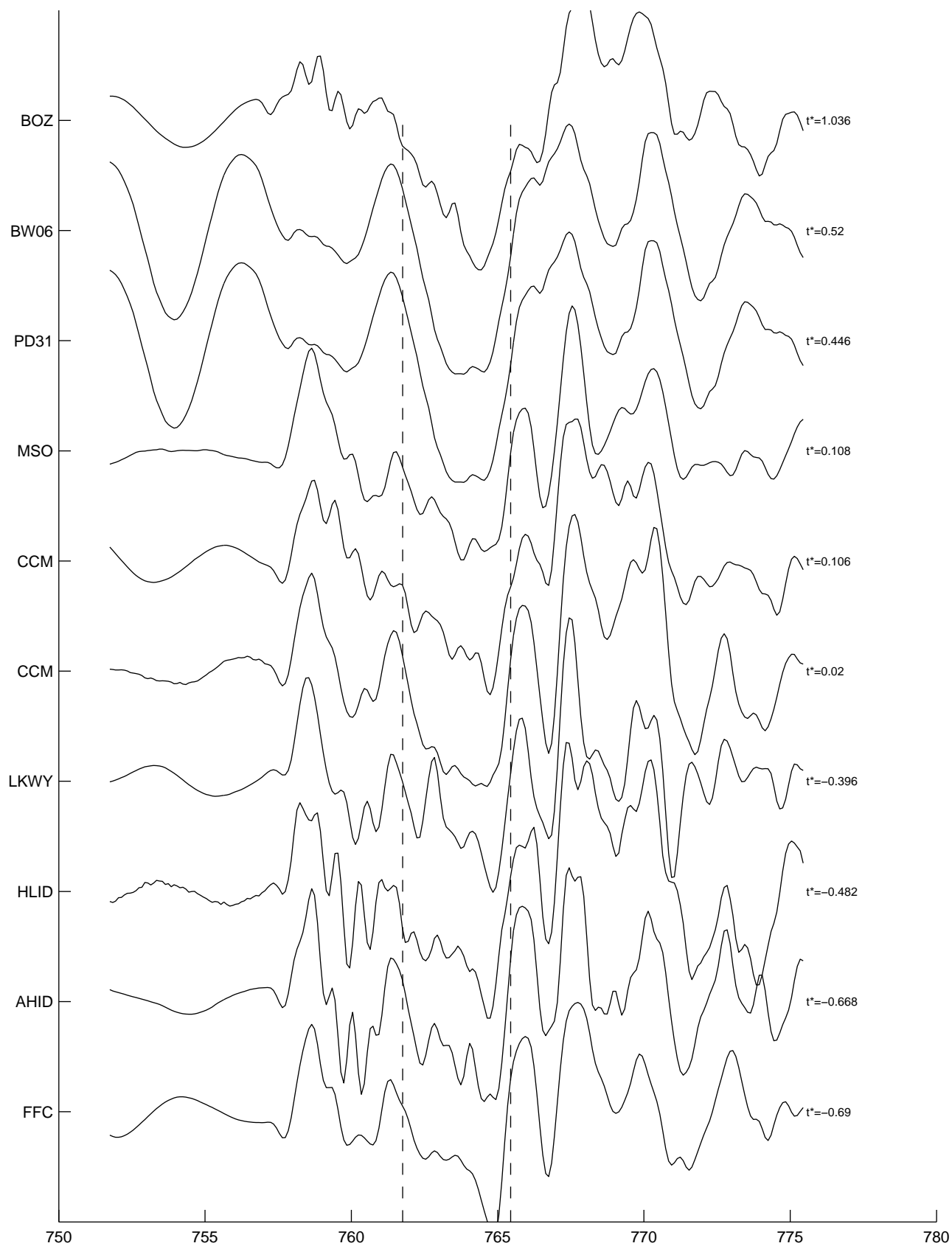




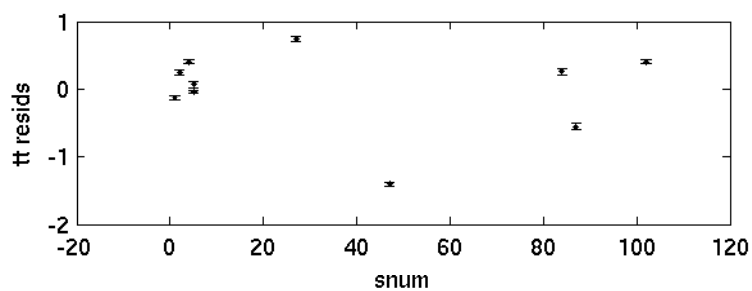
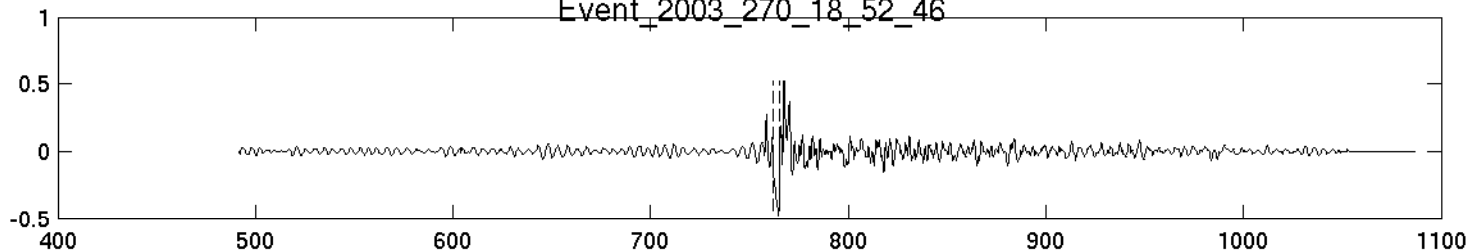
# Sorted by travel time:Event\_2003\_270\_18\_52\_46



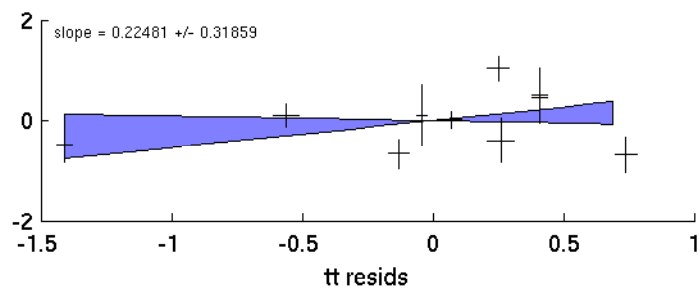
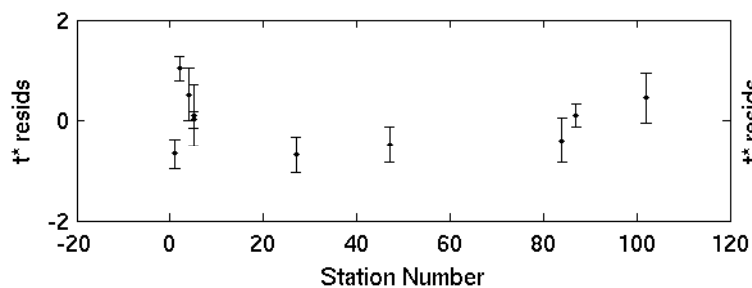
Sorted by  $t^*$ :Event\_2003\_270\_18\_52\_46



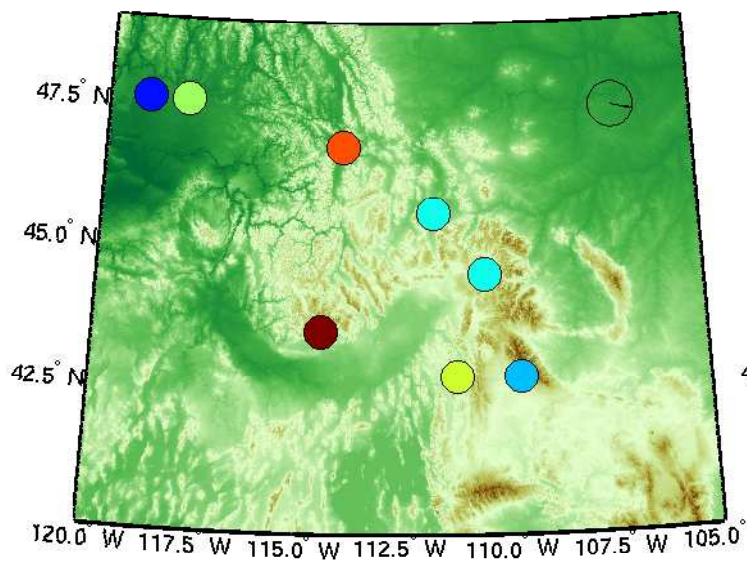
Stack  
Event\_2003\_270\_18\_52\_46



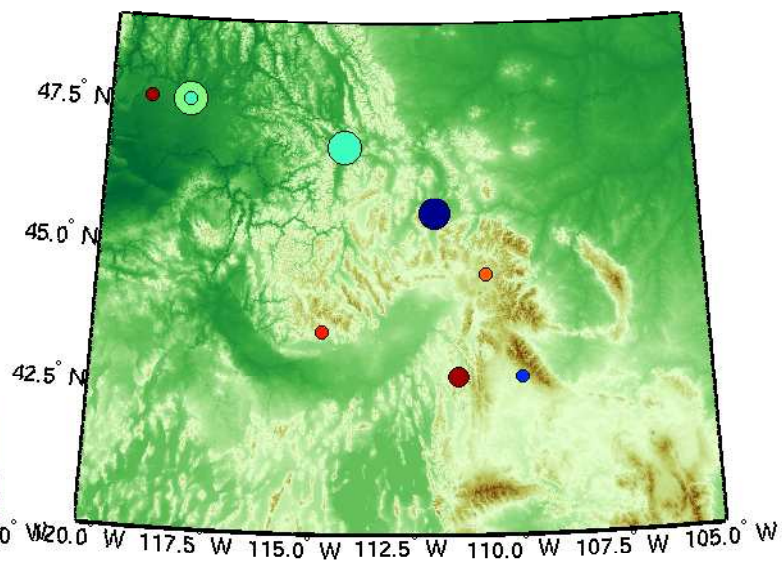
Baz = 285.1713  
Mean xcor value = 0.704  
Range of  $t^*$  values is 1.726  
Median  $t^*$  err is 0.35587  
Slope = 0.22481 +/- 0.31859



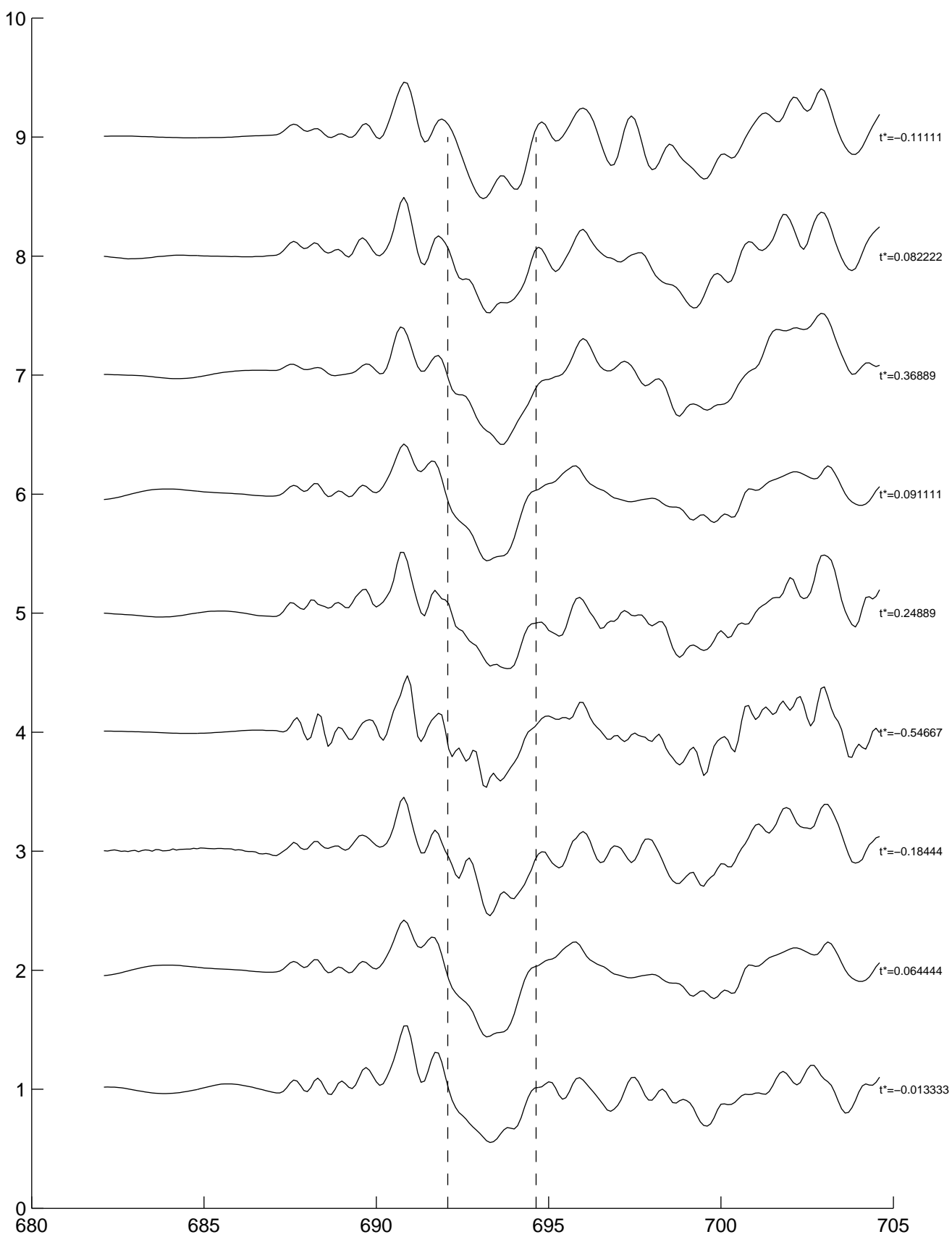
travel time residuals



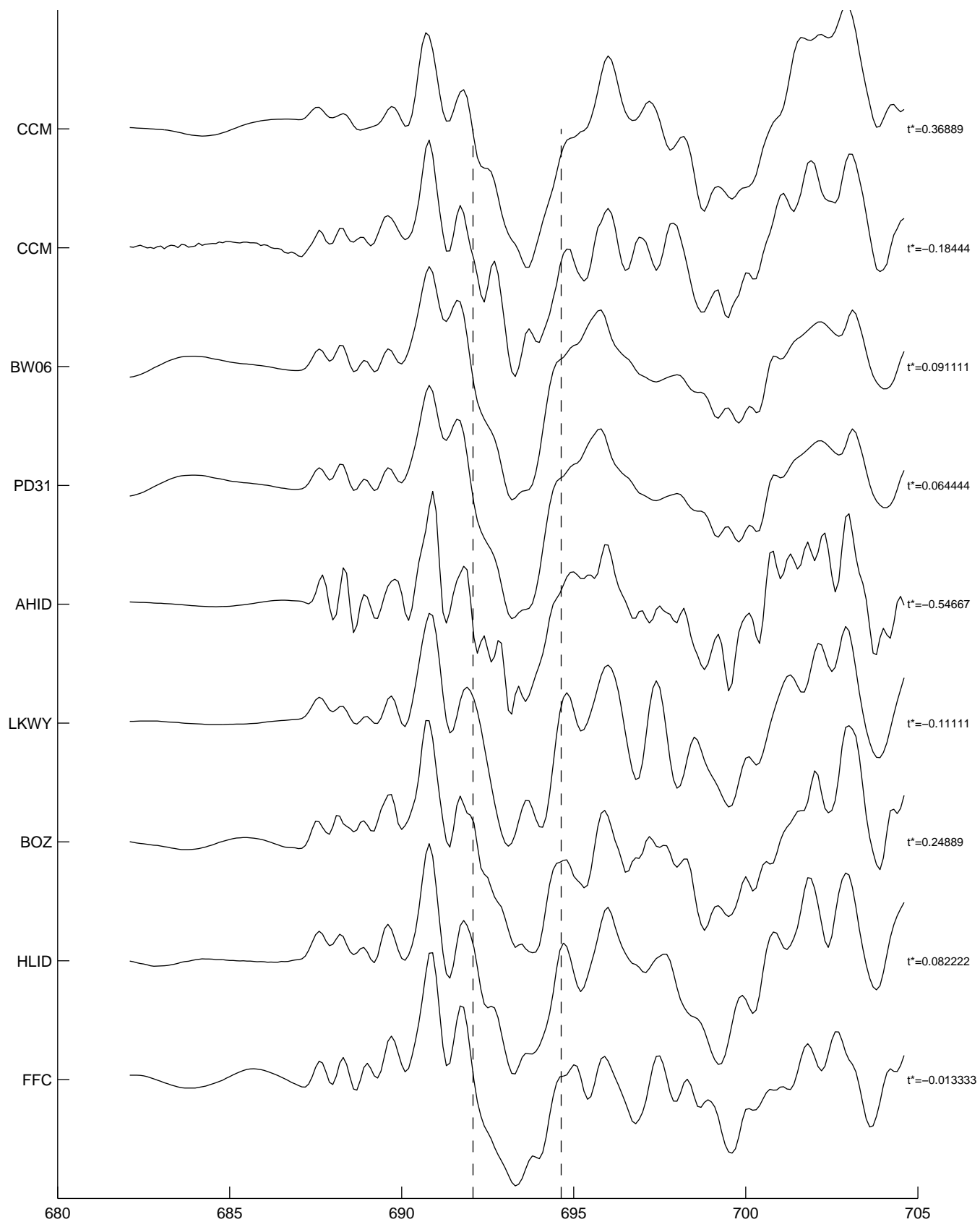
$t^*$  values



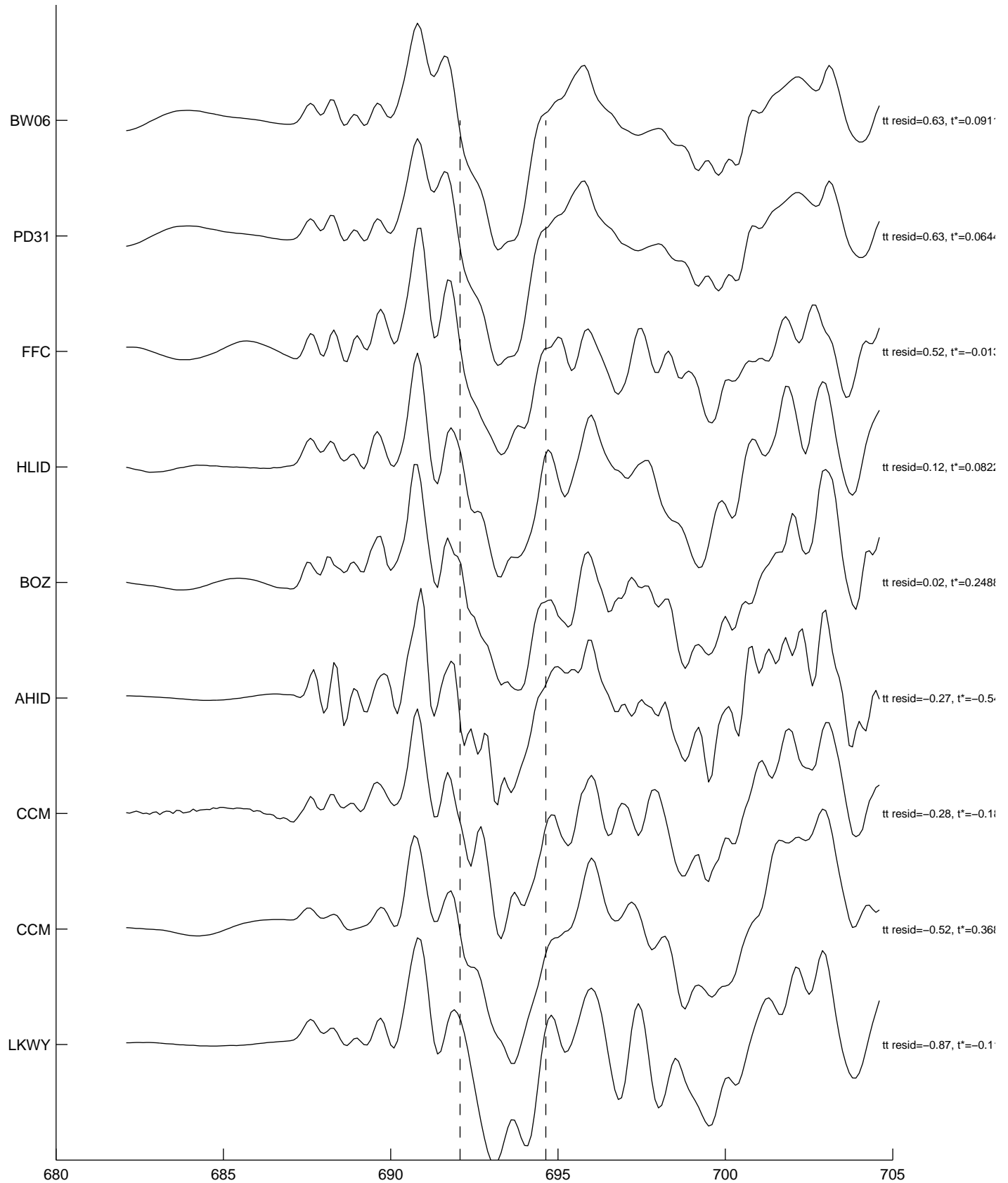
# Event\_2003\_272\_02\_36\_53



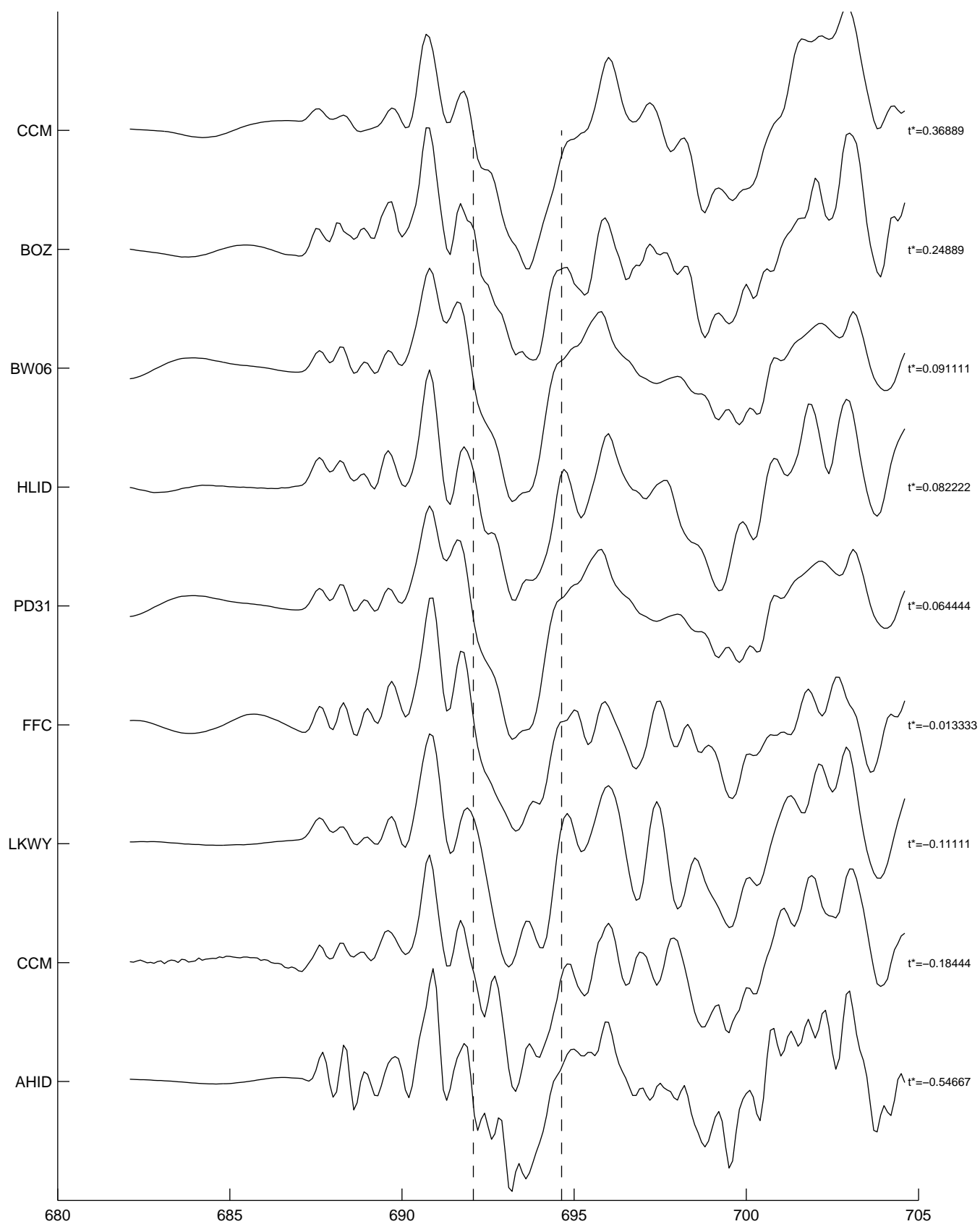
# Sorted by Delta:Event\_2003\_272\_02\_36\_53



# Sorted by travel time:Event\_2003\_272\_02\_36\_53



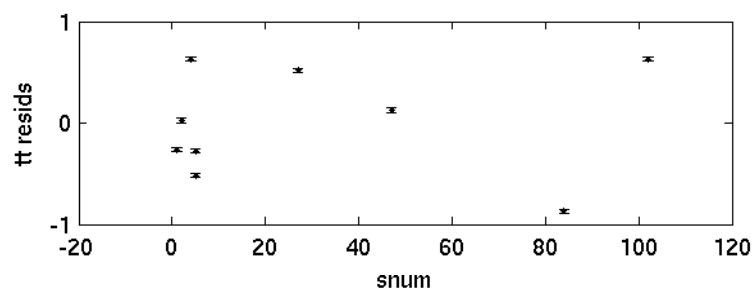
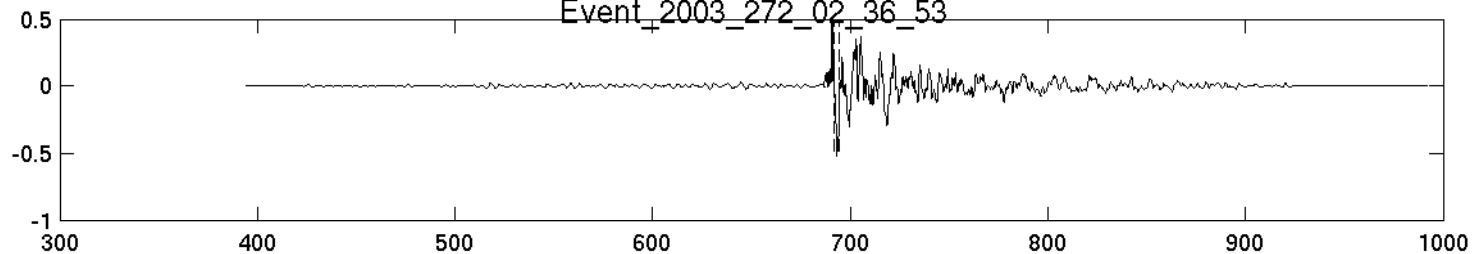
Sorted by t\*:Event\_2003\_272\_02\_36\_53



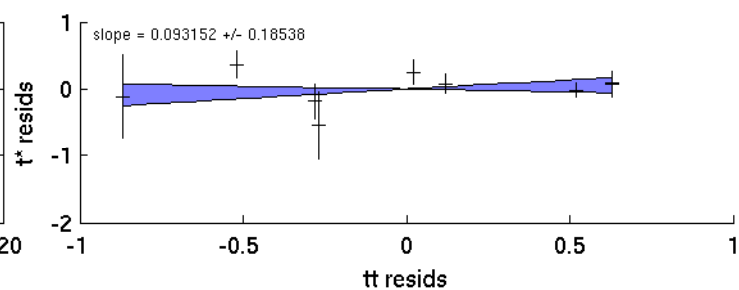
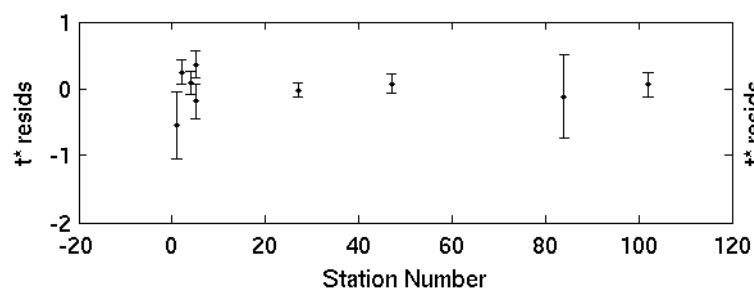


Event\_2003\_272\_02\_36\_53

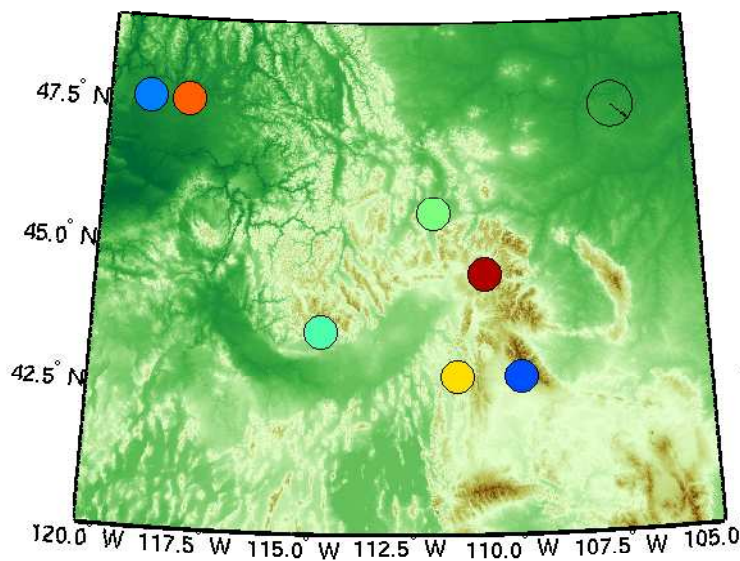
Stack



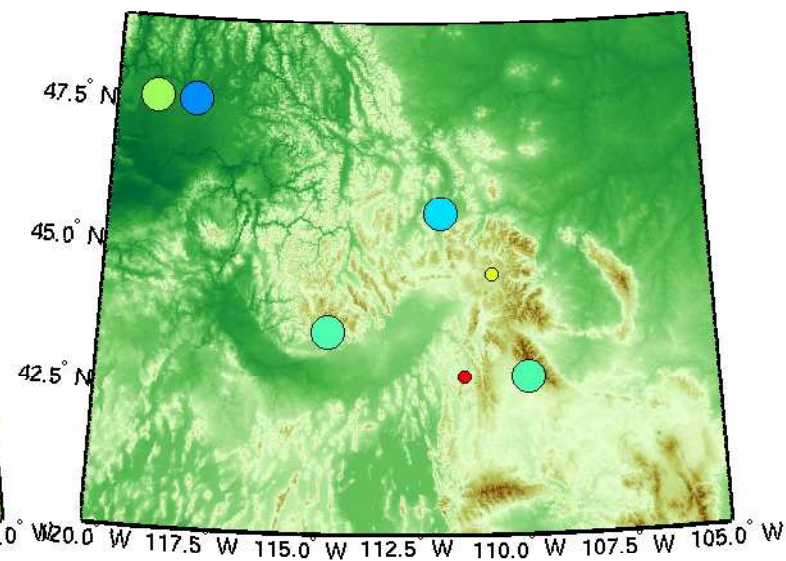
Baz = 312.8634  
Mean xcor value = 0.77222  
Range of  $t^*$  values is 0.91556  
Median  $t^*$  err is 0.17853  
Slope = 0.093152 +/- 0.18538



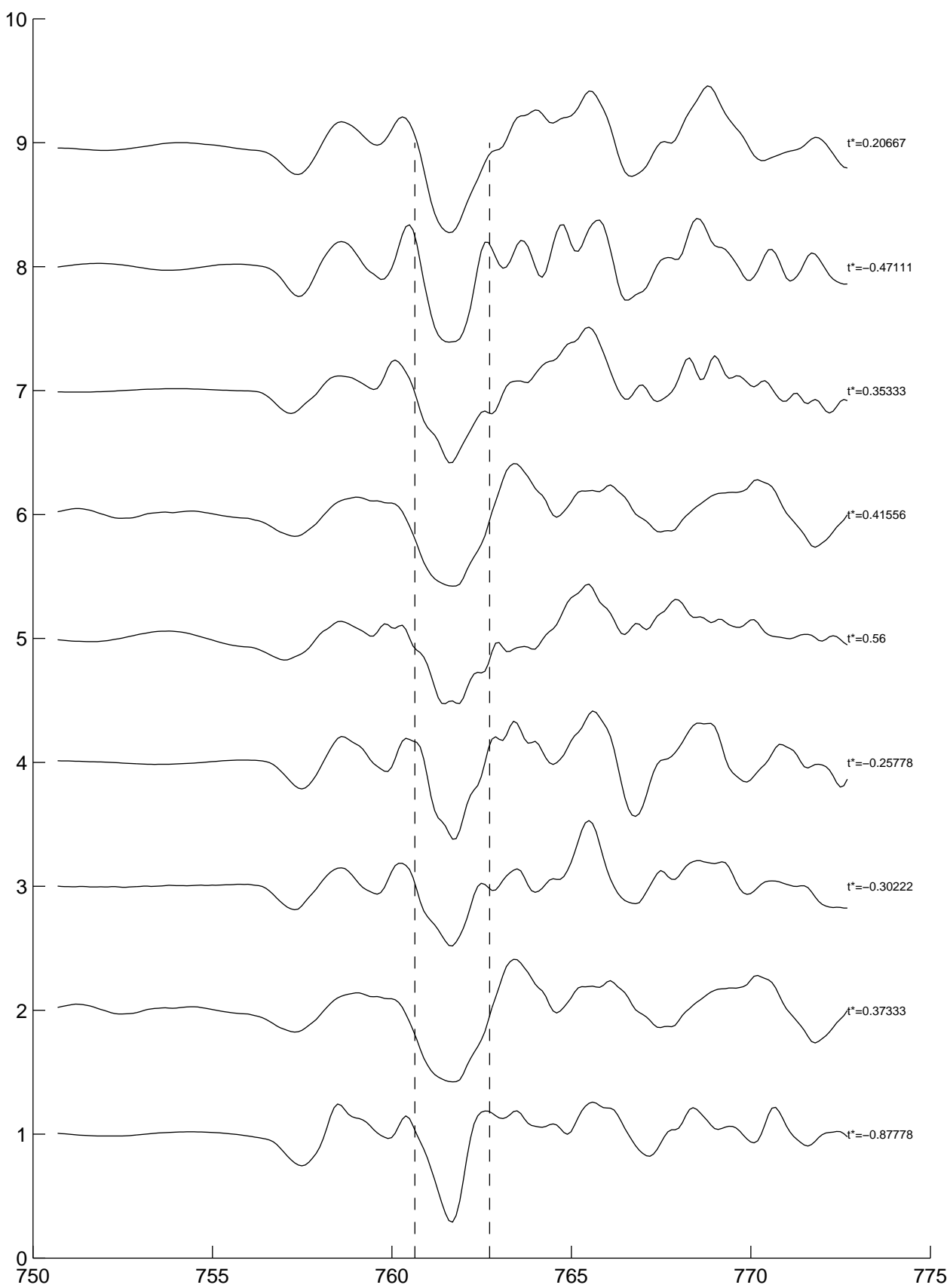
travel time residuals



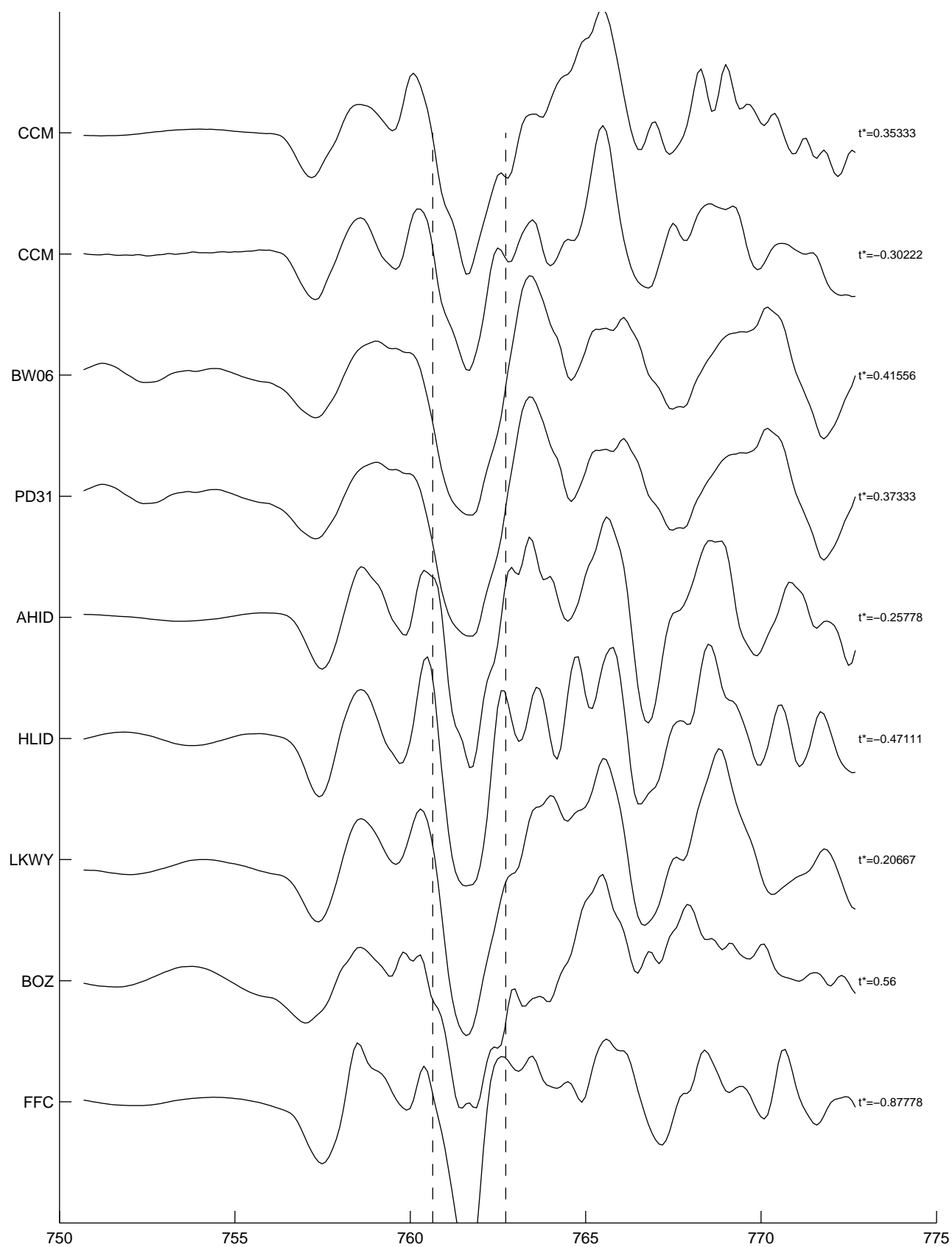
$t^*$  values



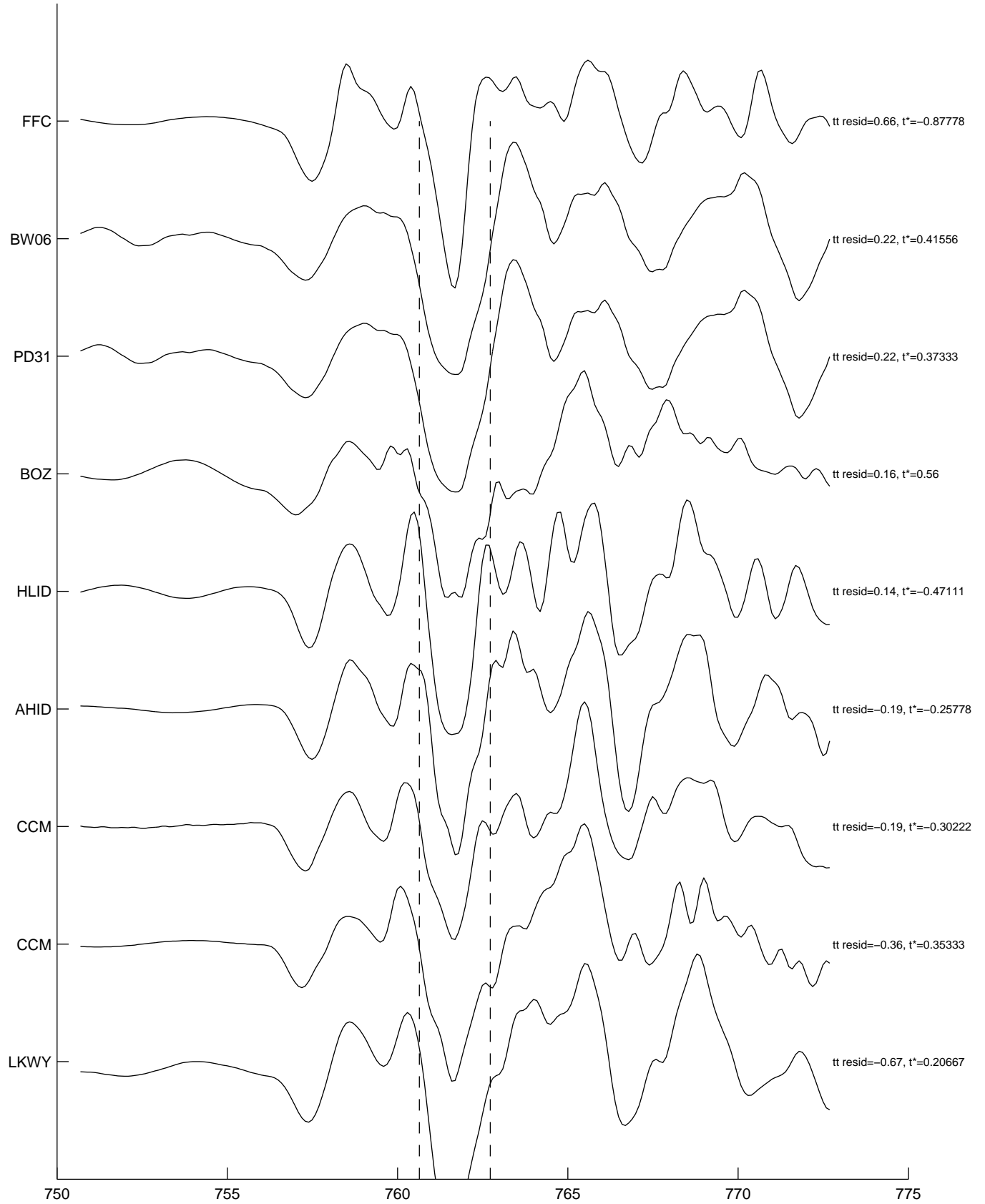
# Event\_2003\_274\_01\_03\_25



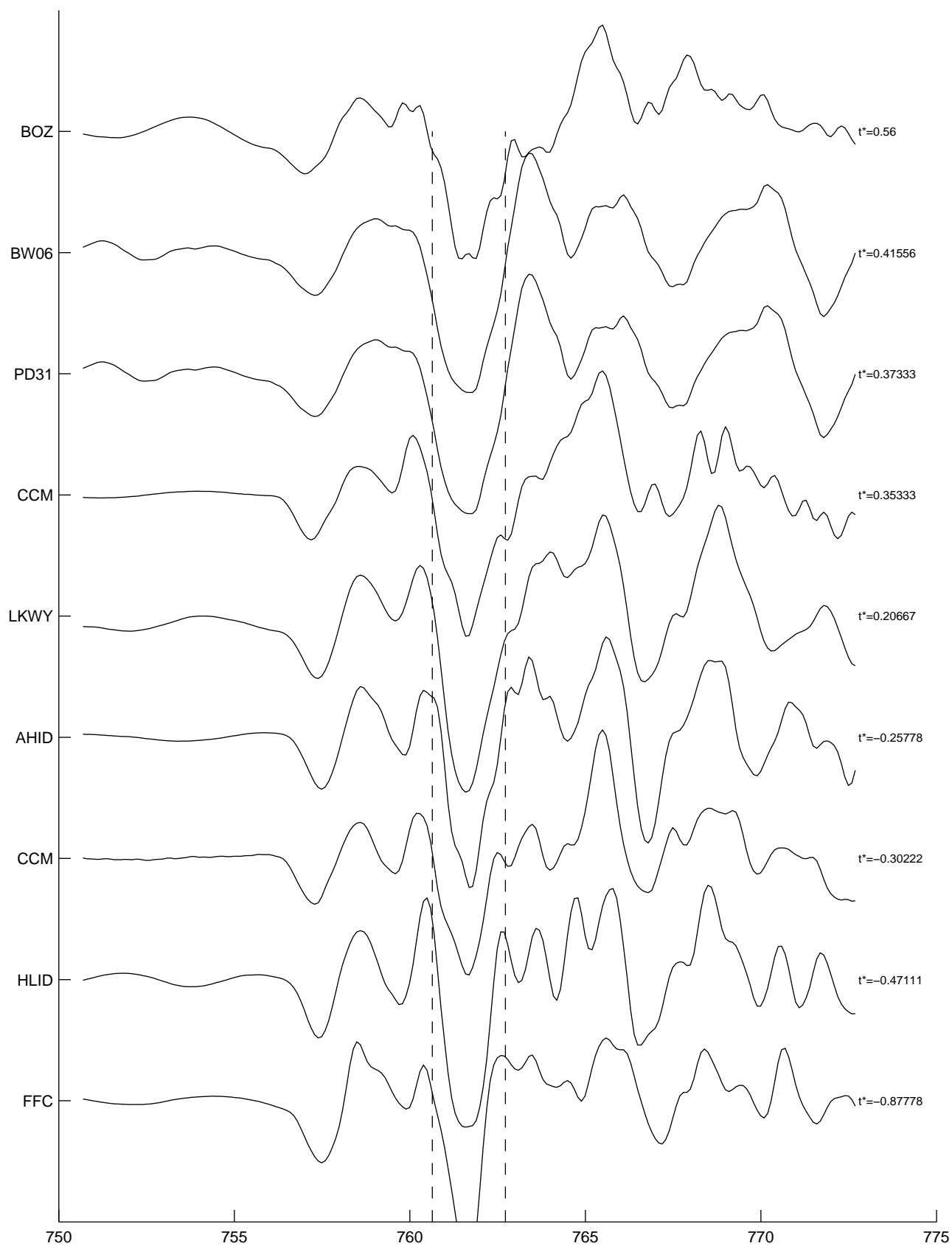
# Sorted by Delta:Event\_2003\_274\_01\_03\_25



# Sorted by travel time:Event\_2003\_274\_01\_03\_25

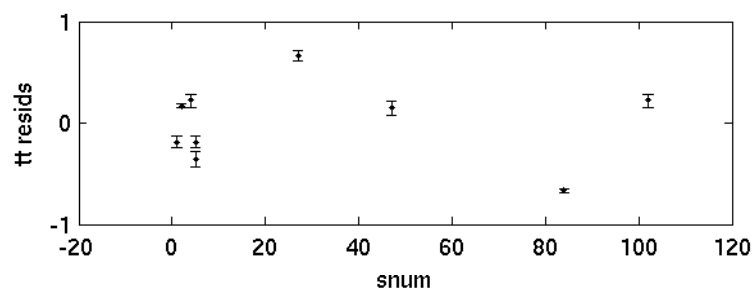
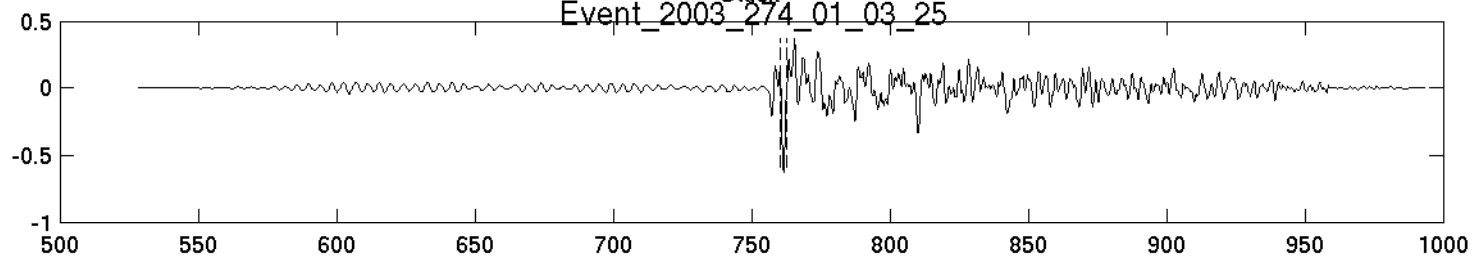


Sorted by  $t^*$ :Event\_2003\_274\_01\_03\_25

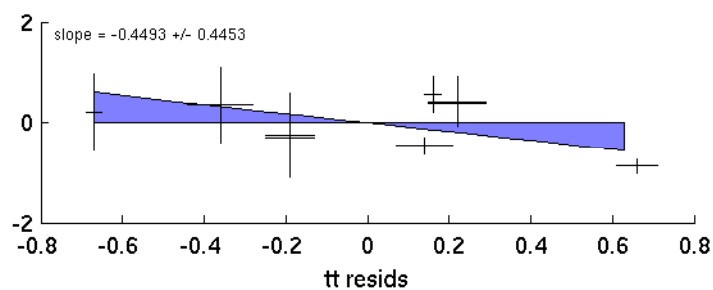
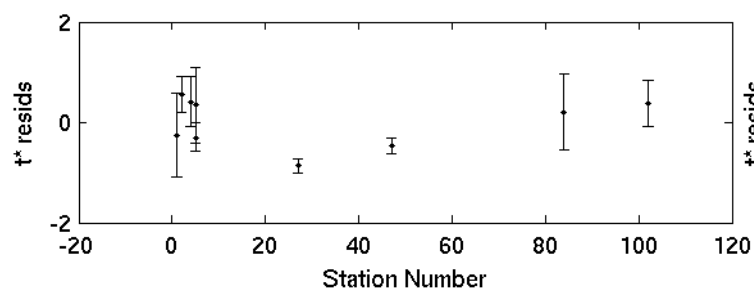


Event\_2003\_274\_01\_03\_25

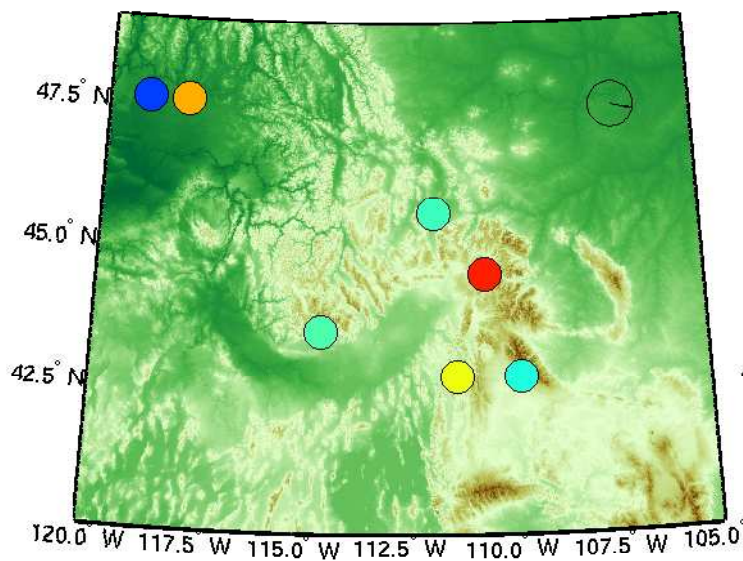
Stack



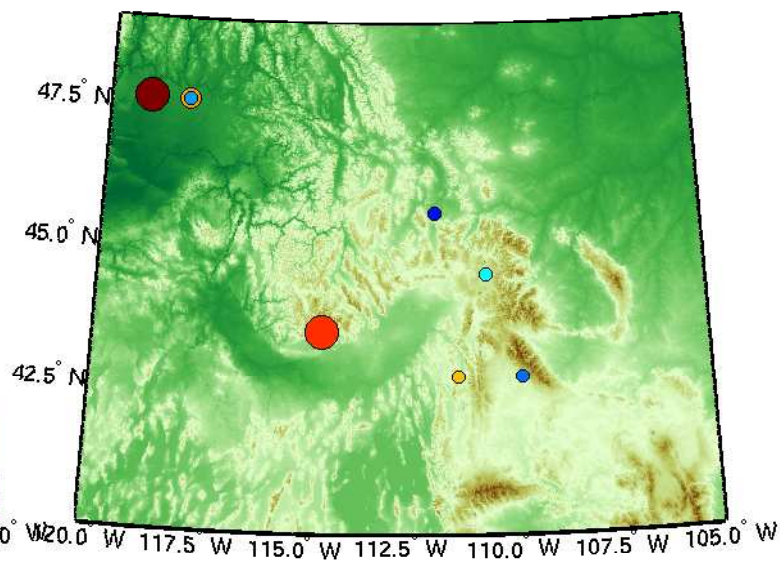
Baz = 285.2207  
Mean xcor value = 0.71667  
Range of  $t^*$  values is 1.4378  
Median  $t^*$  err is 0.45632  
Slope = -0.4493 +/- 0.4453



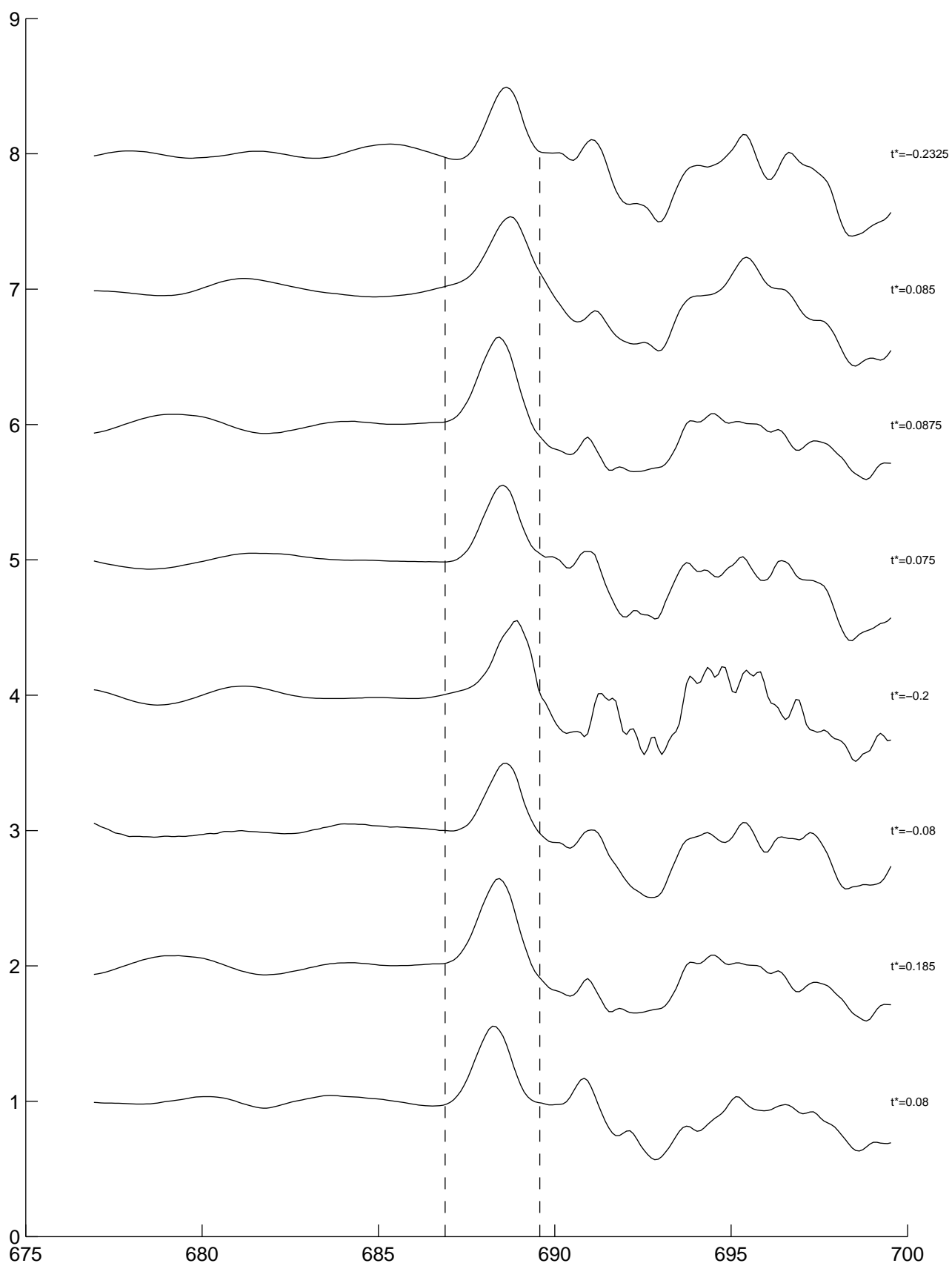
travel time residuals



$t^*$  values

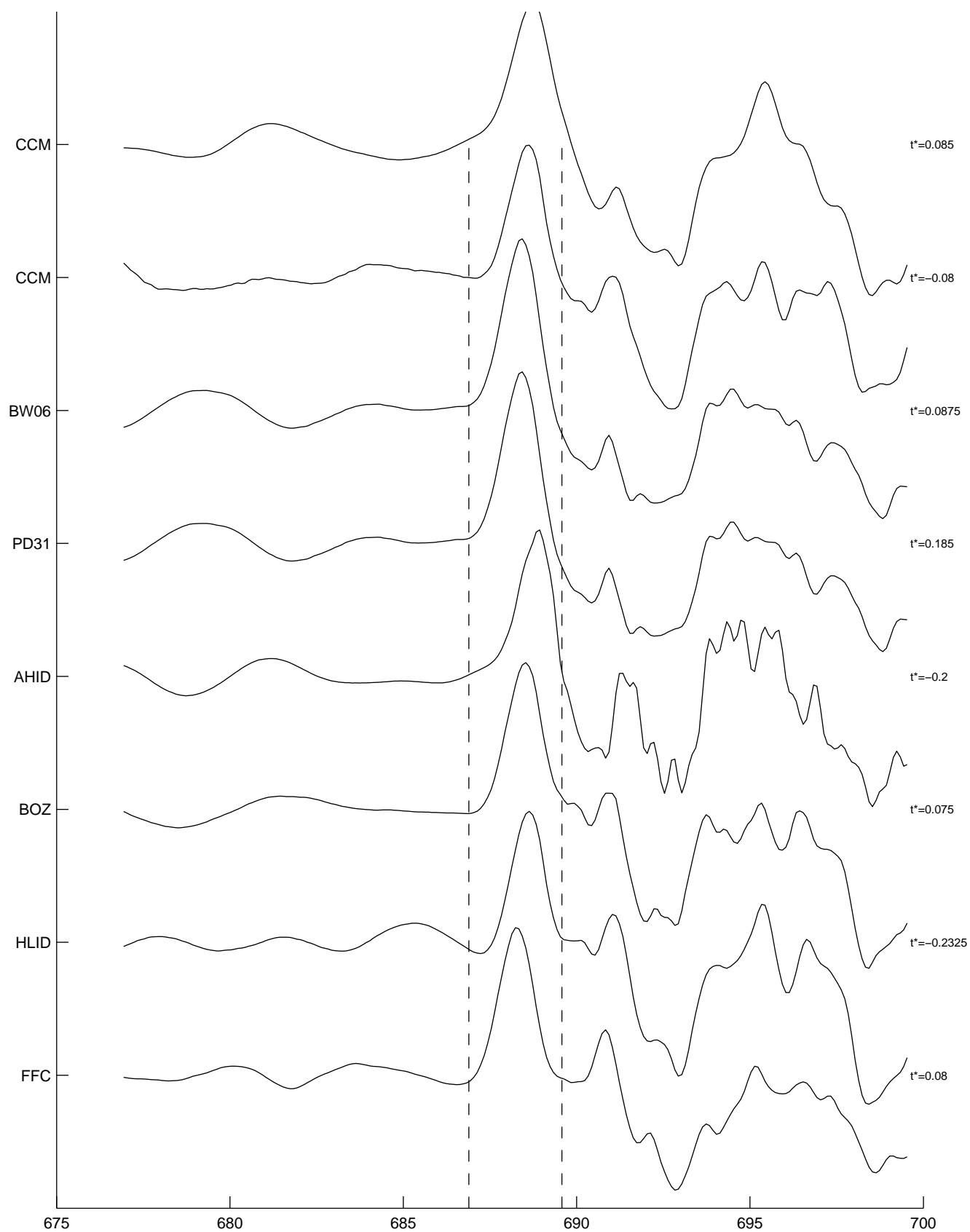


# Event\_2003\_281\_09\_06\_55

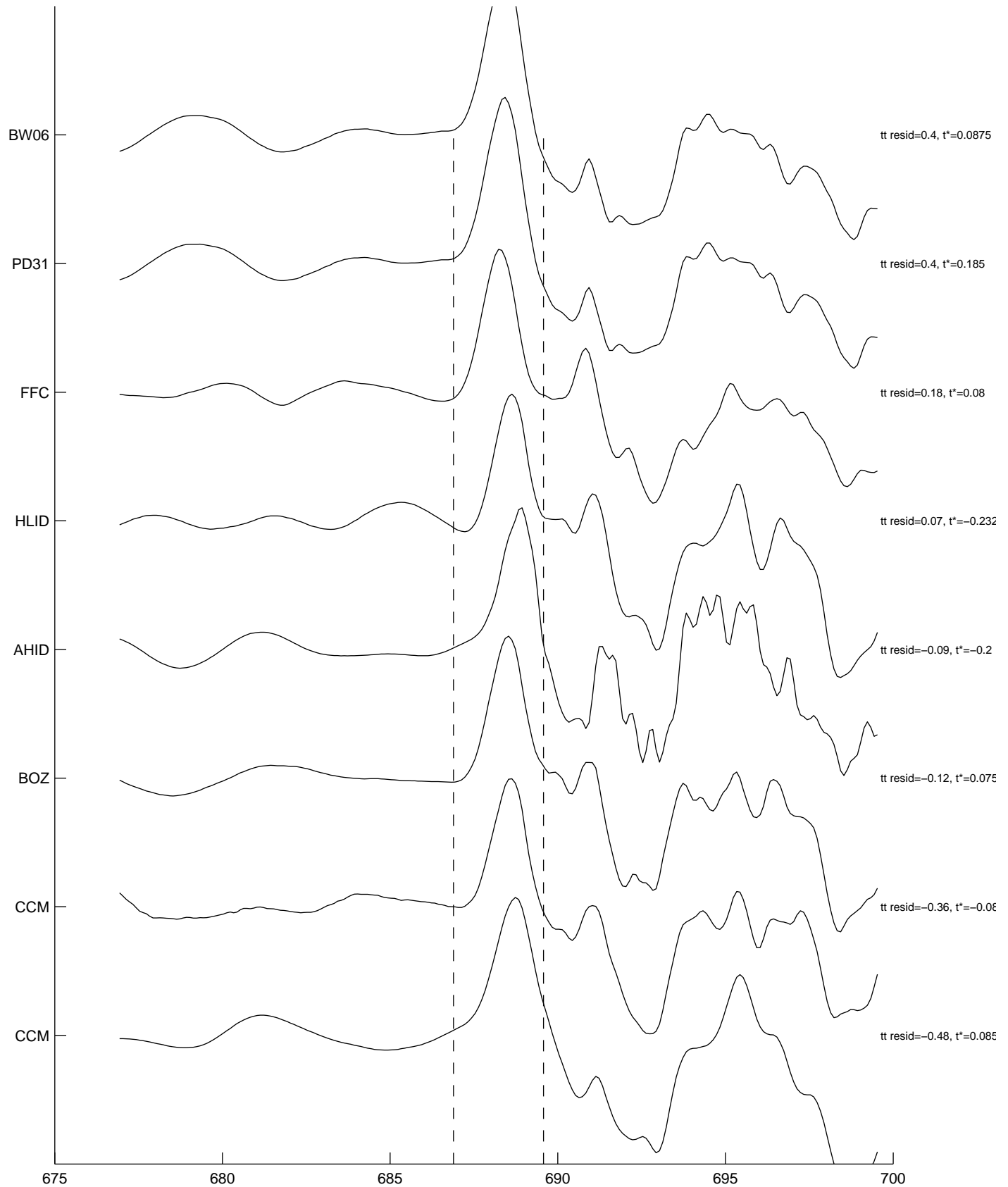




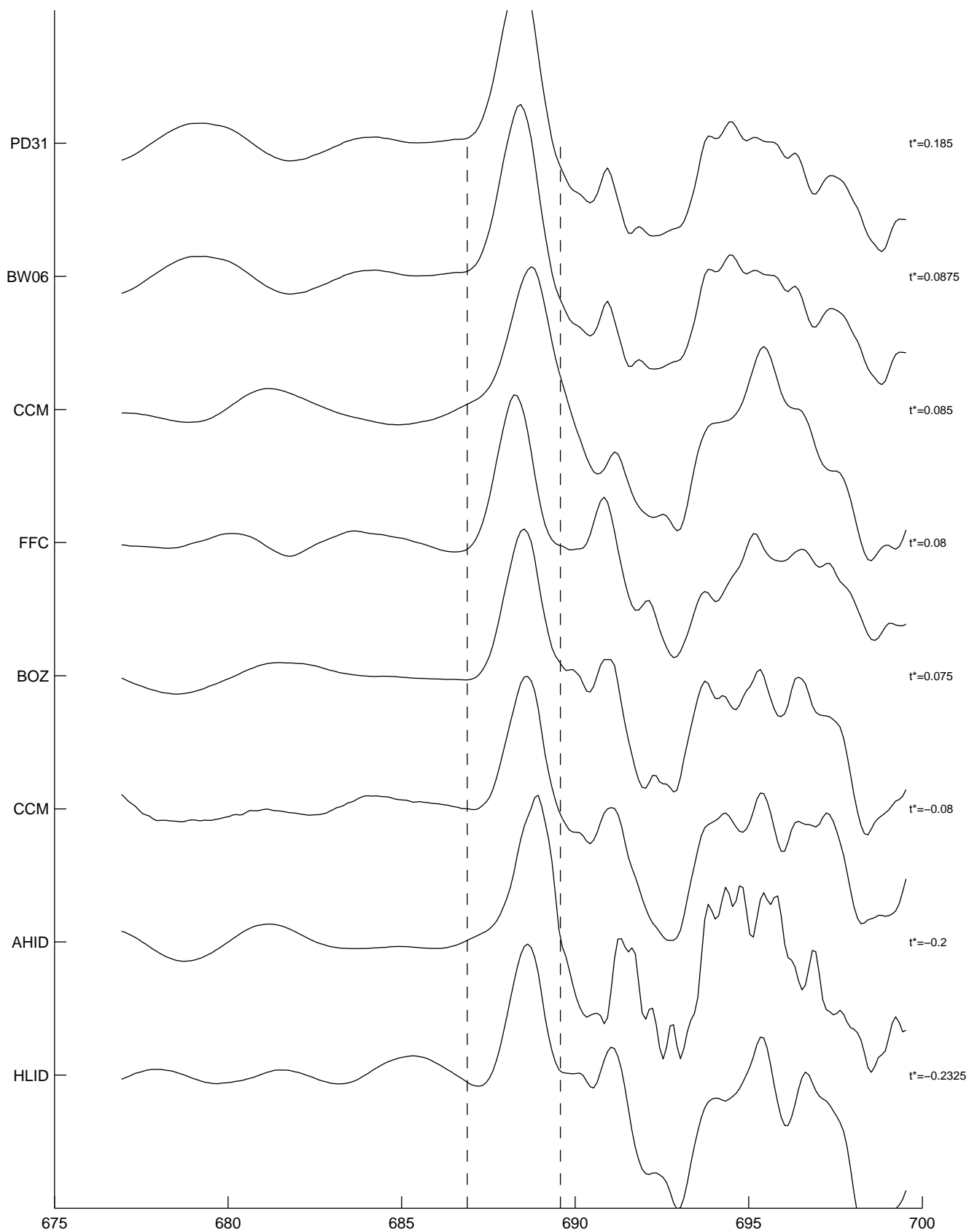
# Sorted by Delta:Event\_2003\_281\_09\_06\_55



# Sorted by travel time: Event\_2003\_281\_09\_06\_55

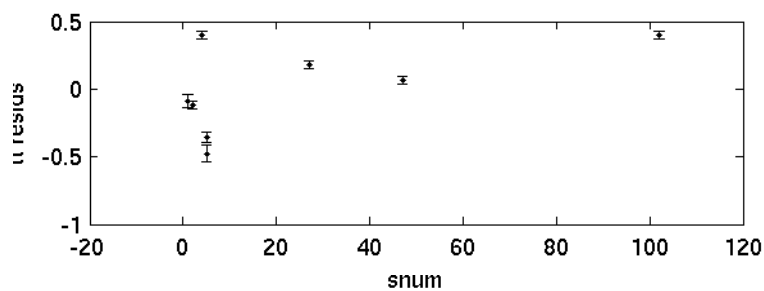
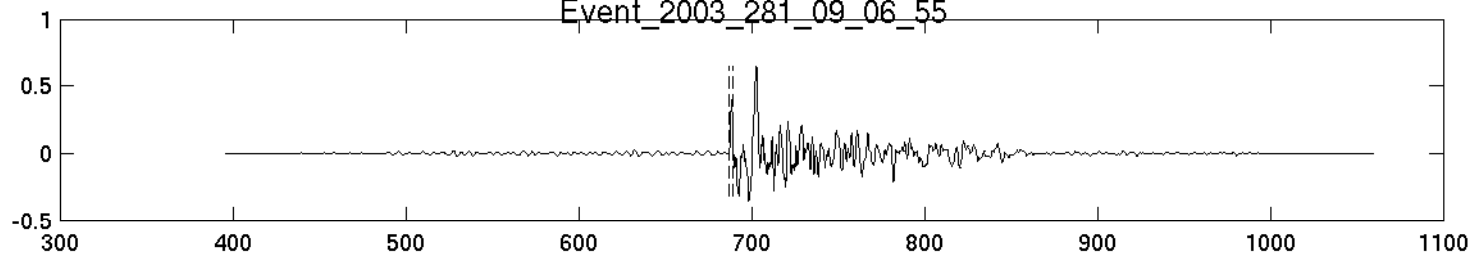


Sorted by  $t^*$ :Event\_2003\_281\_09\_06\_55

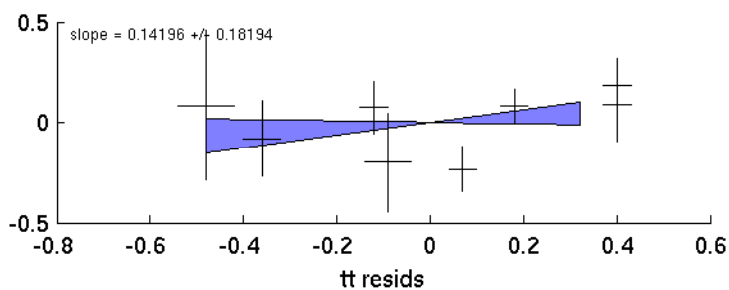
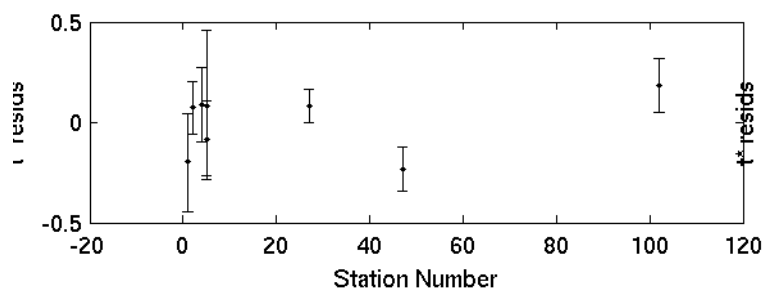


# Event\_2003\_281\_09\_06\_55

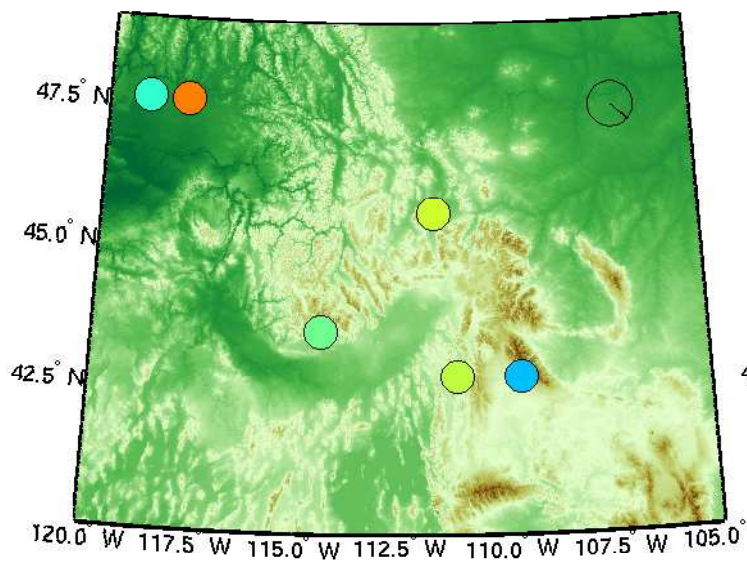
Stack



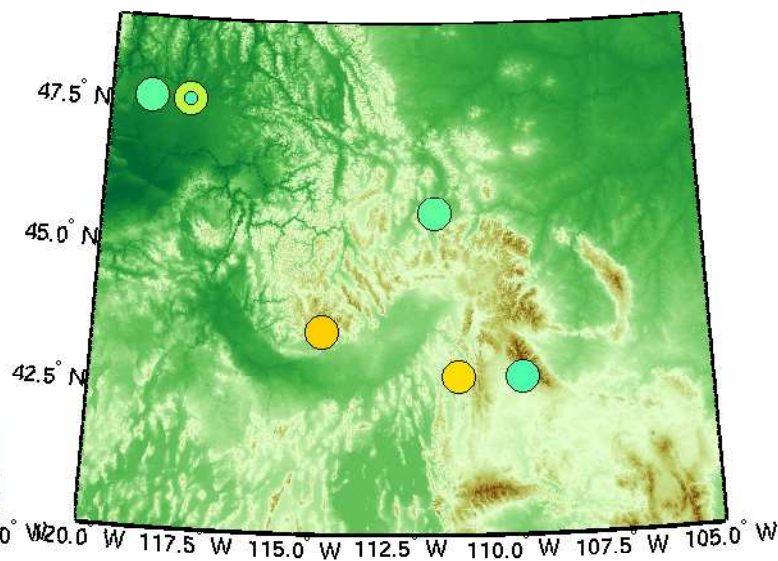
Baz = 313.3331  
Mean xcor value = 0.84625  
Range of  $t^*$  values is 0.4175  
Median  $t^*$  err is 0.15877  
Slope = 0.14196  $\pm$  0.18194



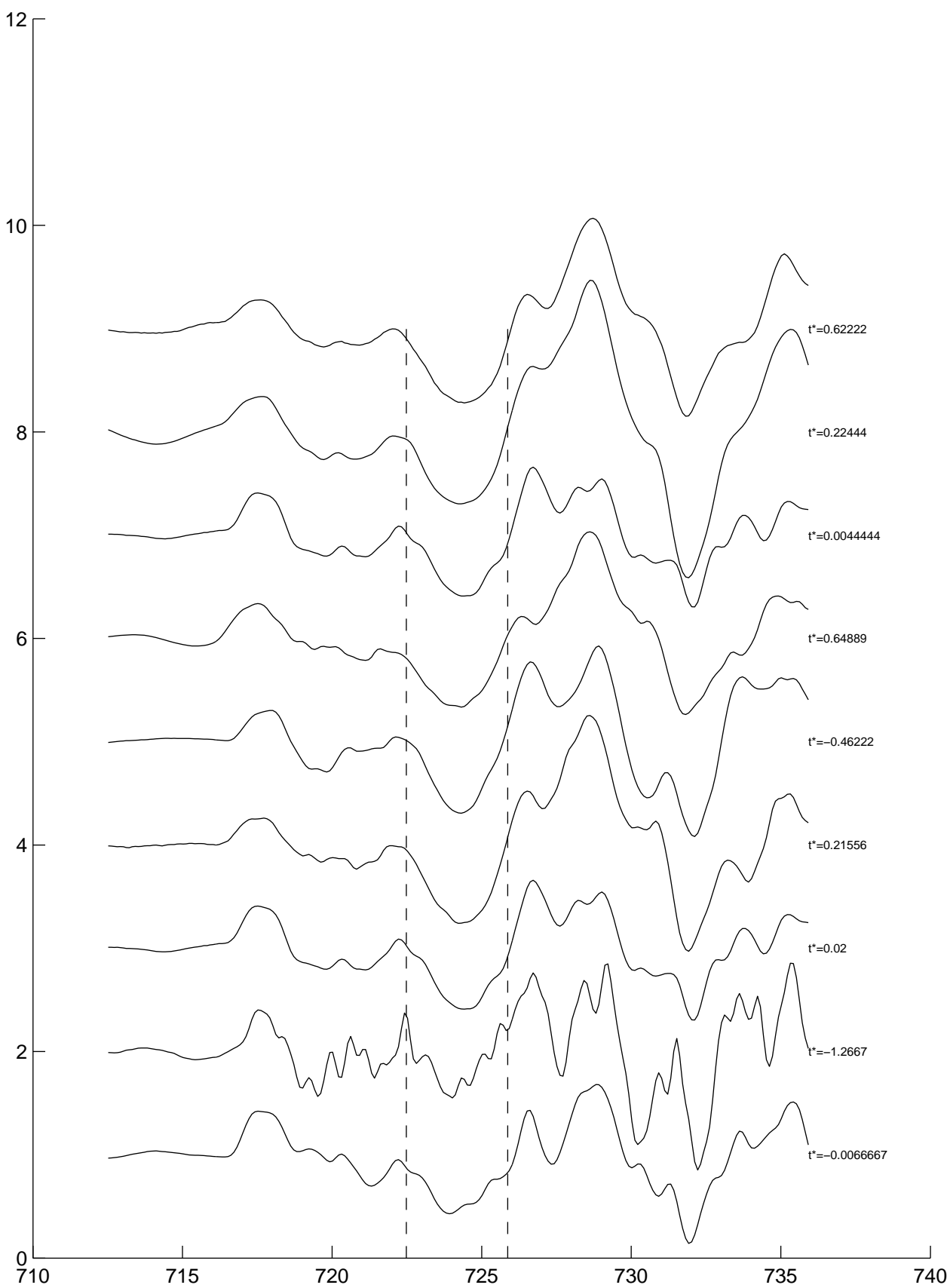
travel time residuals



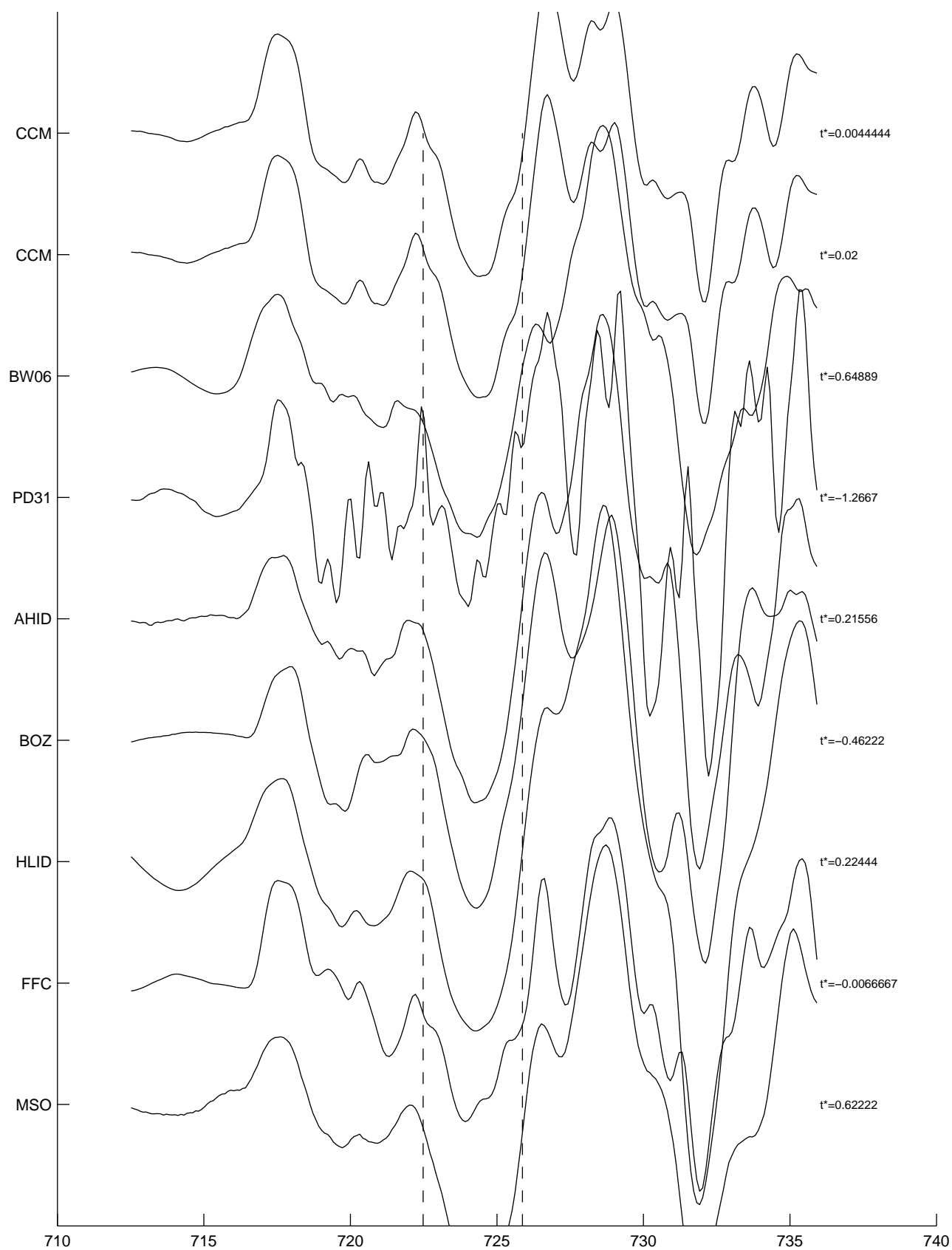
$t^*$  values



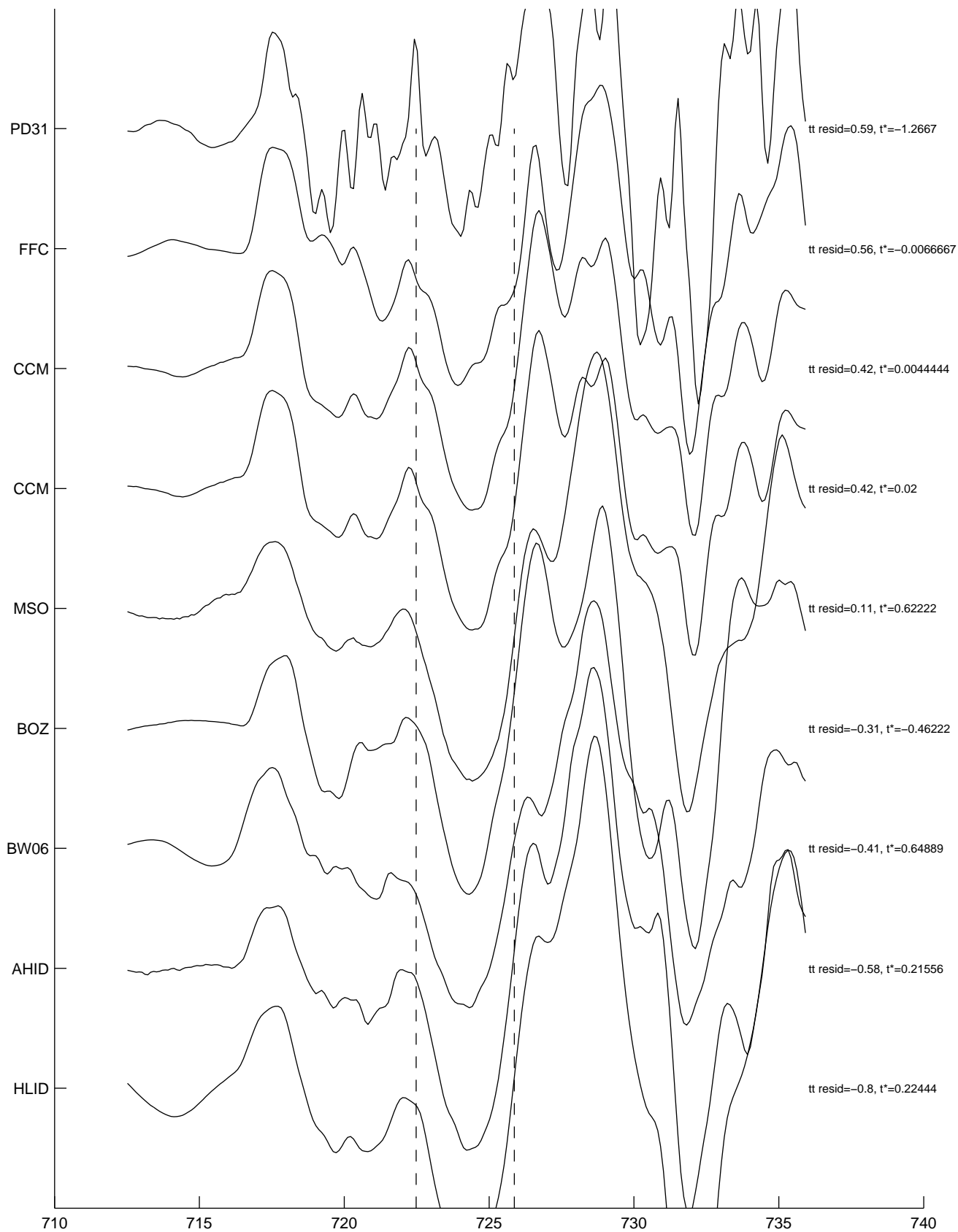
# Event\_2003\_304\_01\_06\_28



# Sorted by Delta:Event\_2003\_304\_01\_06\_28

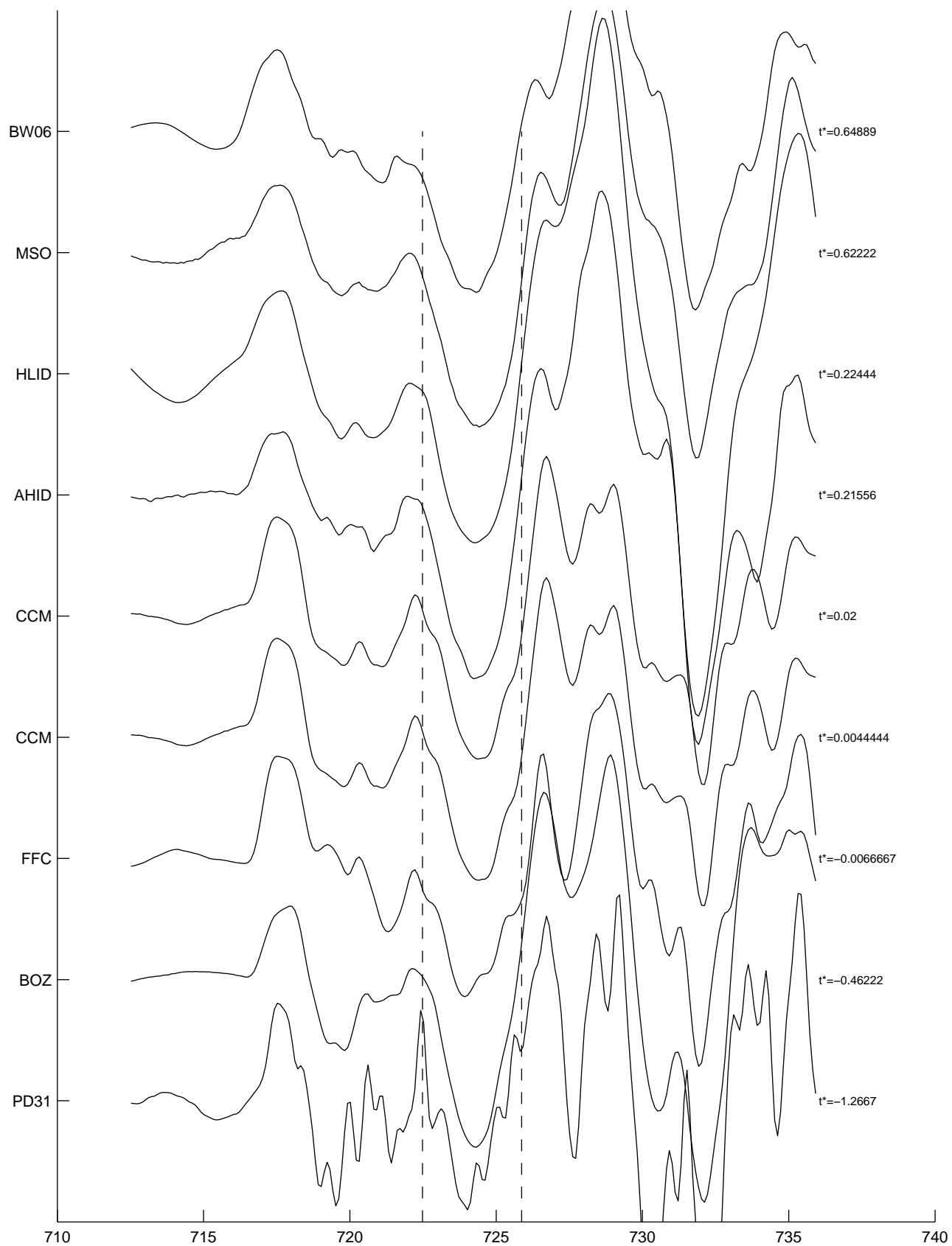


# Sorted by travel time:Event\_2003\_304\_01\_06\_28



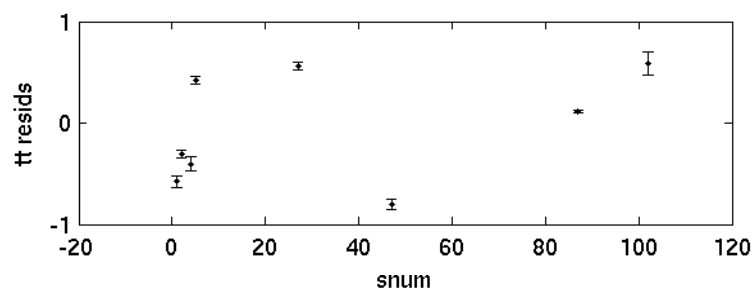
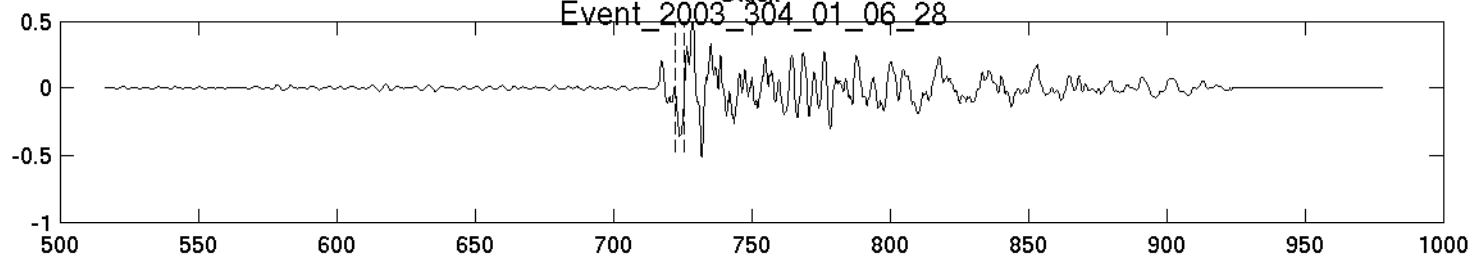


Sorted by t\*:Event\_2003\_304\_01\_06\_28

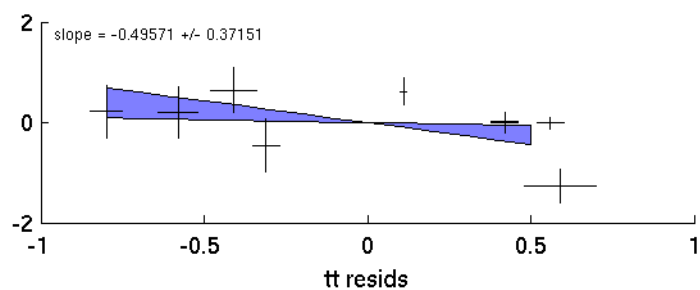
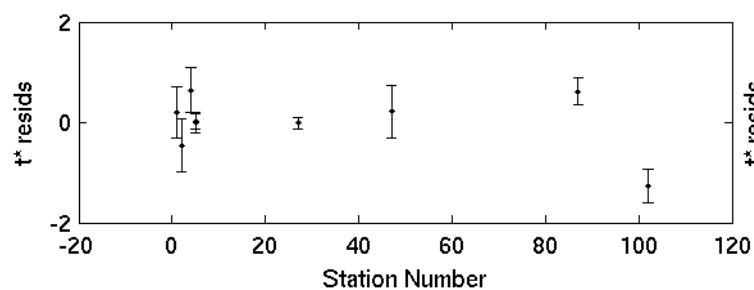


# Event\_2003\_304\_01\_06\_28

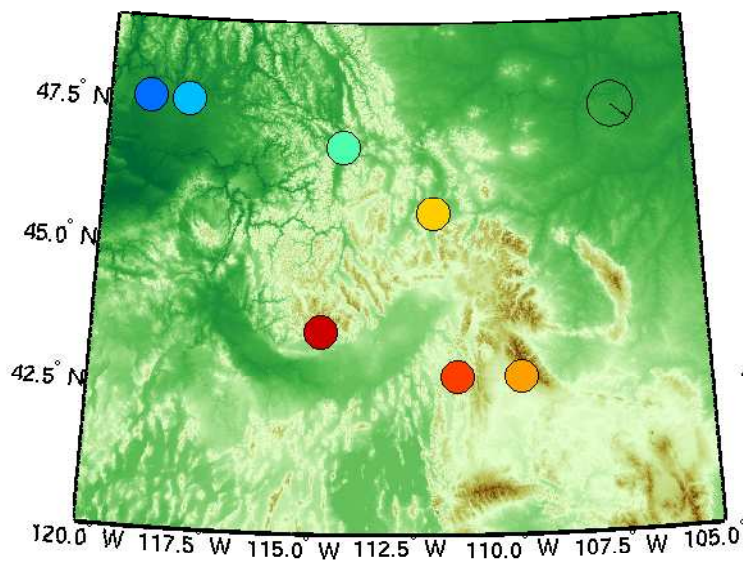
Stack



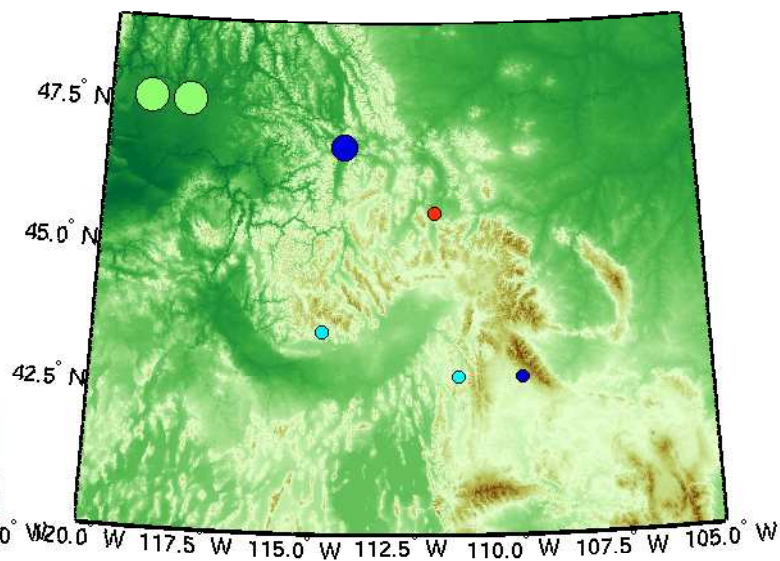
Baz = 310.9506  
Mean xcor value = 0.83667  
Range of  $t^*$  values is 1.9156  
Median  $t^*$  err is 0.33403  
Slope =  $-0.49571 \pm 0.37151$



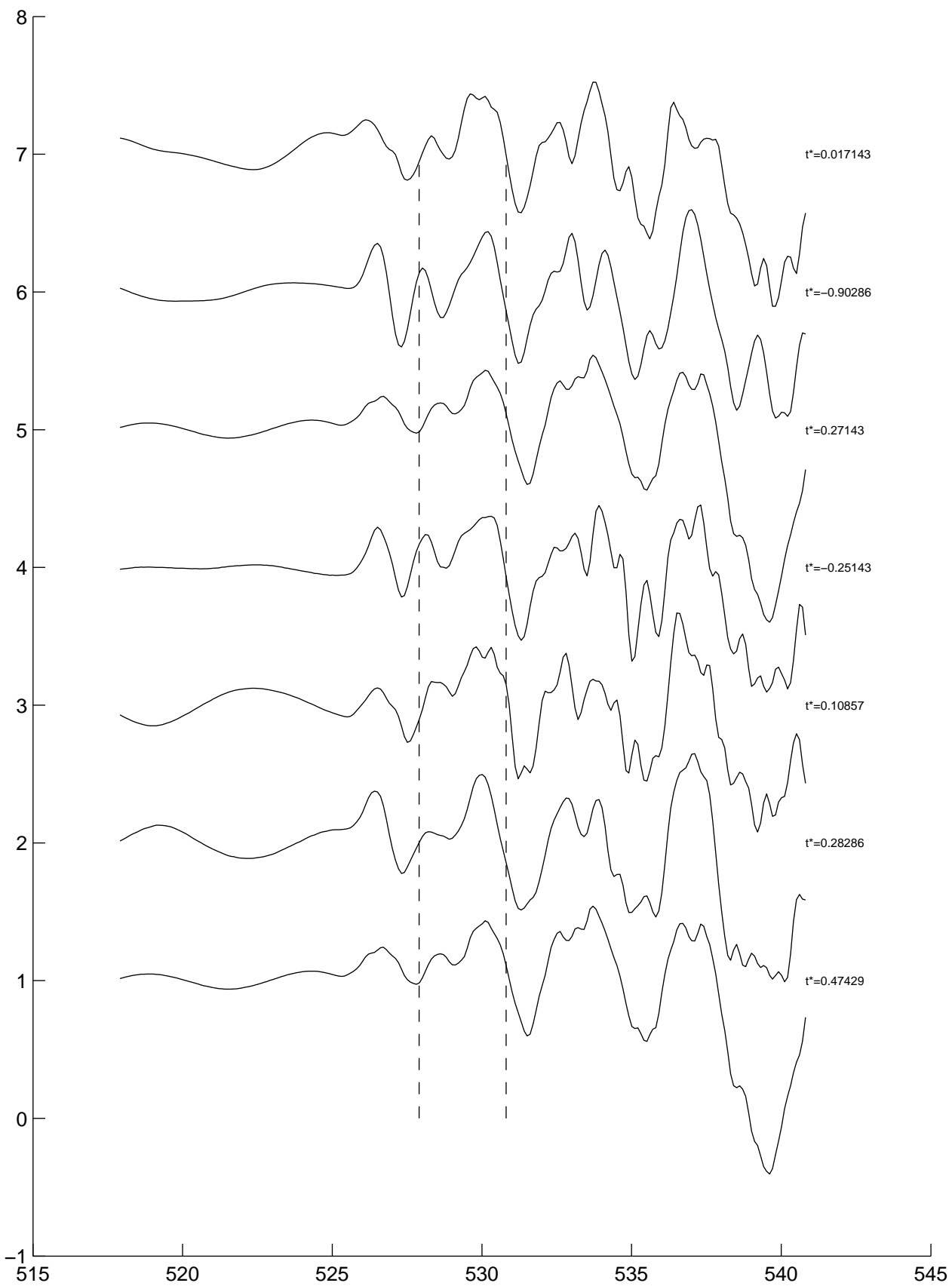
travel time residuals



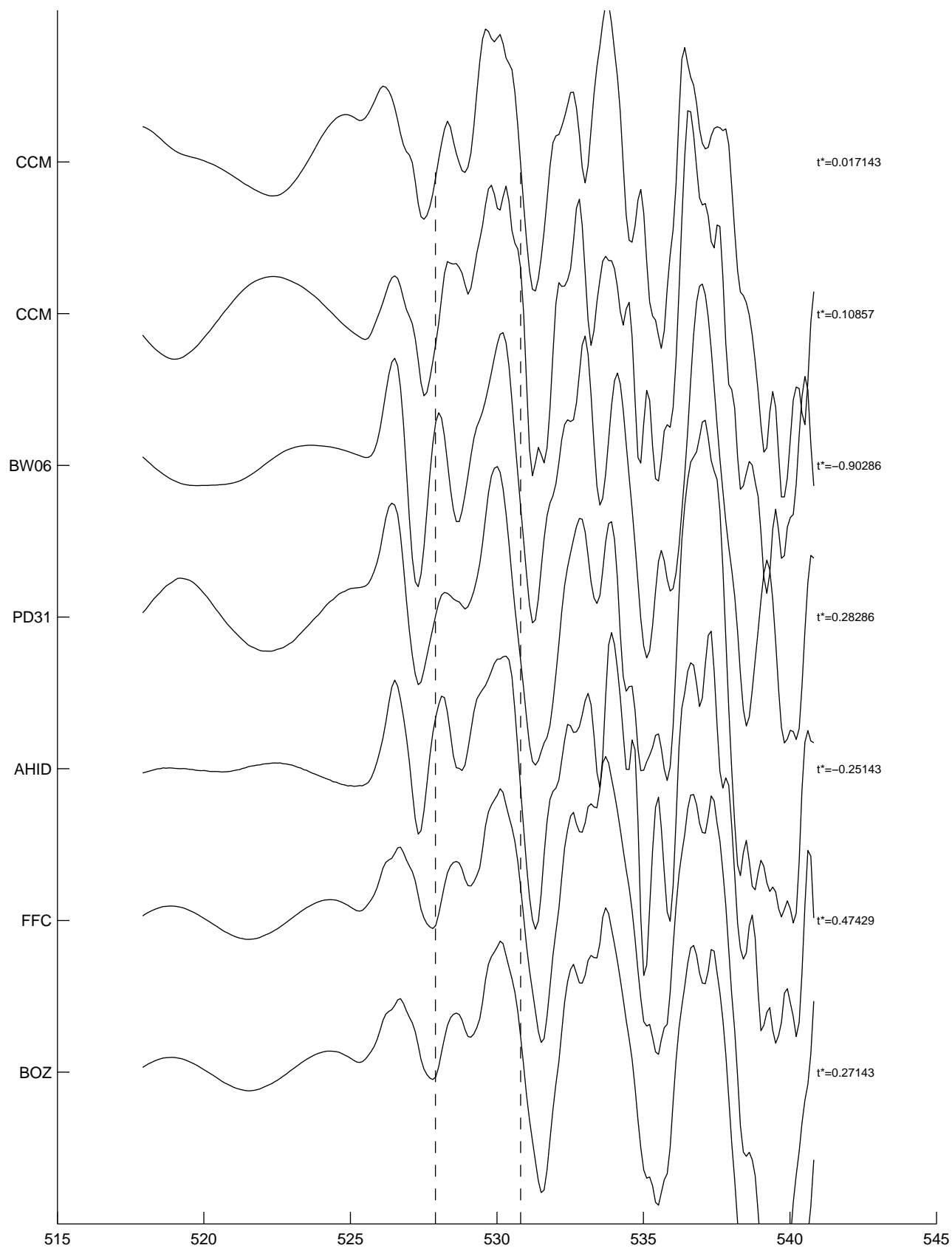
$t^*$  values



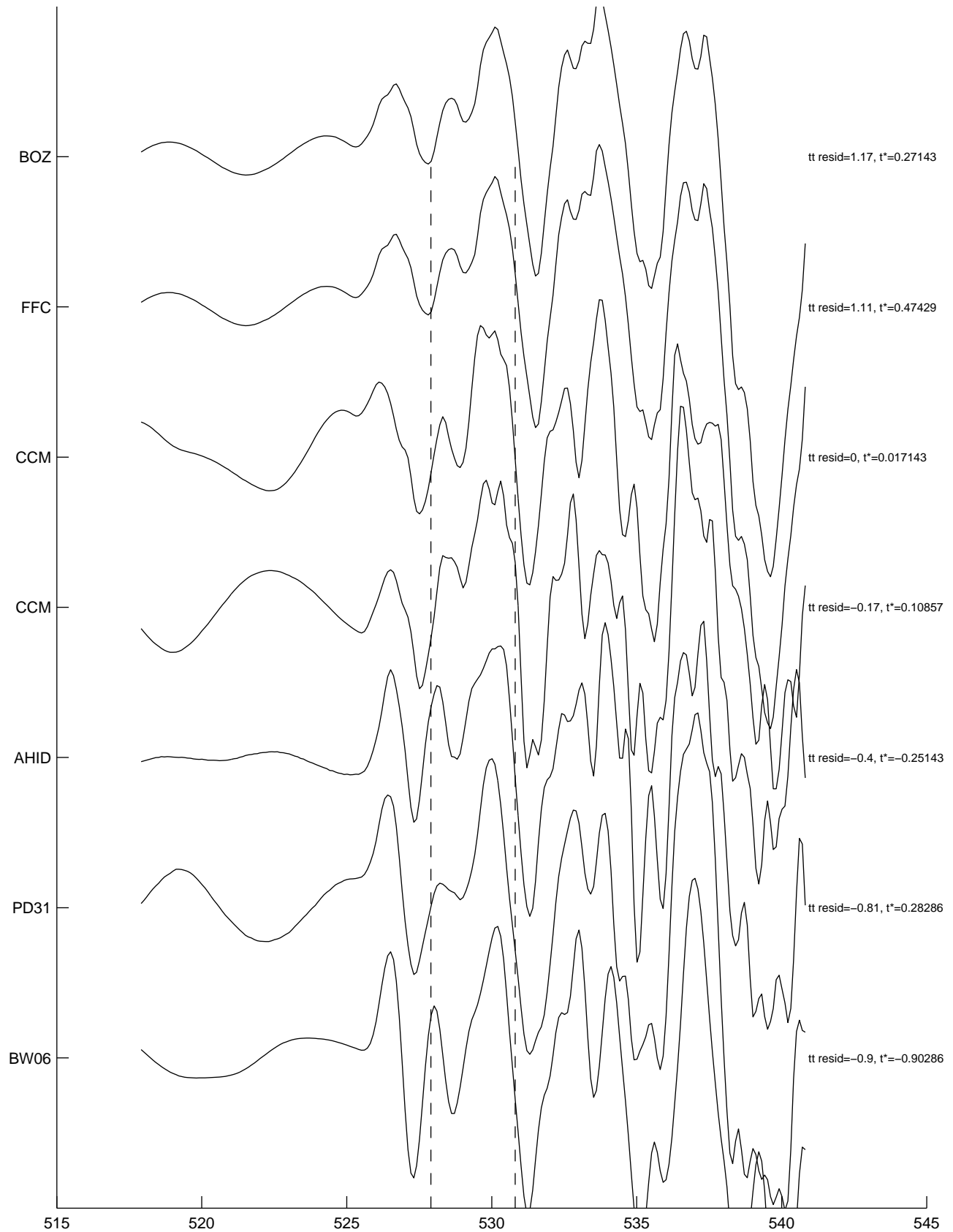
# Event\_2003\_321\_06\_43\_06



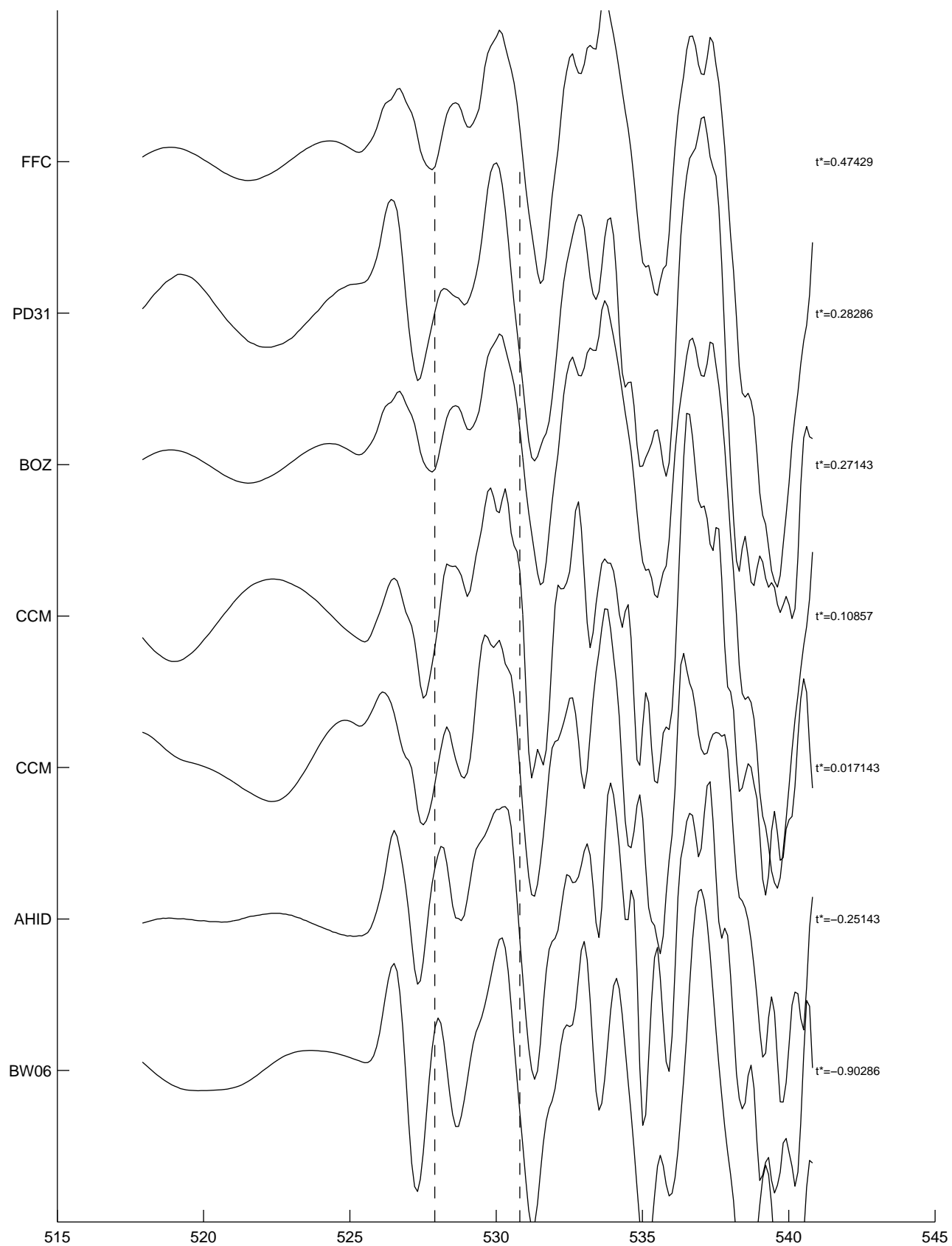
# Sorted by Delta:Event\_2003\_321\_06\_43\_06



# Sorted by travel time:Event\_2003\_321\_06\_43\_06

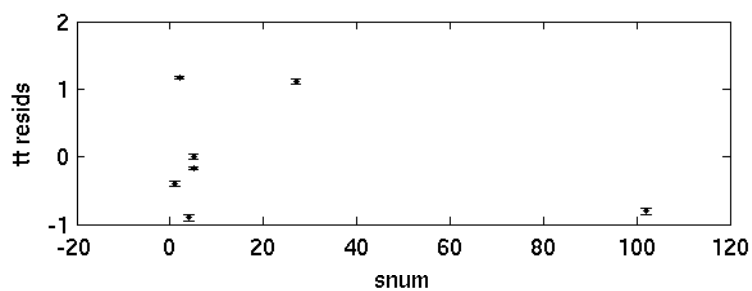
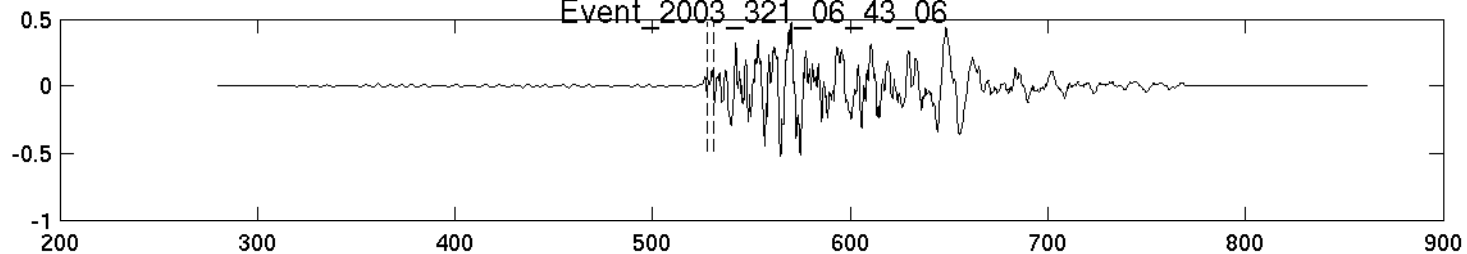


Sorted by  $t^*$ :Event\_2003\_321\_06\_43\_06

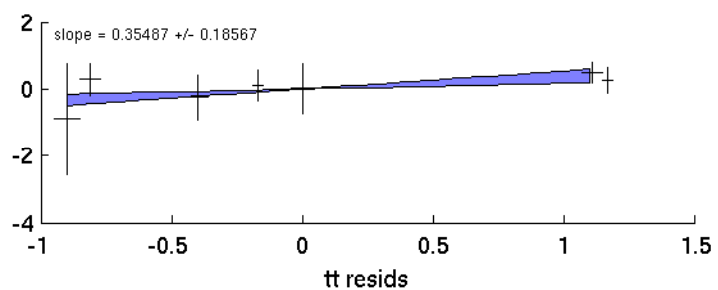
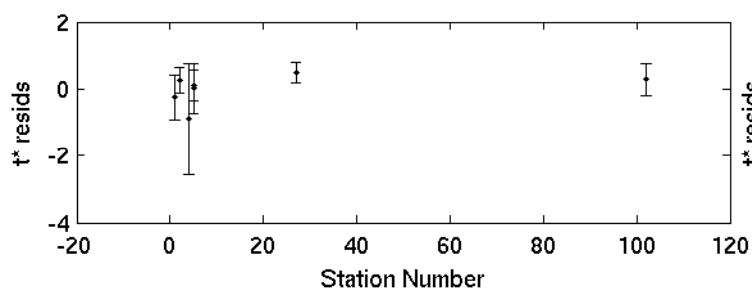


Event\_2003\_321\_06\_43\_06

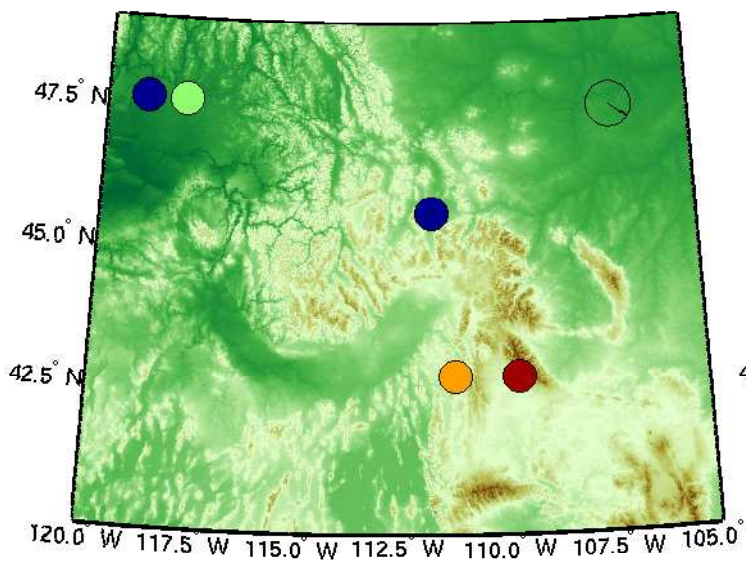
Stack



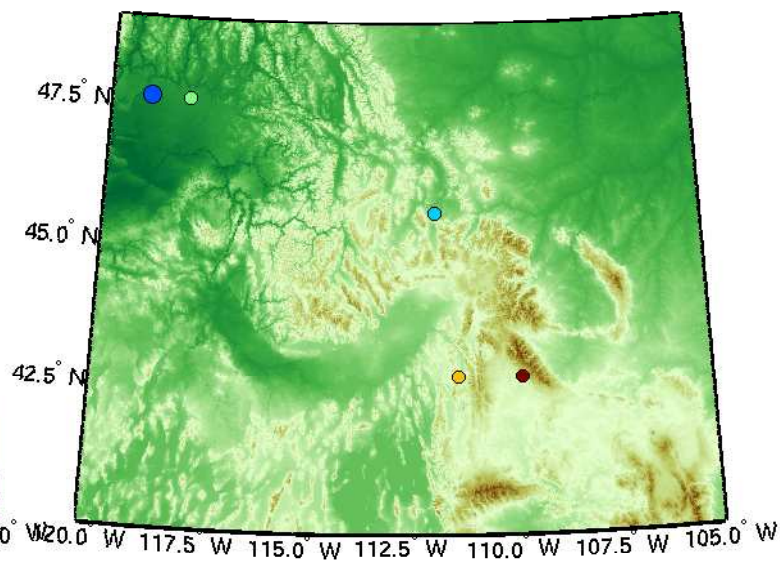
Baz = 306.3147  
Mean xcor value = 0.75714  
Range of  $t^*$  values is 1.3771  
Median  $t^*$  err is 0.46902  
Slope = 0.35487 +/- 0.18567



travel time residuals

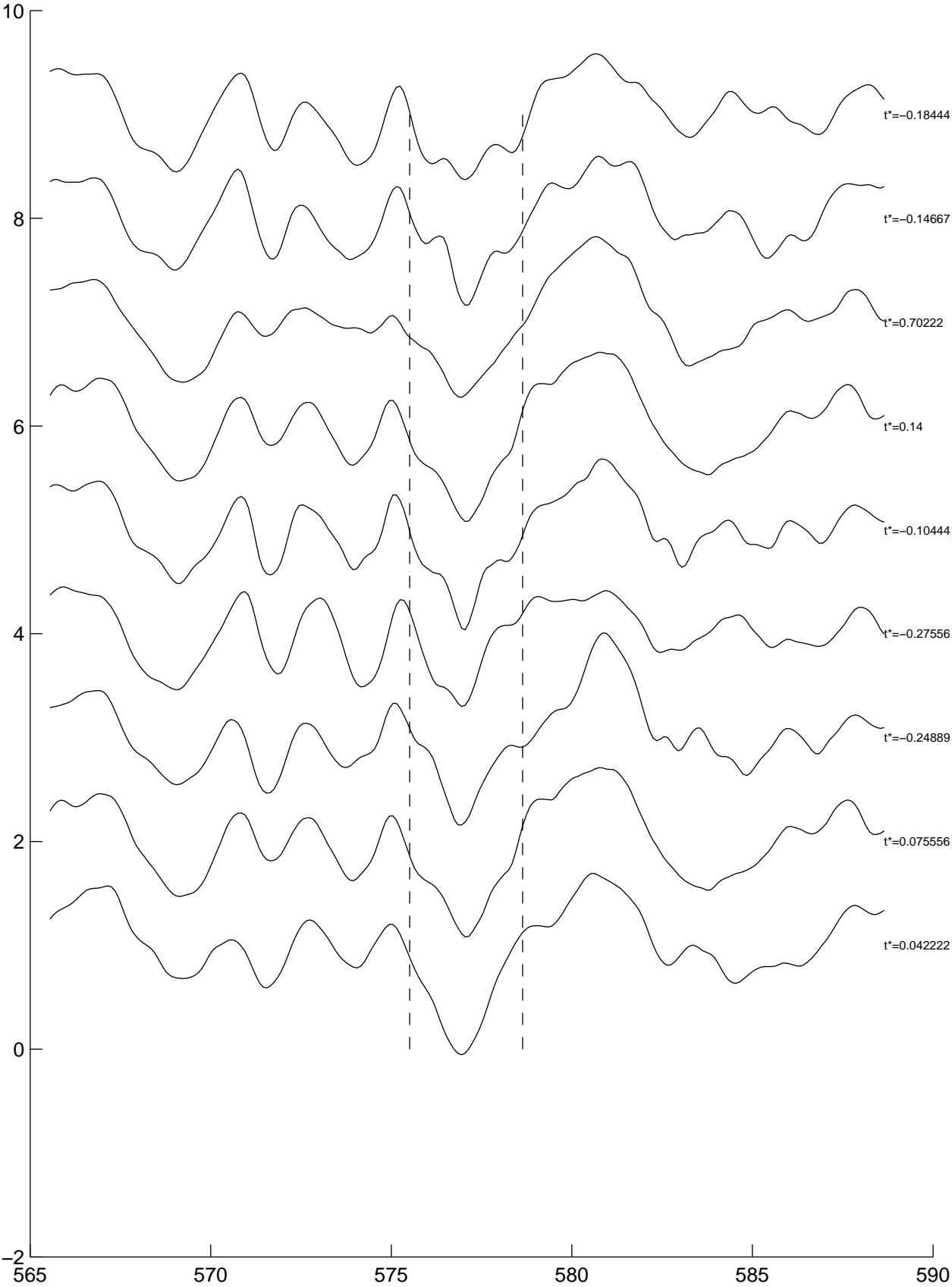


$t^*$  values

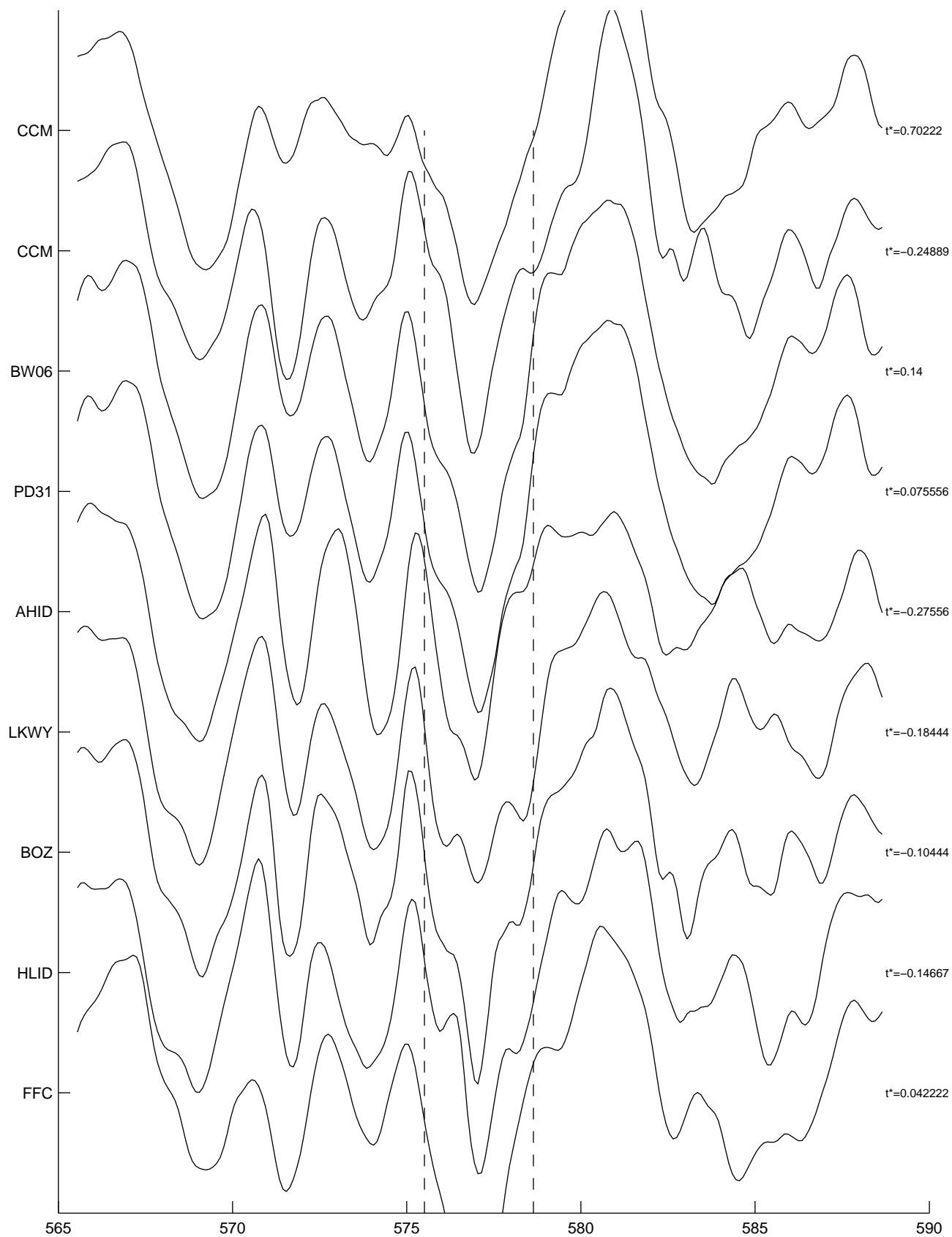




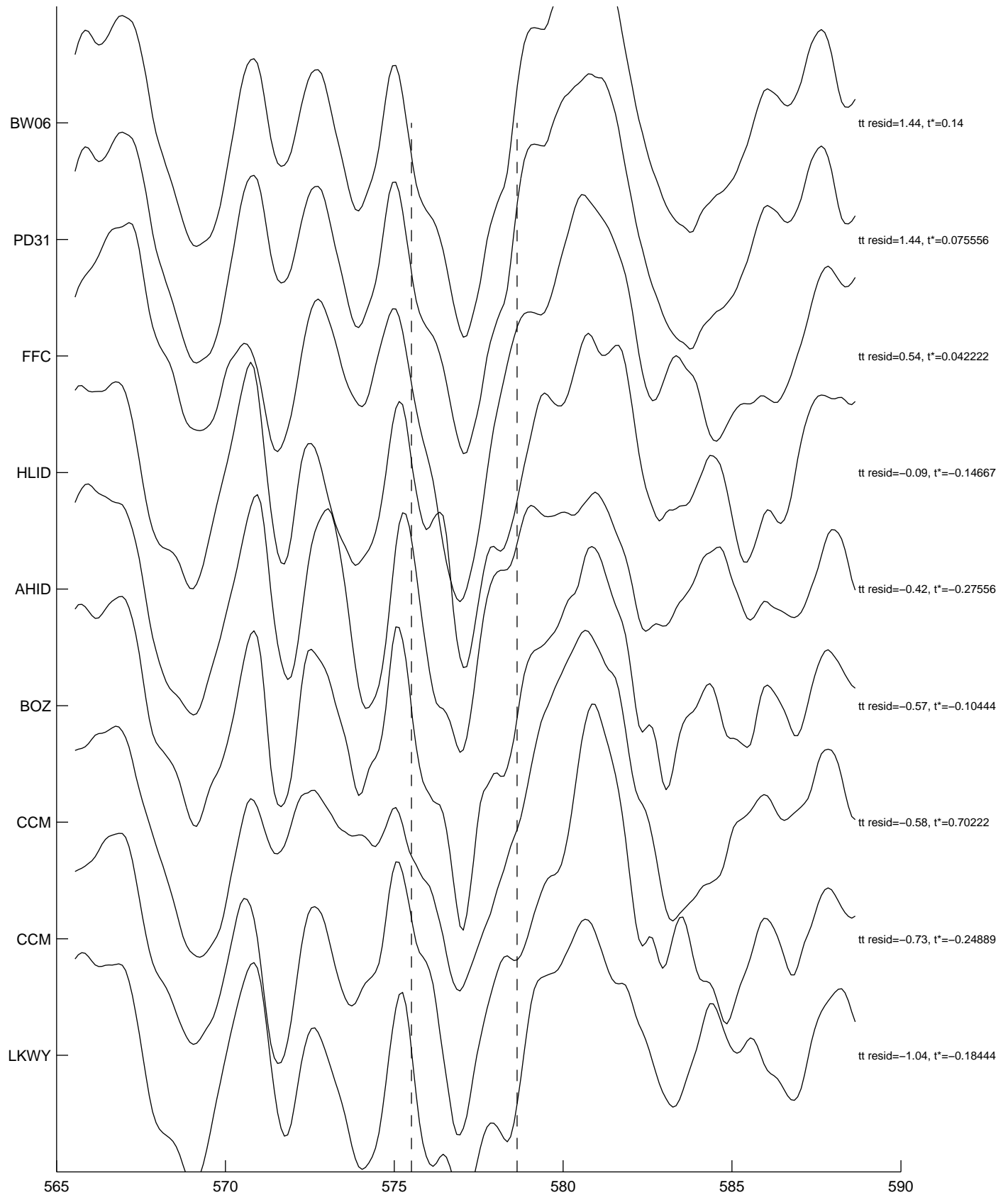
Event\_2003\_339\_21\_26\_09



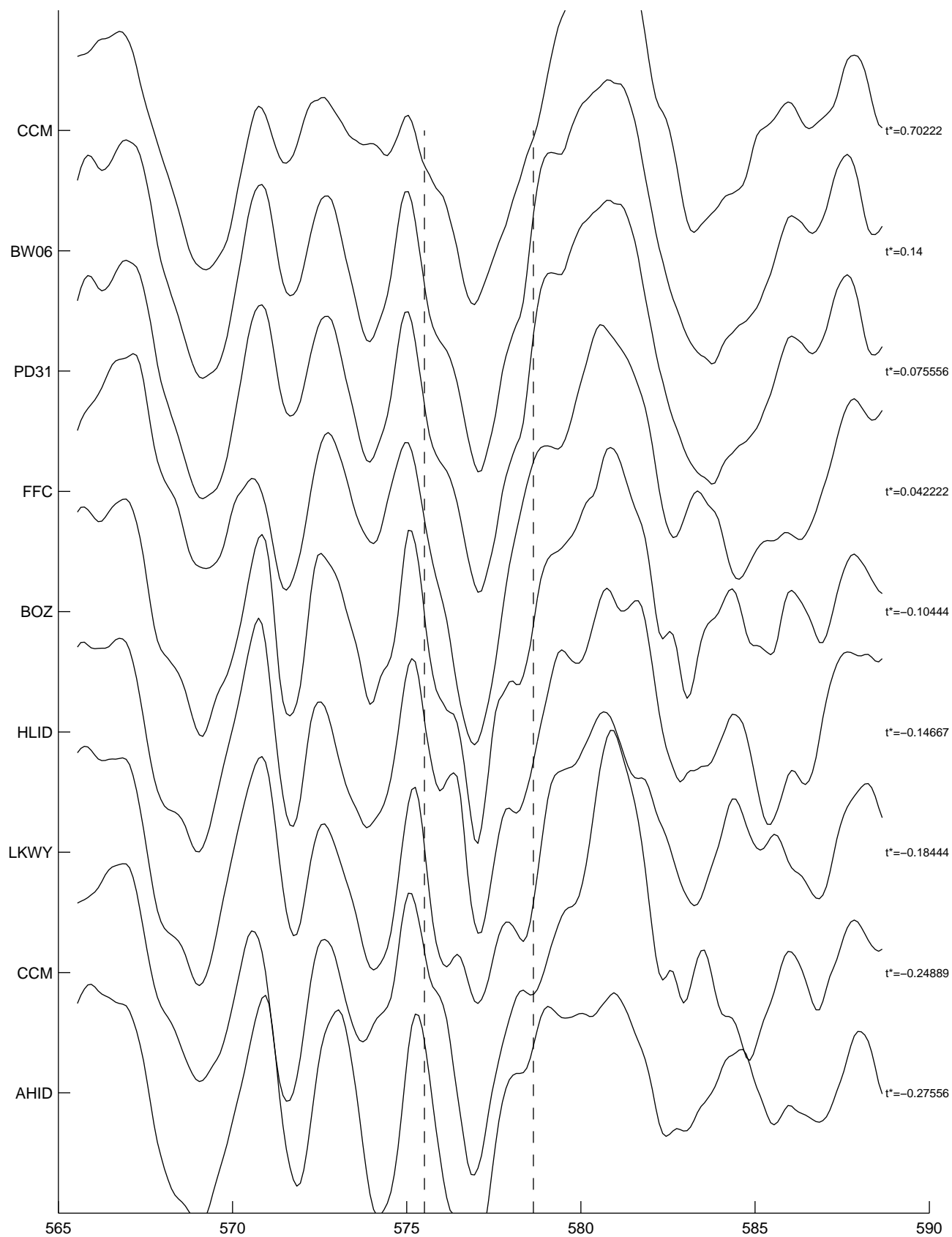
# Sorted by Delta:Event\_2003\_339\_21\_26\_09



# Sorted by travel time:Event\_2003\_339\_21\_26\_09

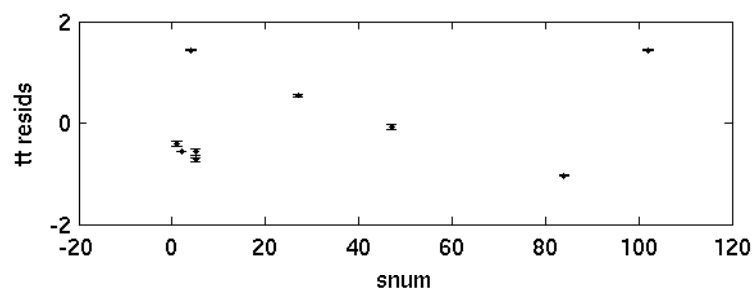
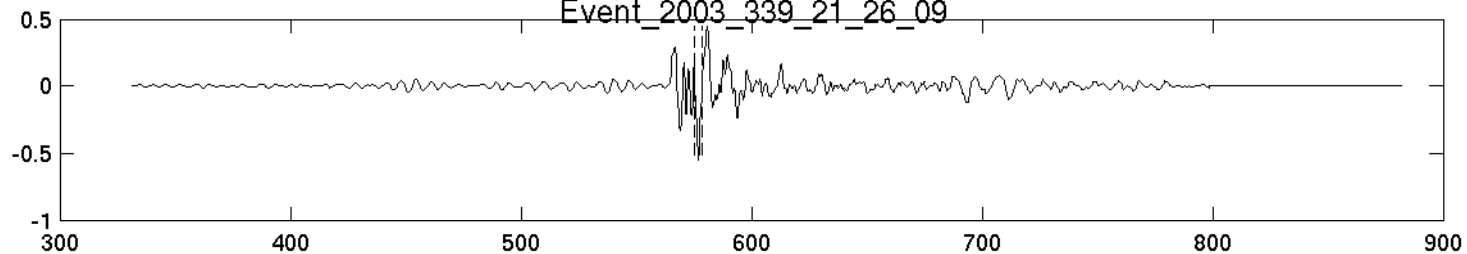


Sorted by t\*:Event\_2003\_339\_21\_26\_09

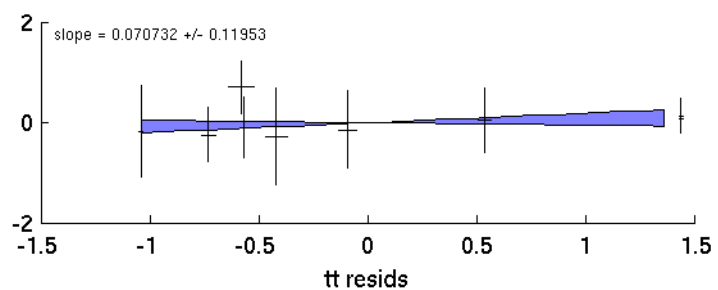
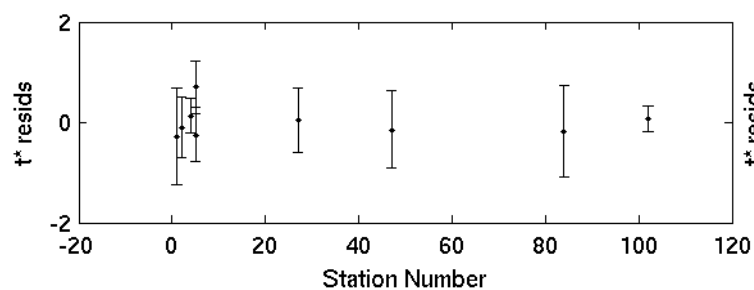


Event\_2003\_339\_21\_26\_09

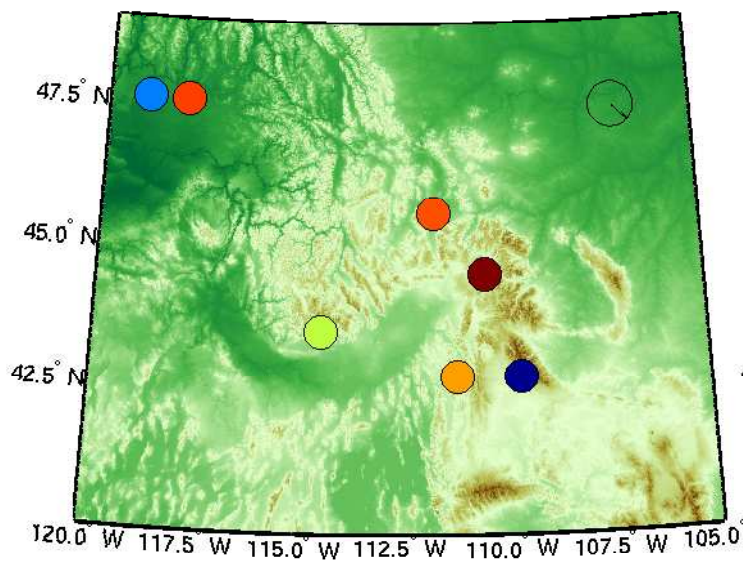
Stack



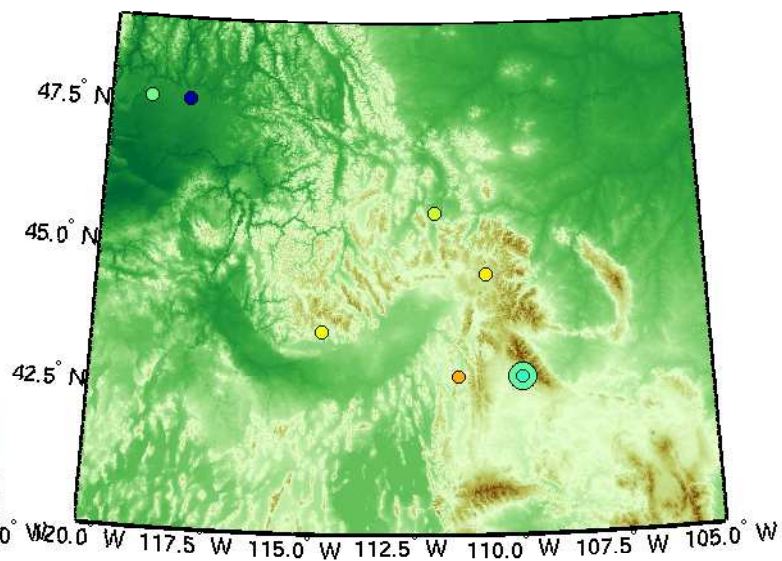
Baz = 315.3748  
Mean xcor value = 0.76333  
Range of  $t^*$  values is 0.97778  
Median  $t^*$  err is 0.60665  
Slope = 0.070732 +/- 0.11953



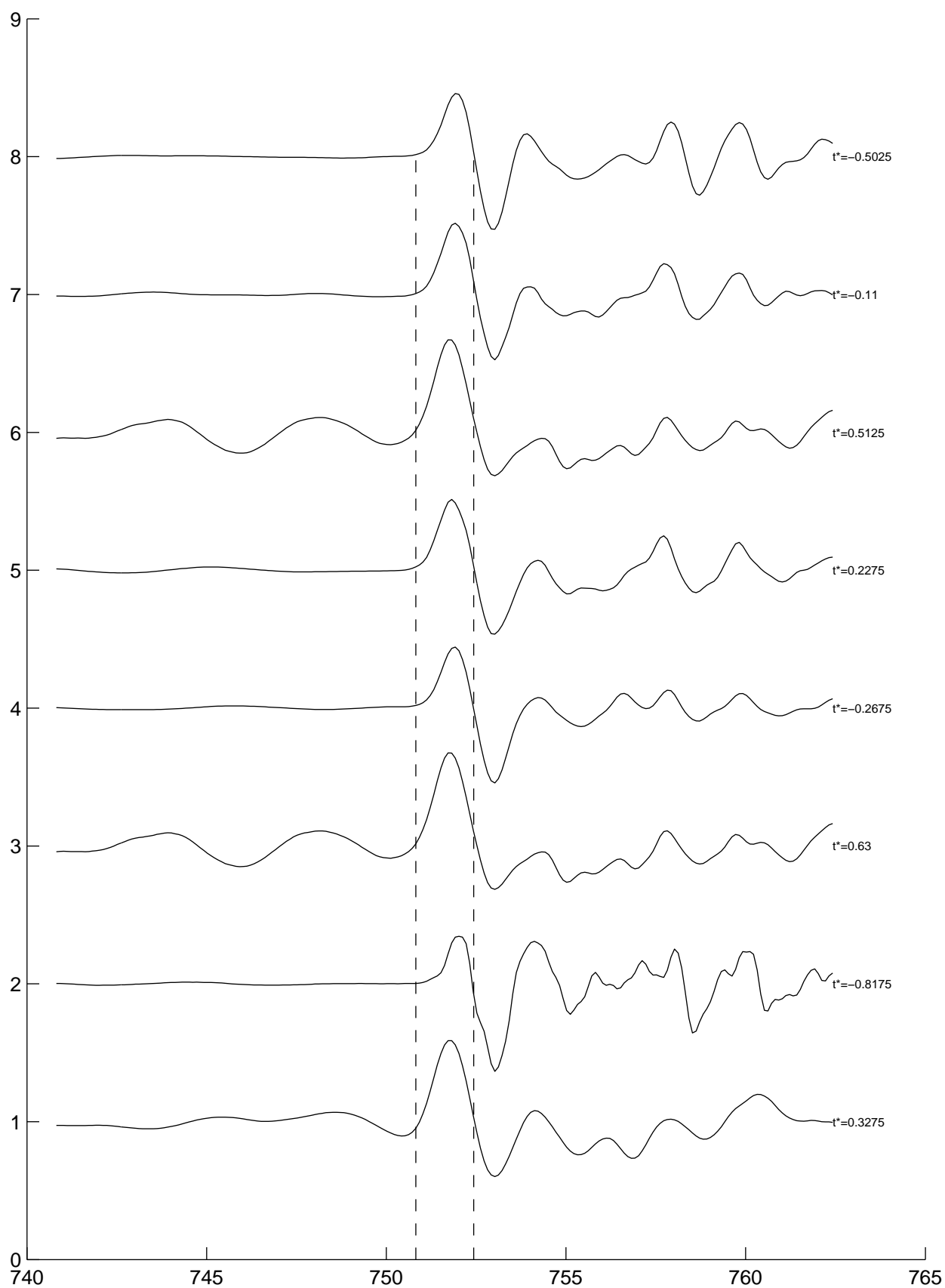
travel time residuals



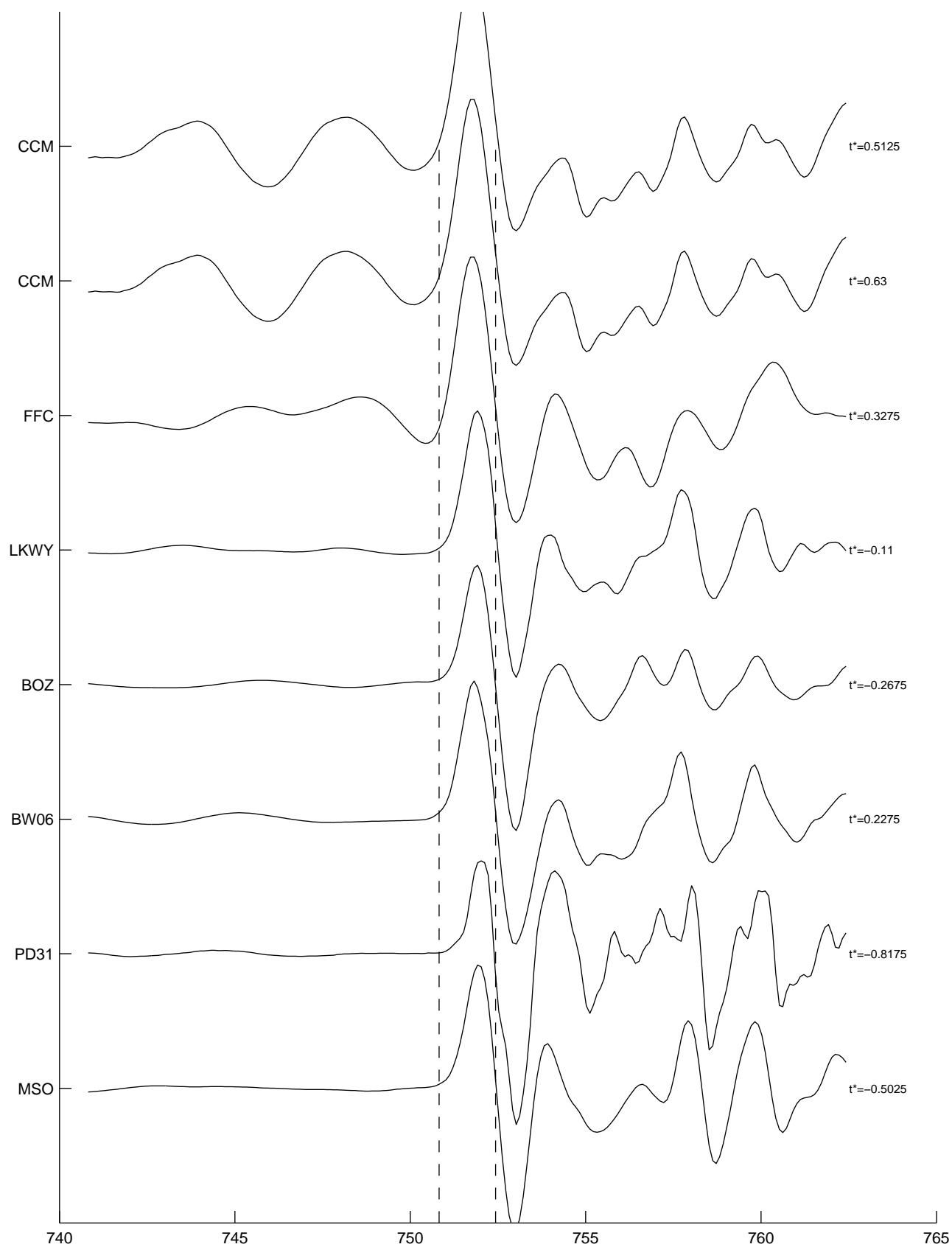
$t^*$  values



# Event\_2004\_025\_11\_43\_11

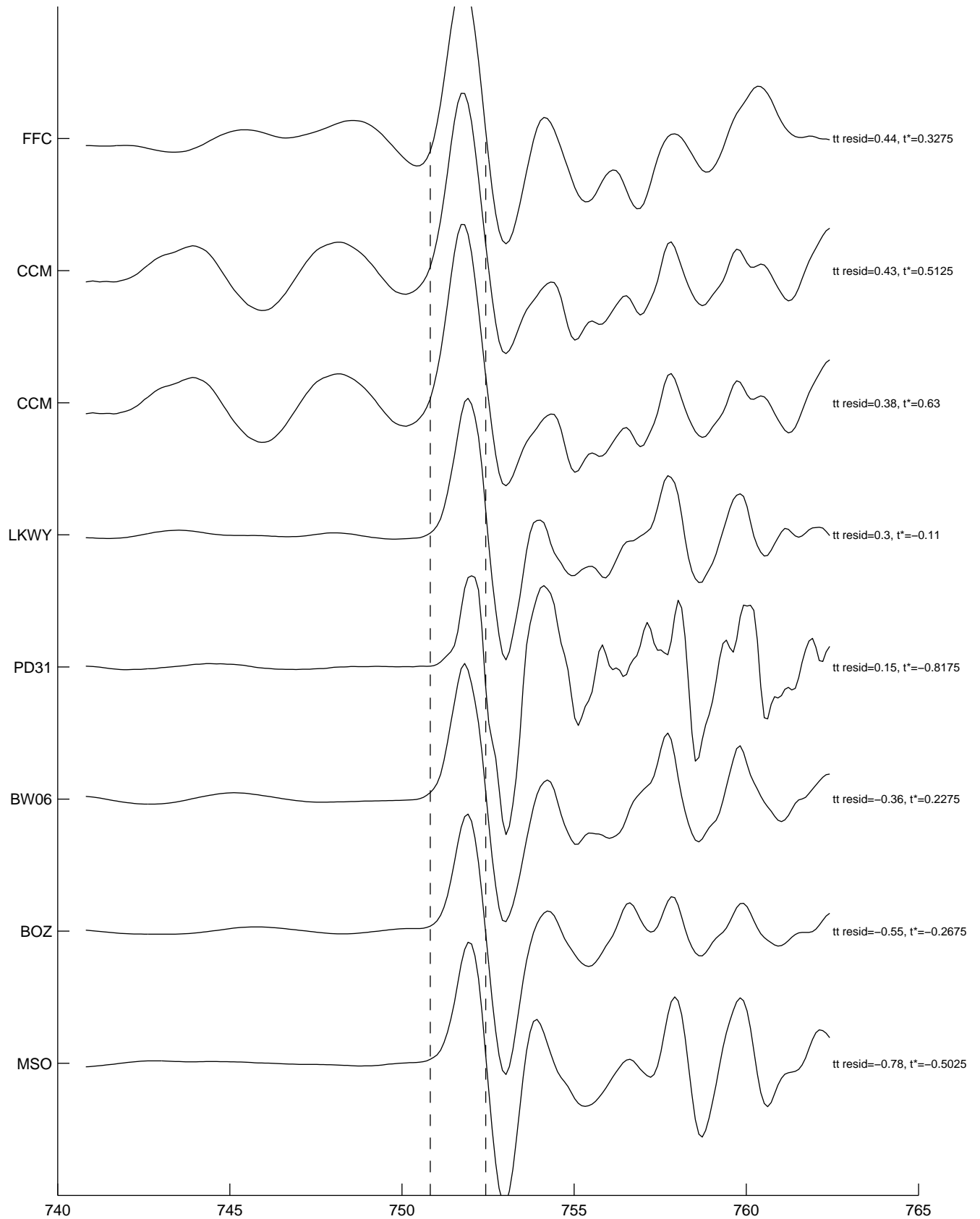


# Sorted by Delta:Event\_2004\_025\_11\_43\_11

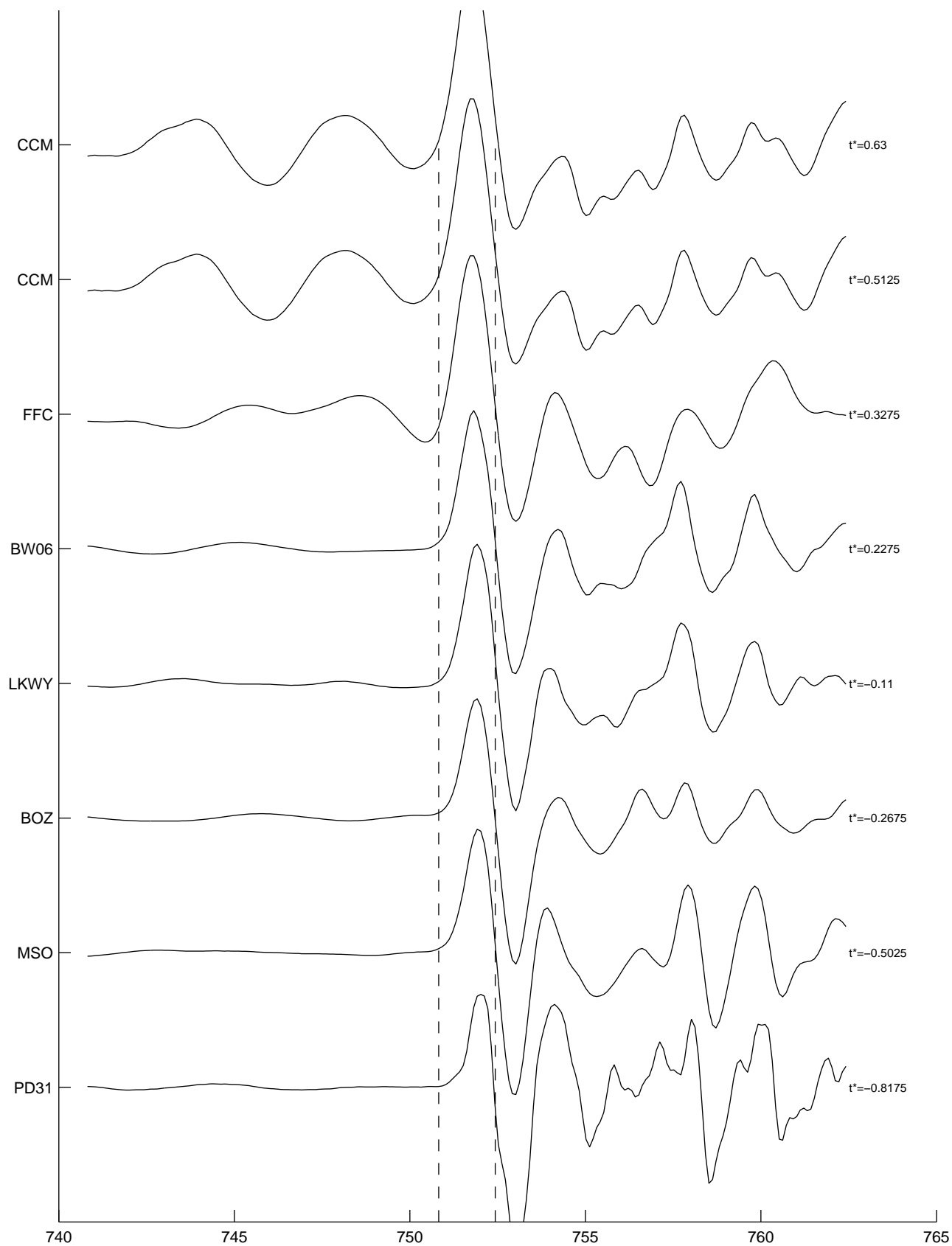




# Sorted by travel time:Event\_2004\_025\_11\_43\_11

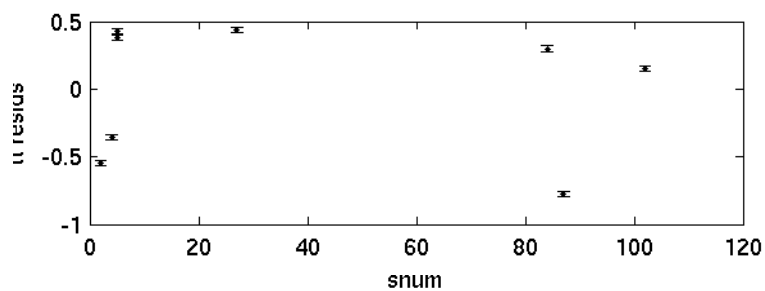
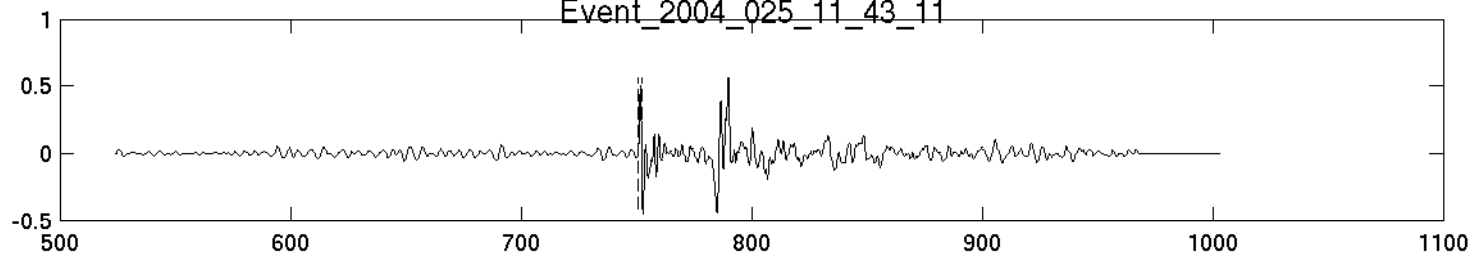


Sorted by  $t^*$ :Event\_2004\_025\_11\_43\_11

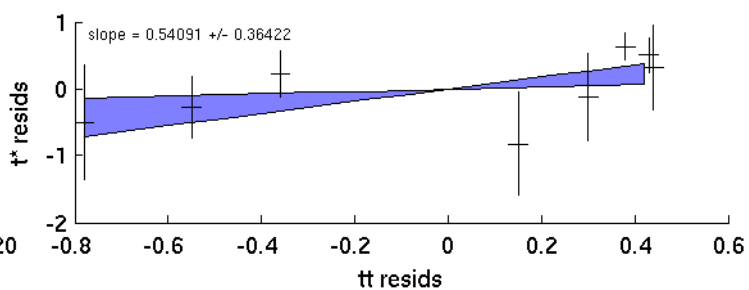
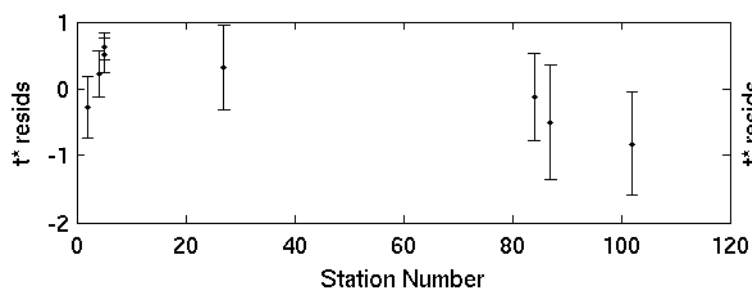


Event\_2004\_025\_11\_43\_11

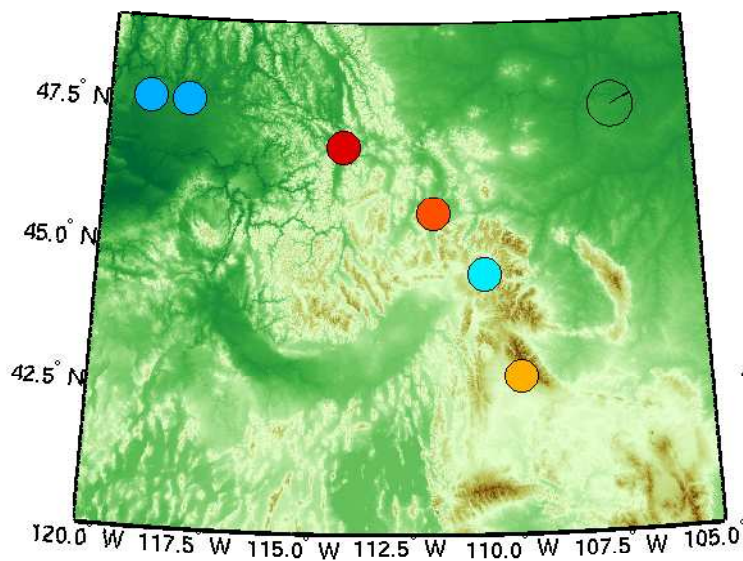
Stack



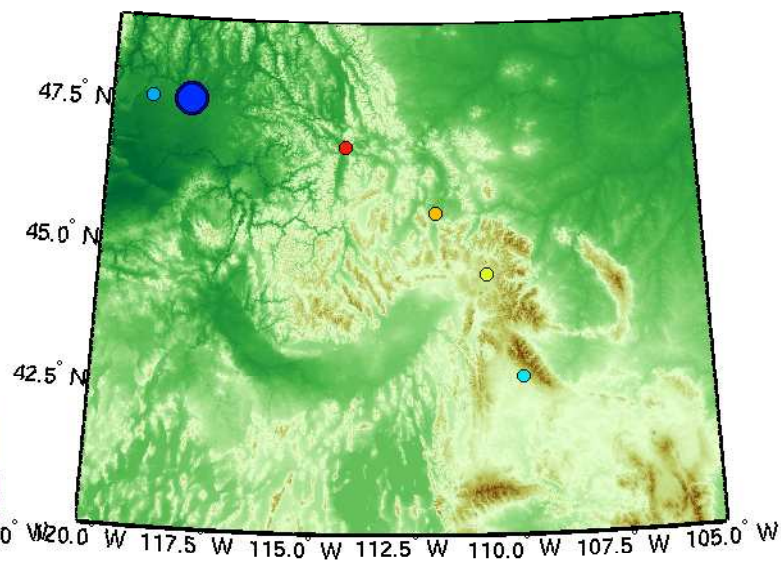
Baz = 242.9144  
Mean xcor value = 0.72875  
Range of  $t^*$  values is 1.4475  
Median  $t^*$  err is 0.54076  
Slope = 0.54091 +/- 0.36422



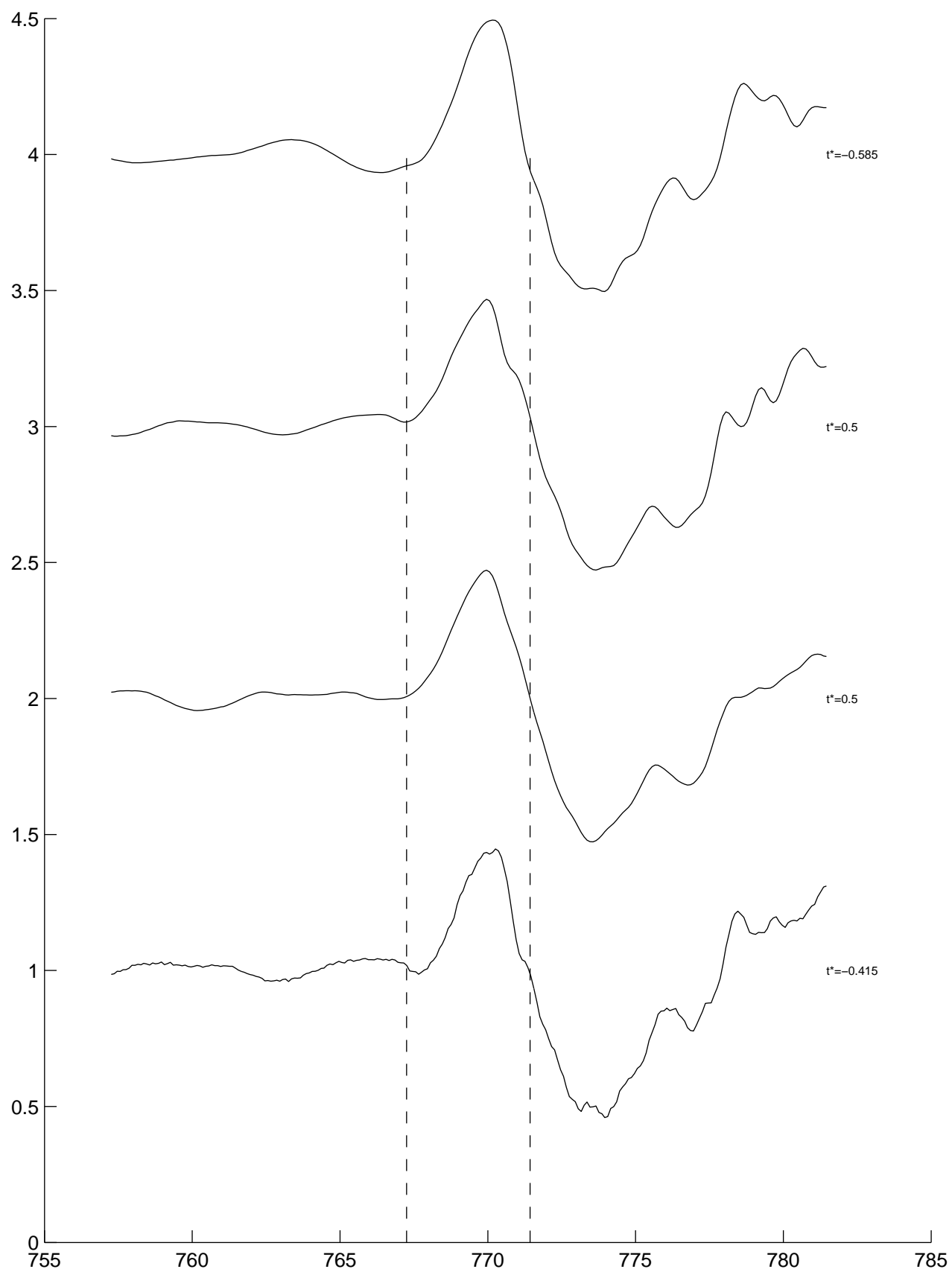
travel time residuals



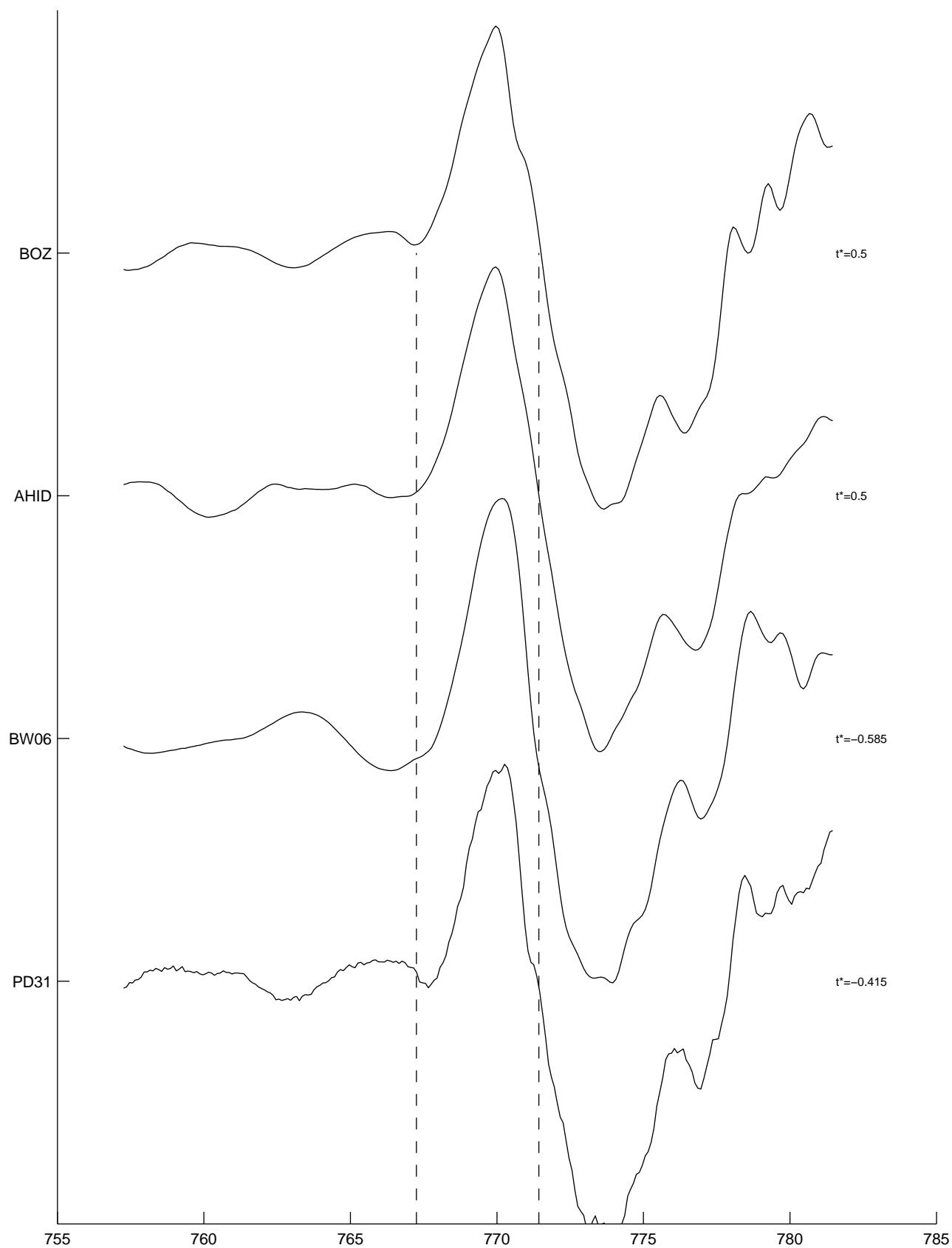
$t^*$  values



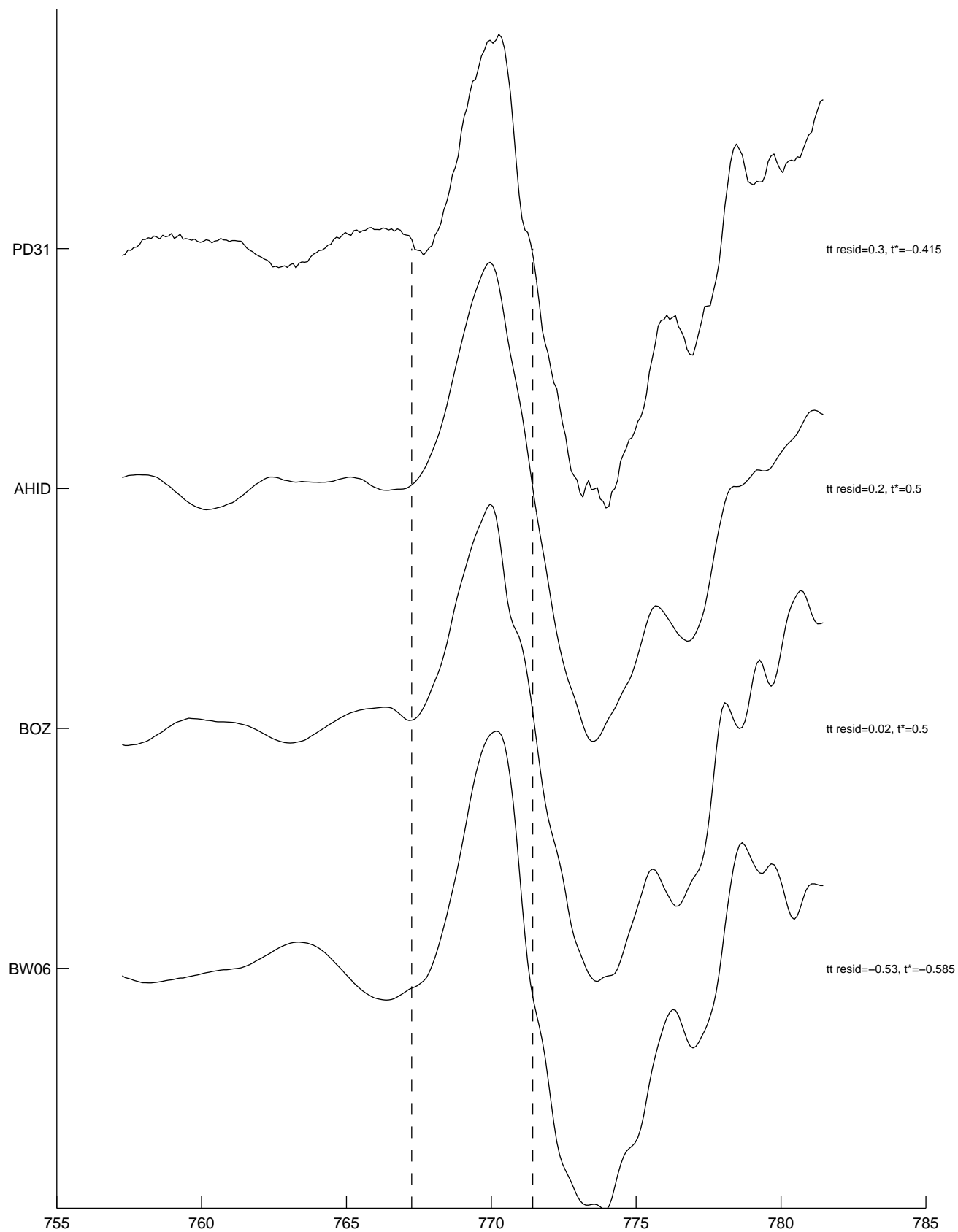
# Event\_2004\_124\_04\_36\_50



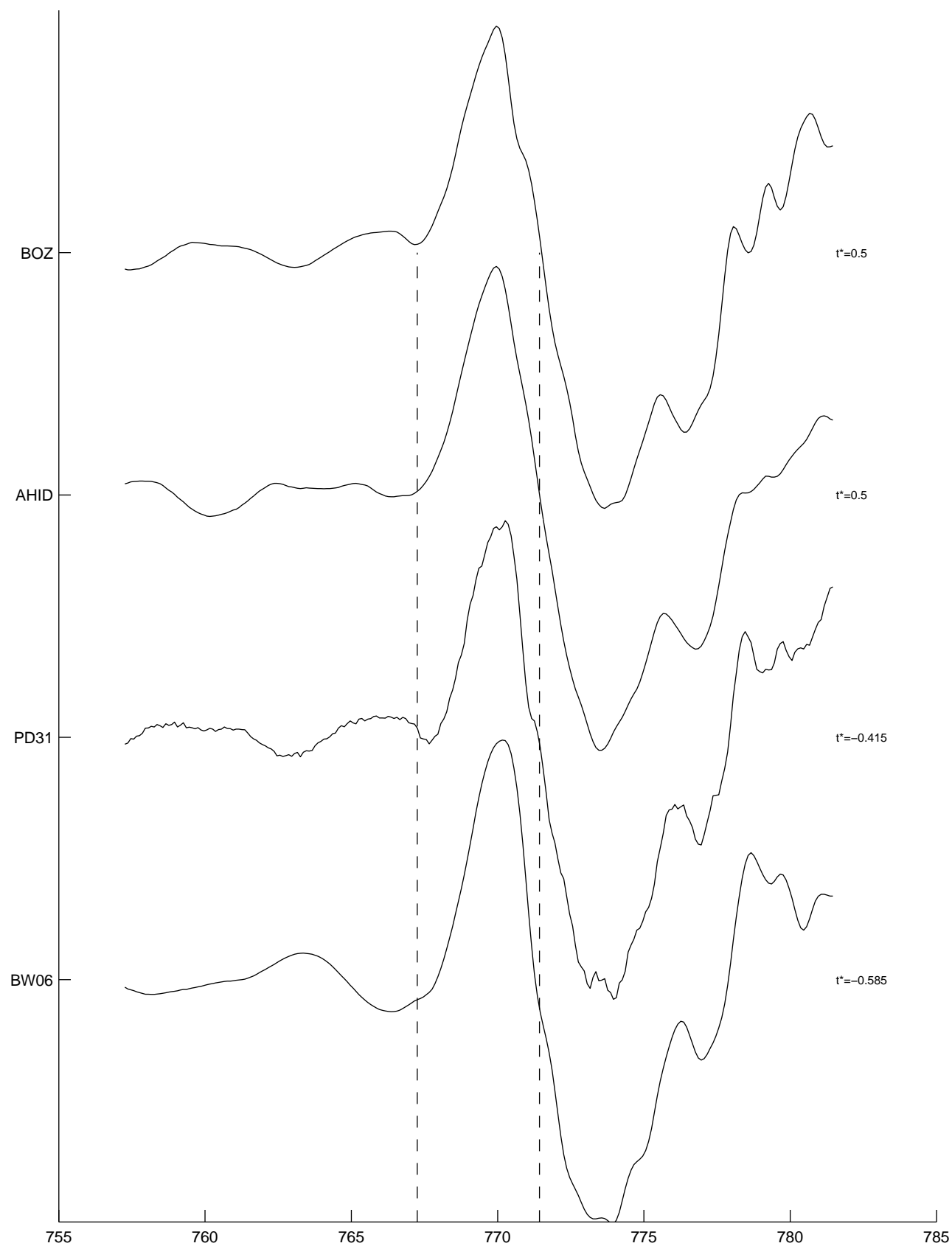
# Sorted by Delta:Event\_2004\_124\_04\_36\_50



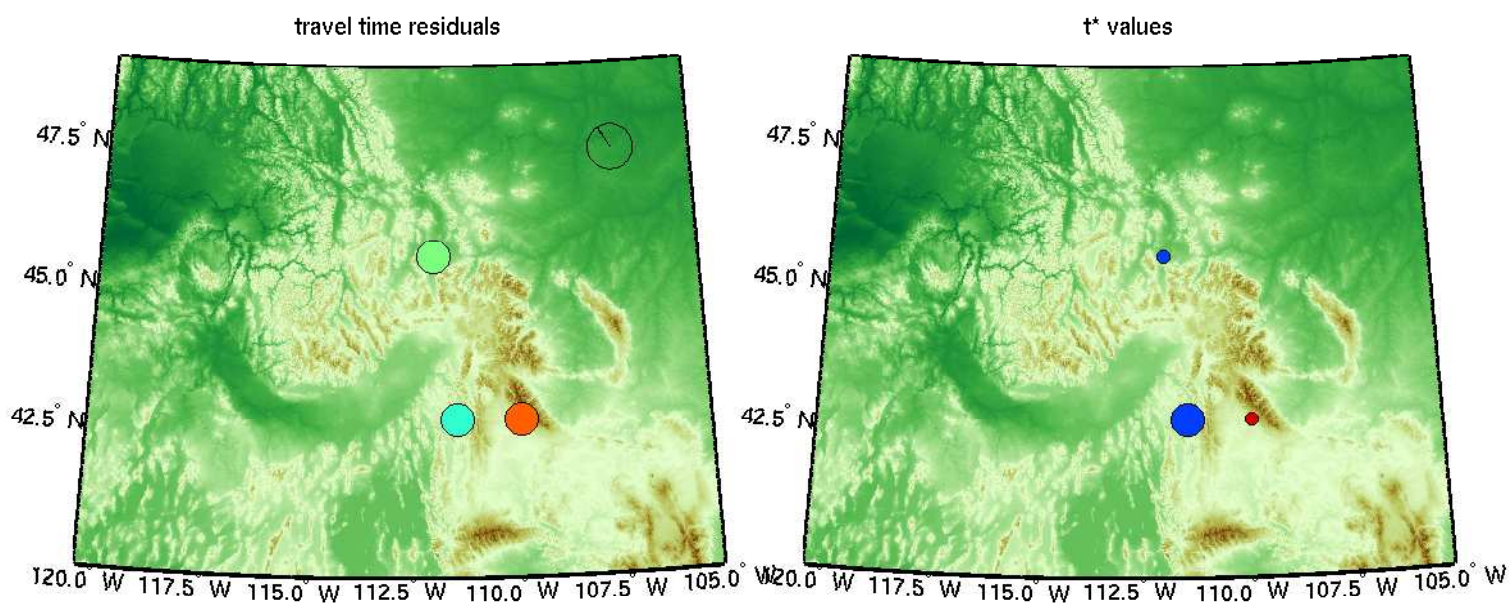
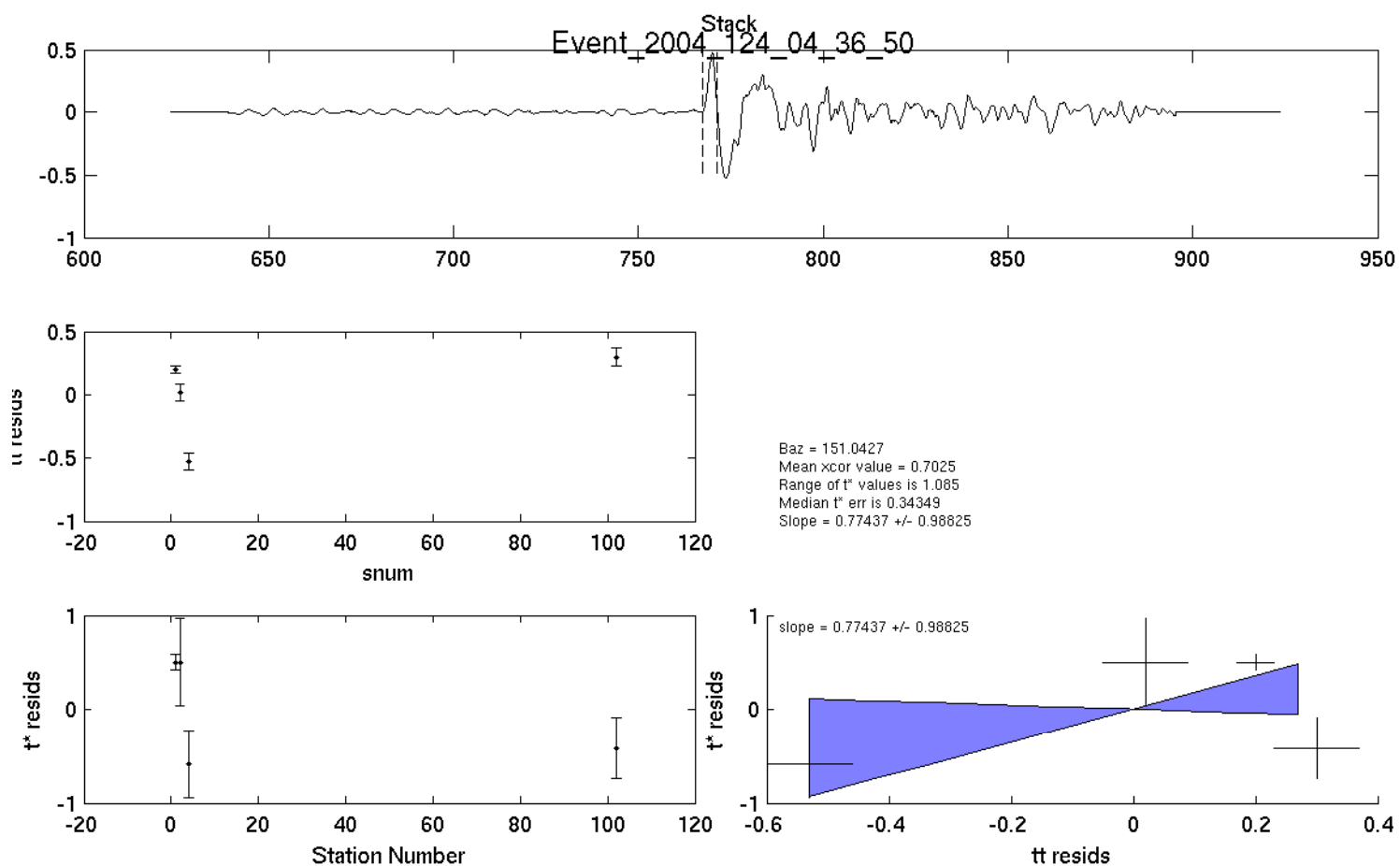
# Sorted by travel time:Event\_2004\_124\_04\_36\_50



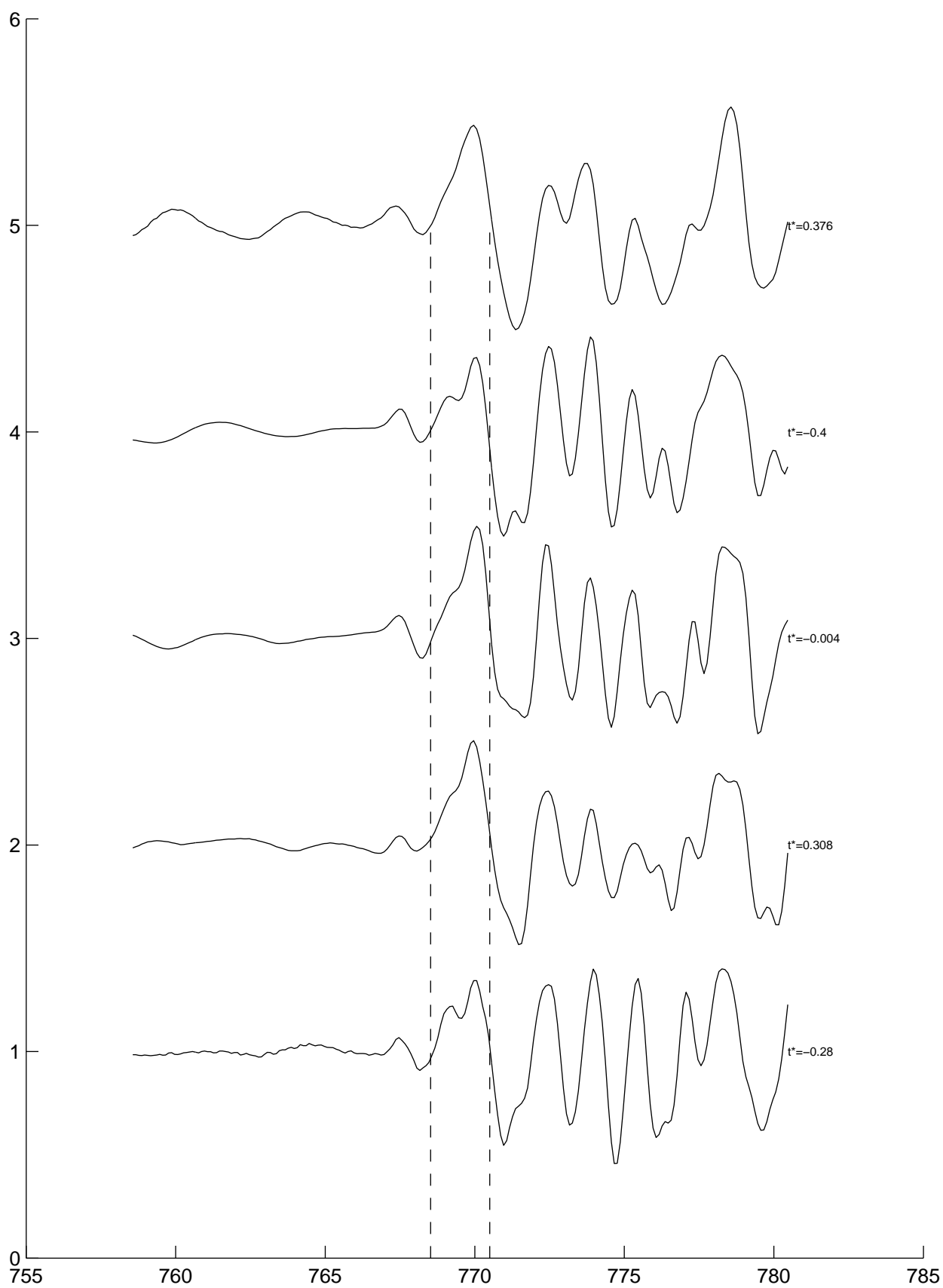
Sorted by  $t^*$ :Event\_2004\_124\_04\_36\_50



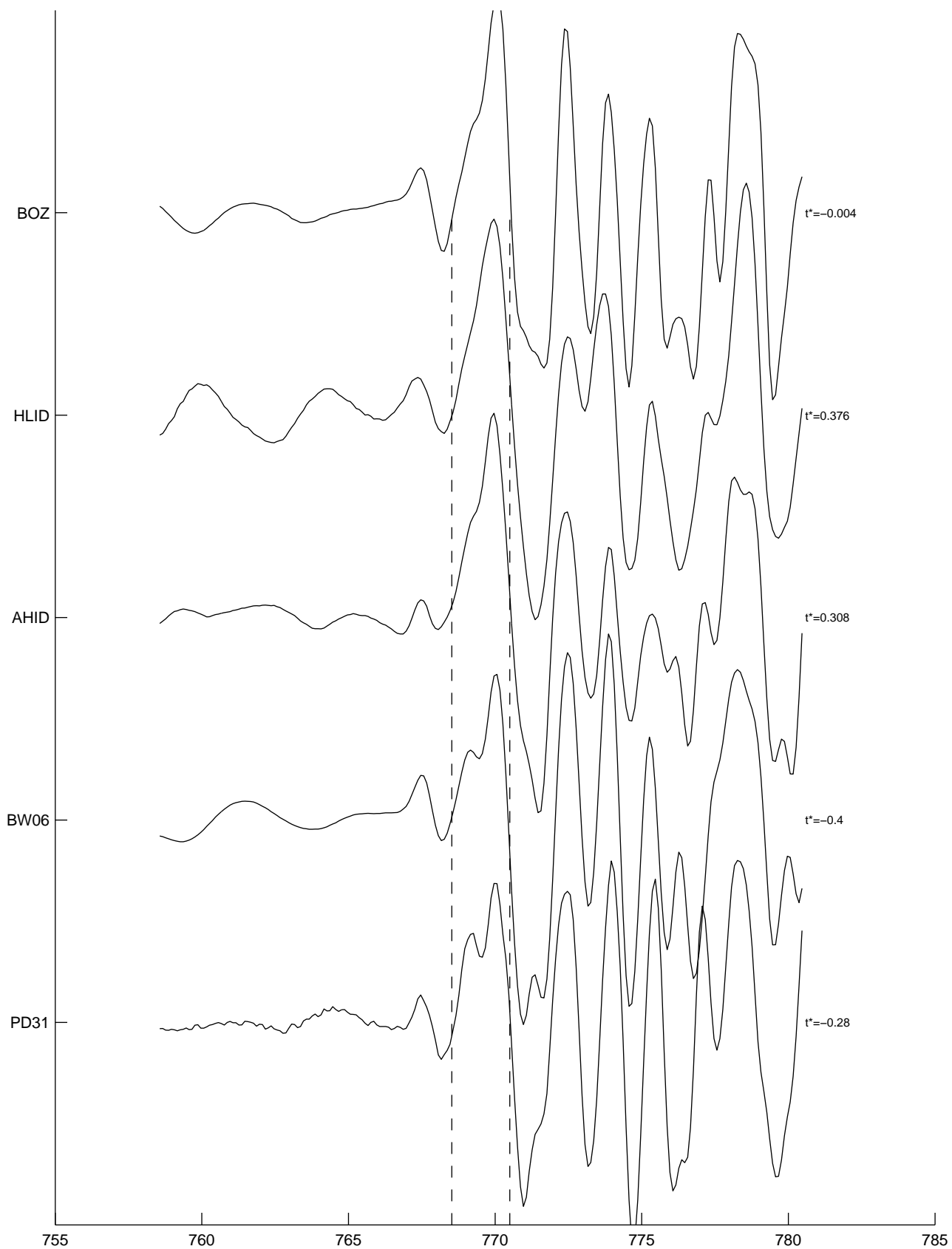




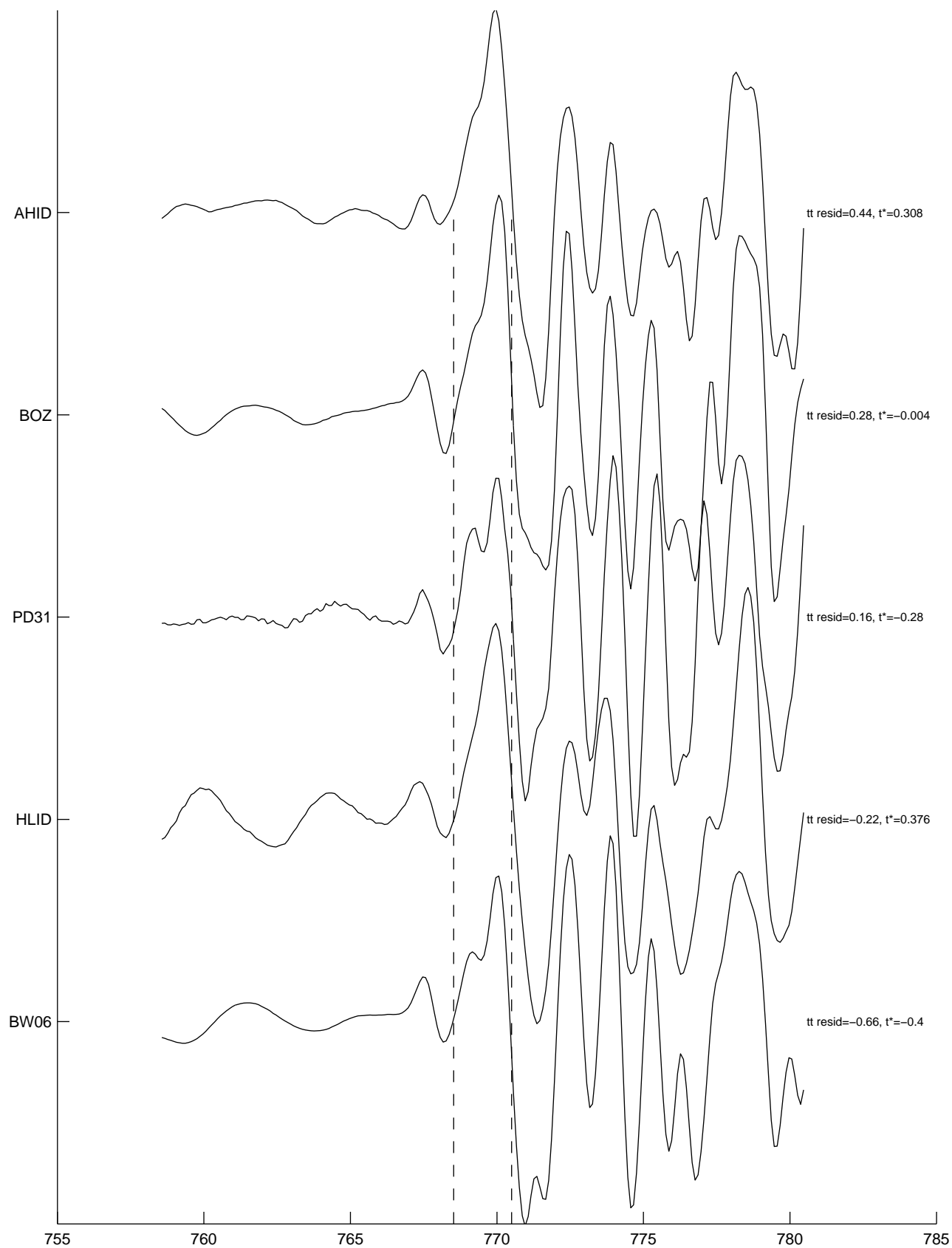
# Event\_2004\_241\_13\_41\_27



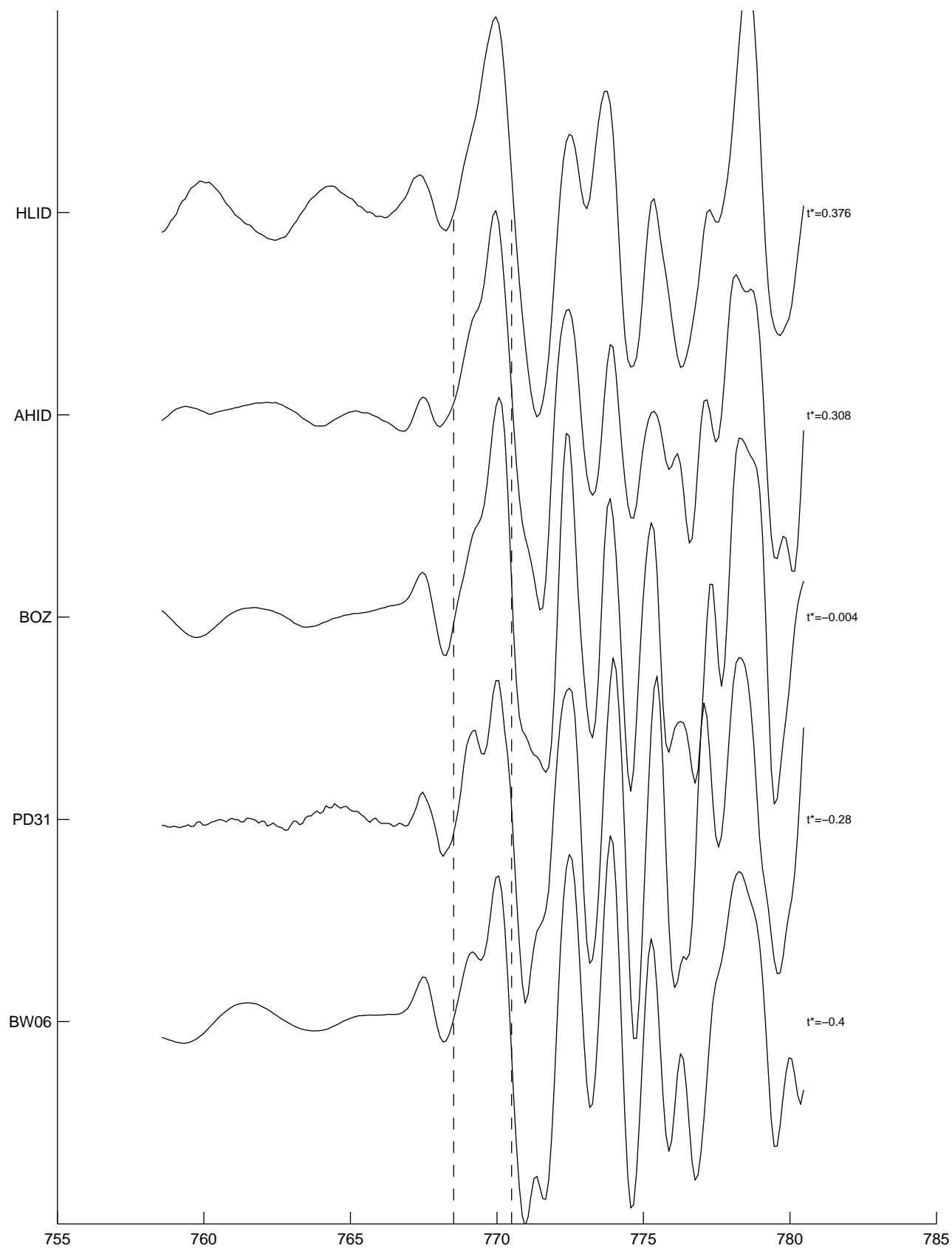
# Sorted by Delta:Event\_2004\_241\_13\_41\_27



# Sorted by travel time: Event\_2004\_241\_13\_41\_27

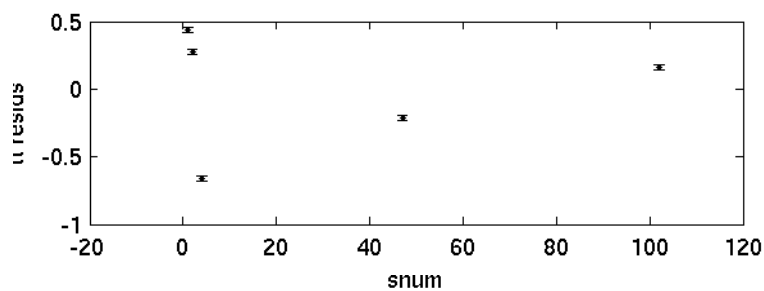
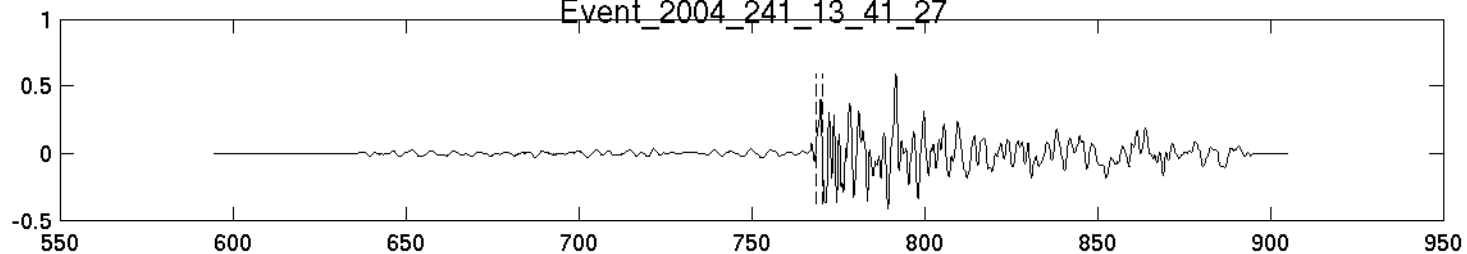


Sorted by t\*:Event\_2004\_241\_13\_41\_27

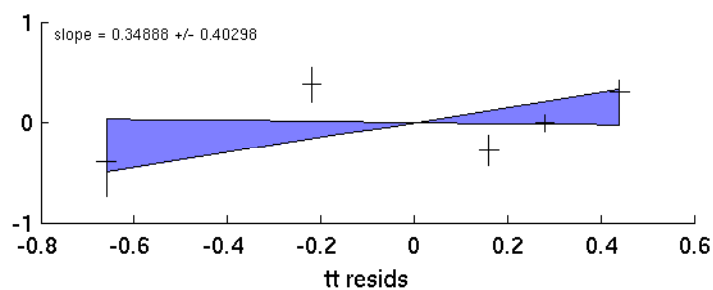
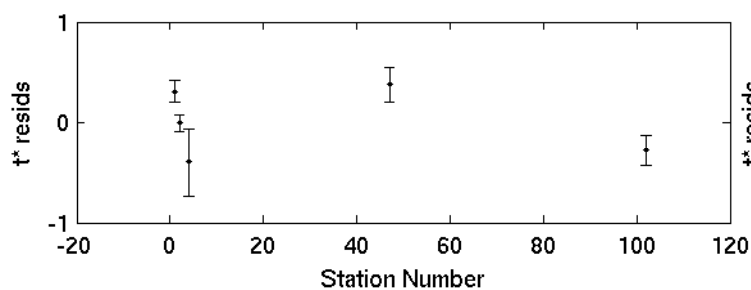


# Event\_2004\_241\_13\_41\_27

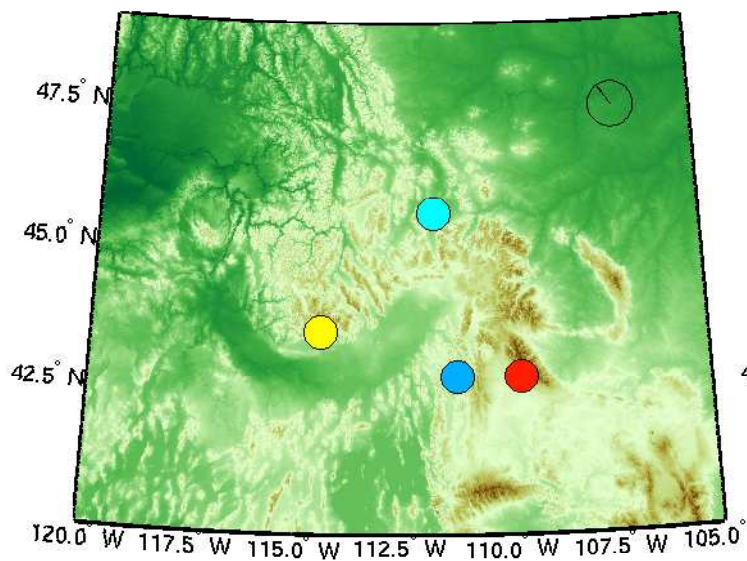
Stack



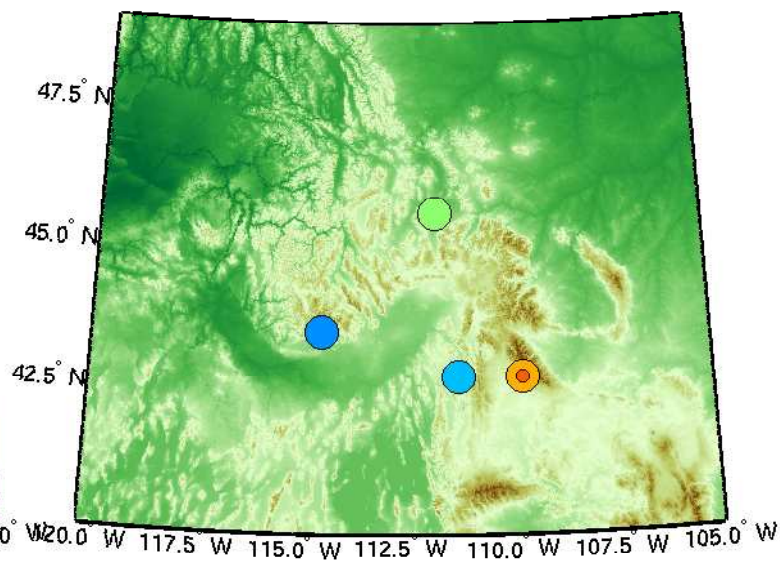
Baz = 147.1873  
Mean xcor value = 0.75  
Range of t\* values is 0.776  
Median t\* err is 0.15294  
Slope = 0.34888 +/- 0.40298



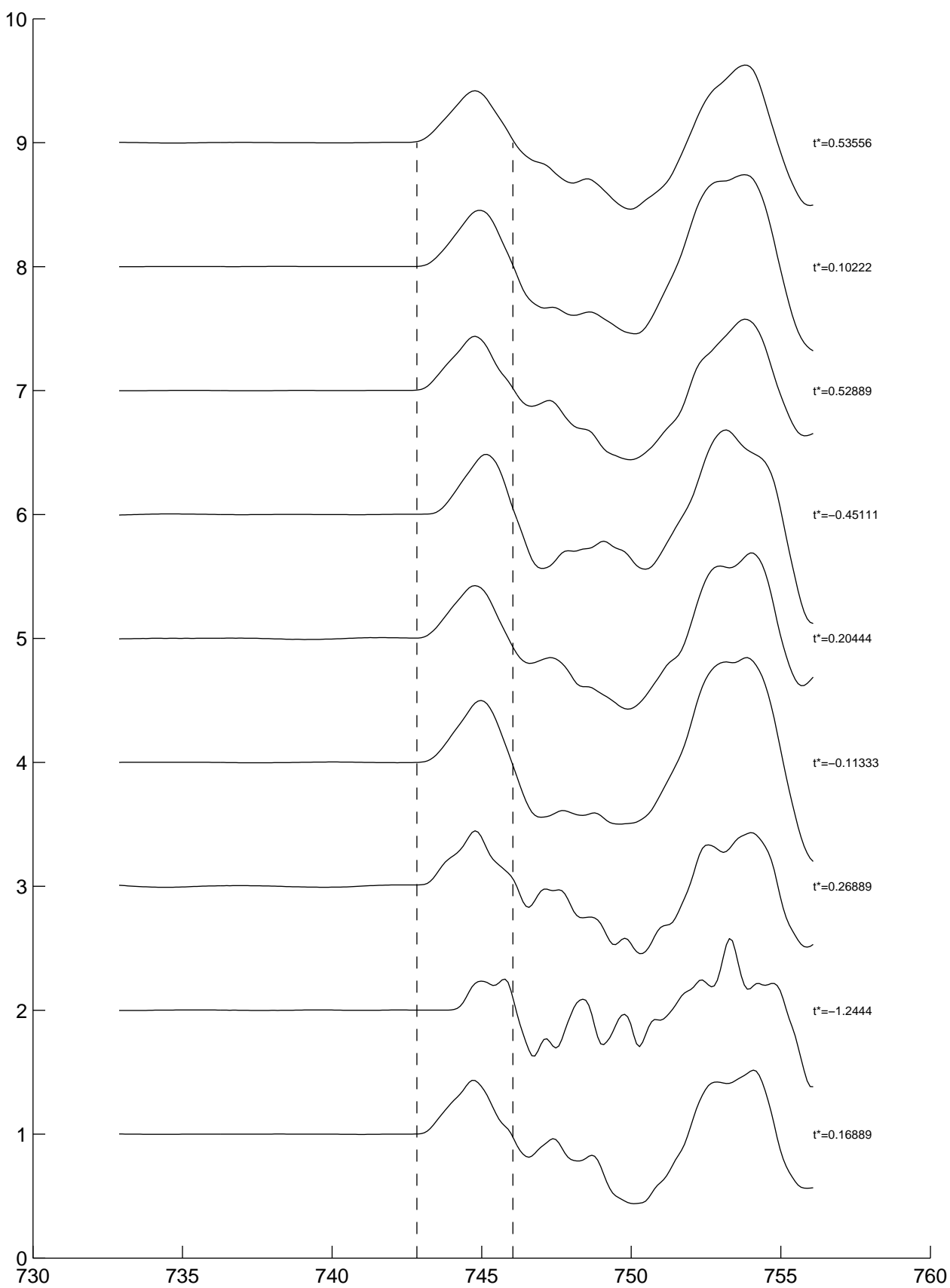
travel time residuals



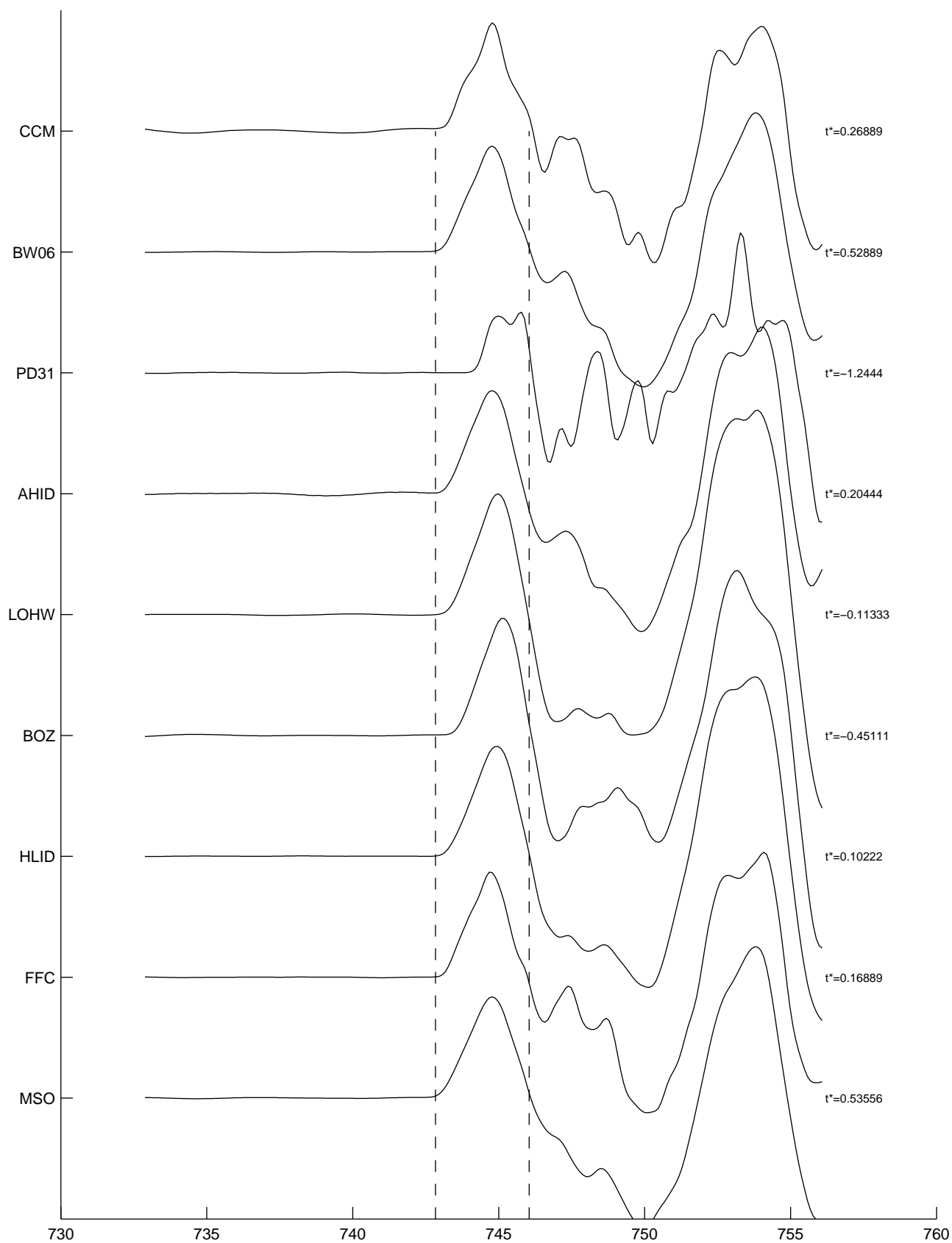
t\* values



# Event\_2004\_249\_10\_07\_07

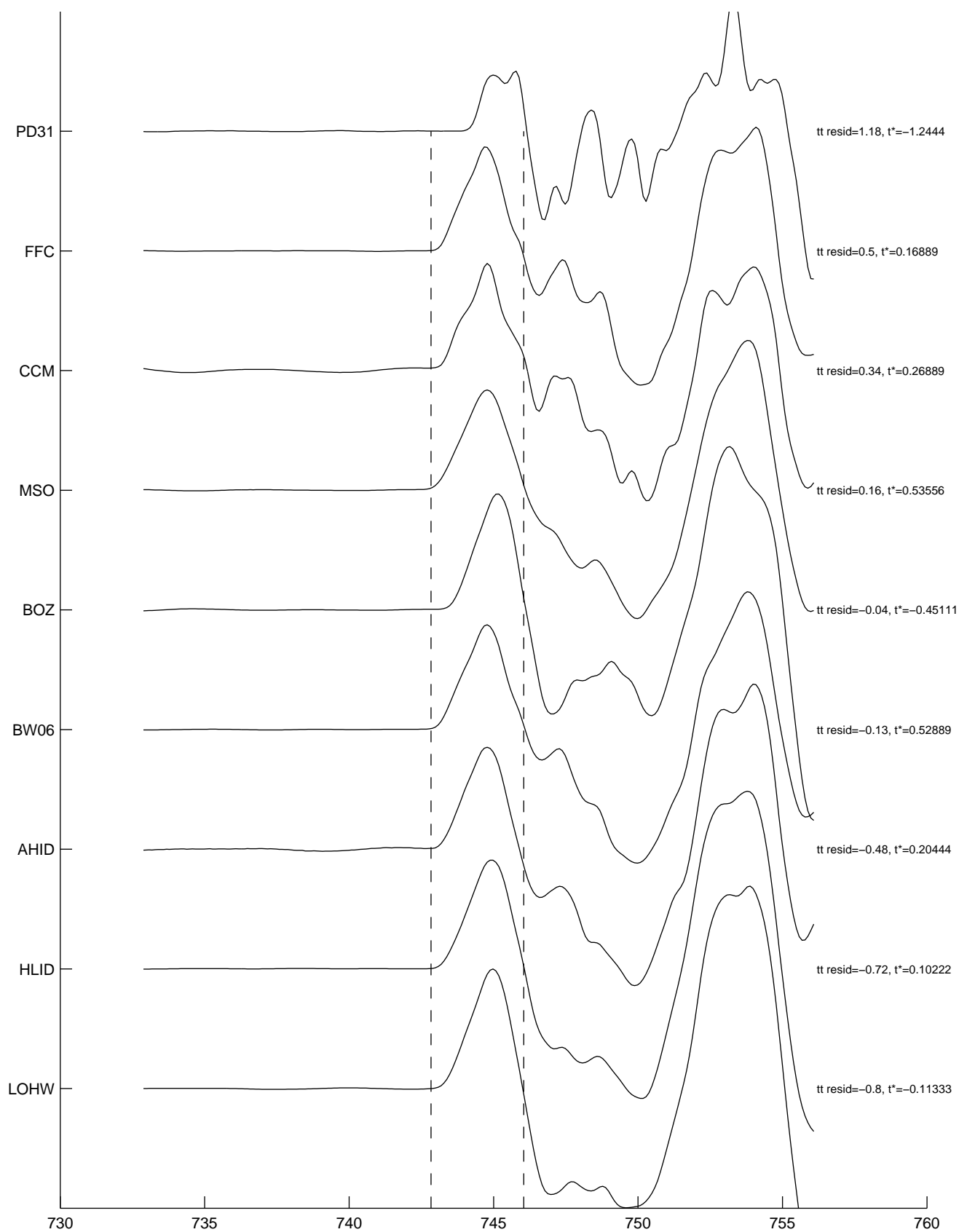


# Sorted by Delta:Event\_2004\_249\_10\_07\_07

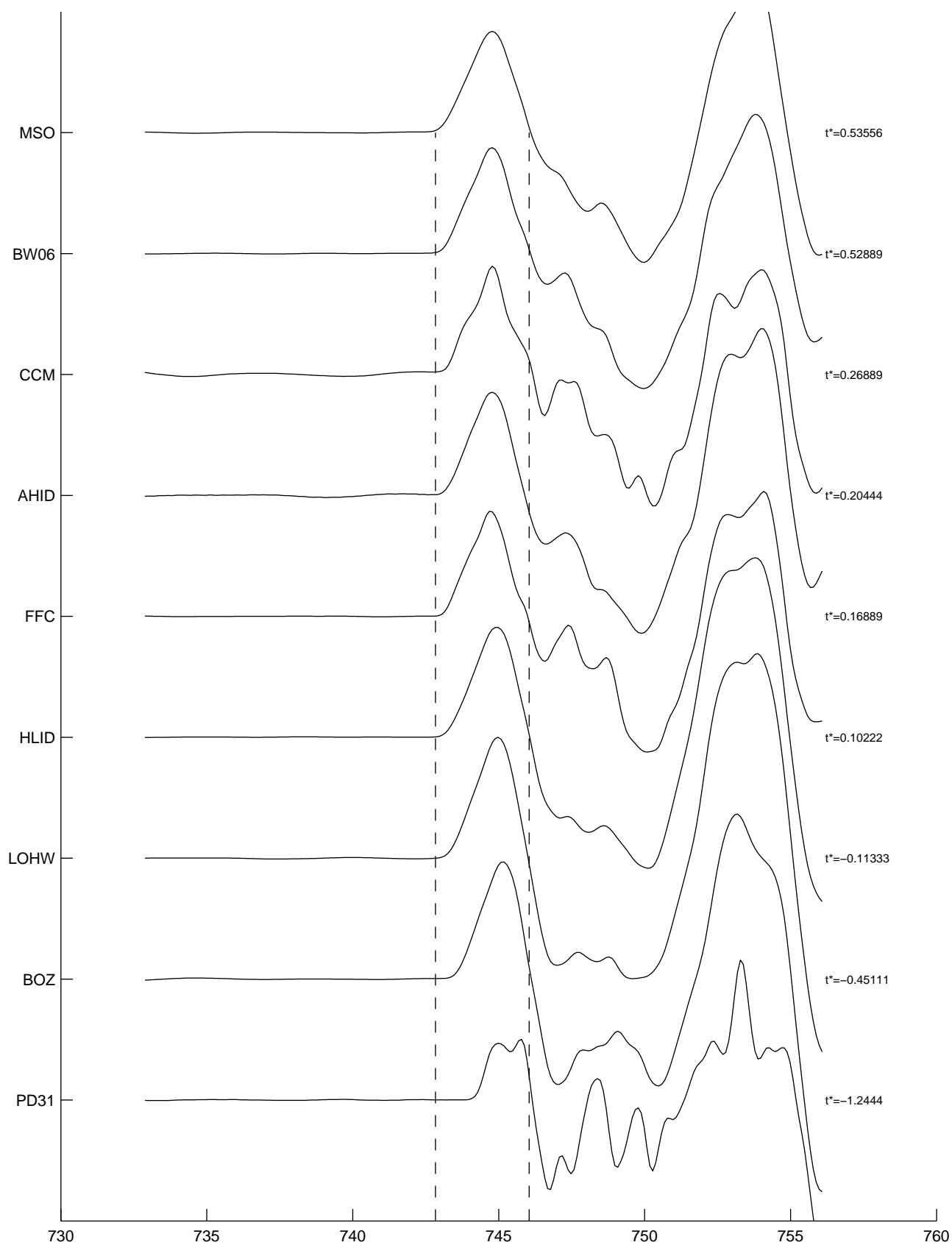




# Sorted by travel time:Event\_2004\_249\_10\_07\_07

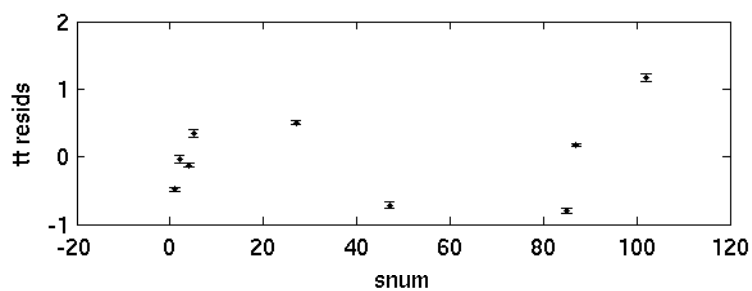
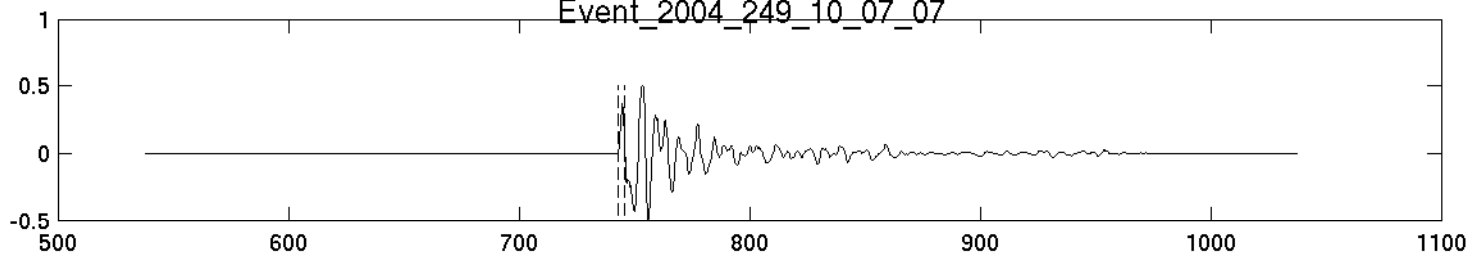


# Sorted by t\*:Event\_2004\_249\_10\_07\_07

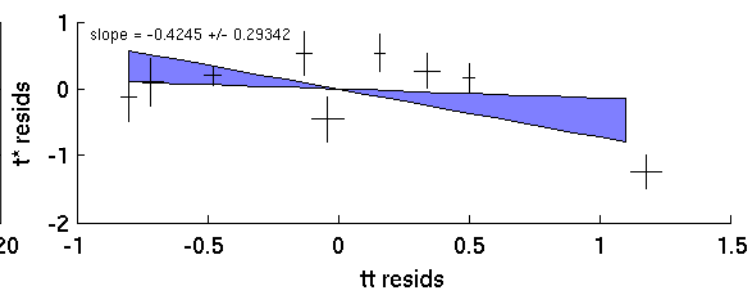
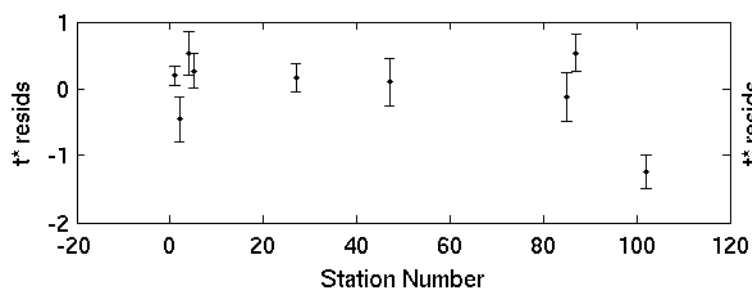


# Event\_2004\_249\_10\_07\_07

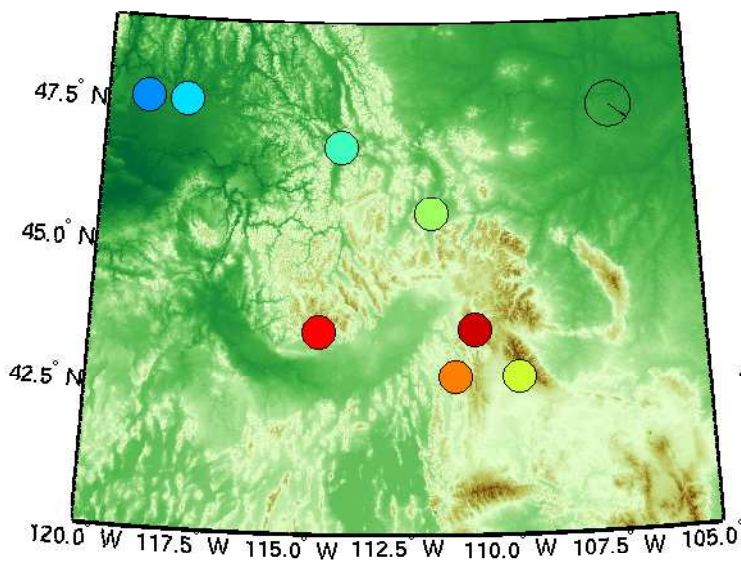
Stack



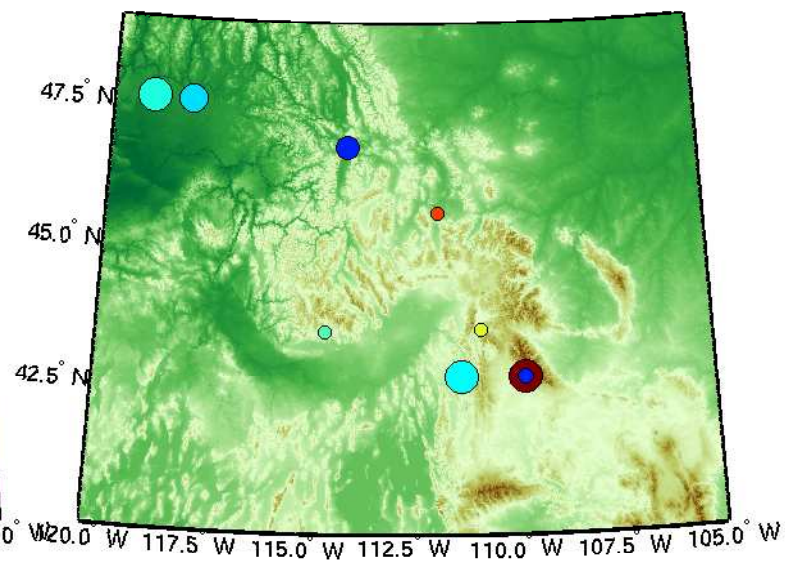
Baz = 310.0907  
Mean xcor value = 0.88333  
Range of  $t^*$  values is 1.78  
Median  $t^*$  err is 0.27458  
Slope =  $-0.4245 \pm 0.29342$



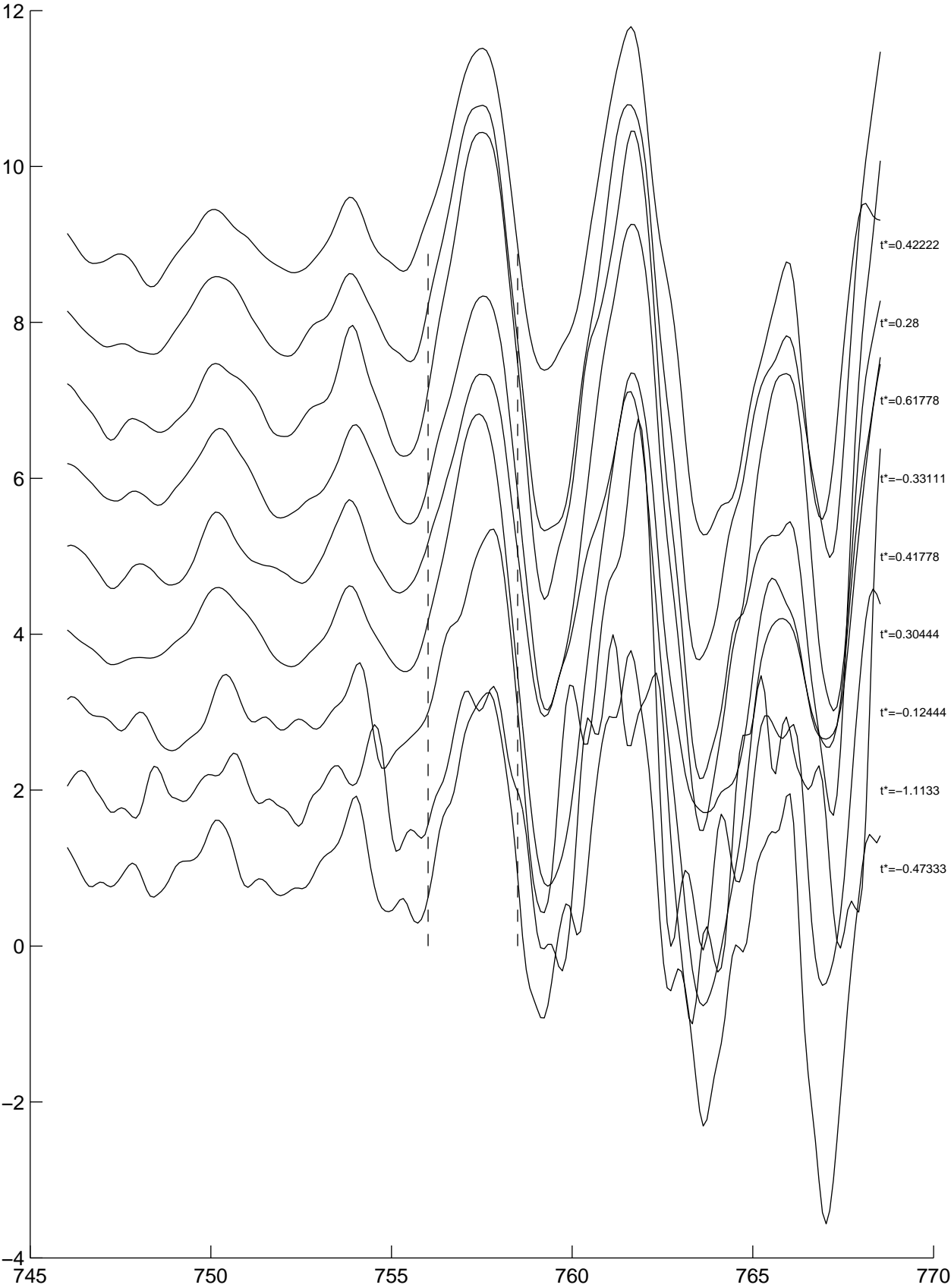
travel time residuals



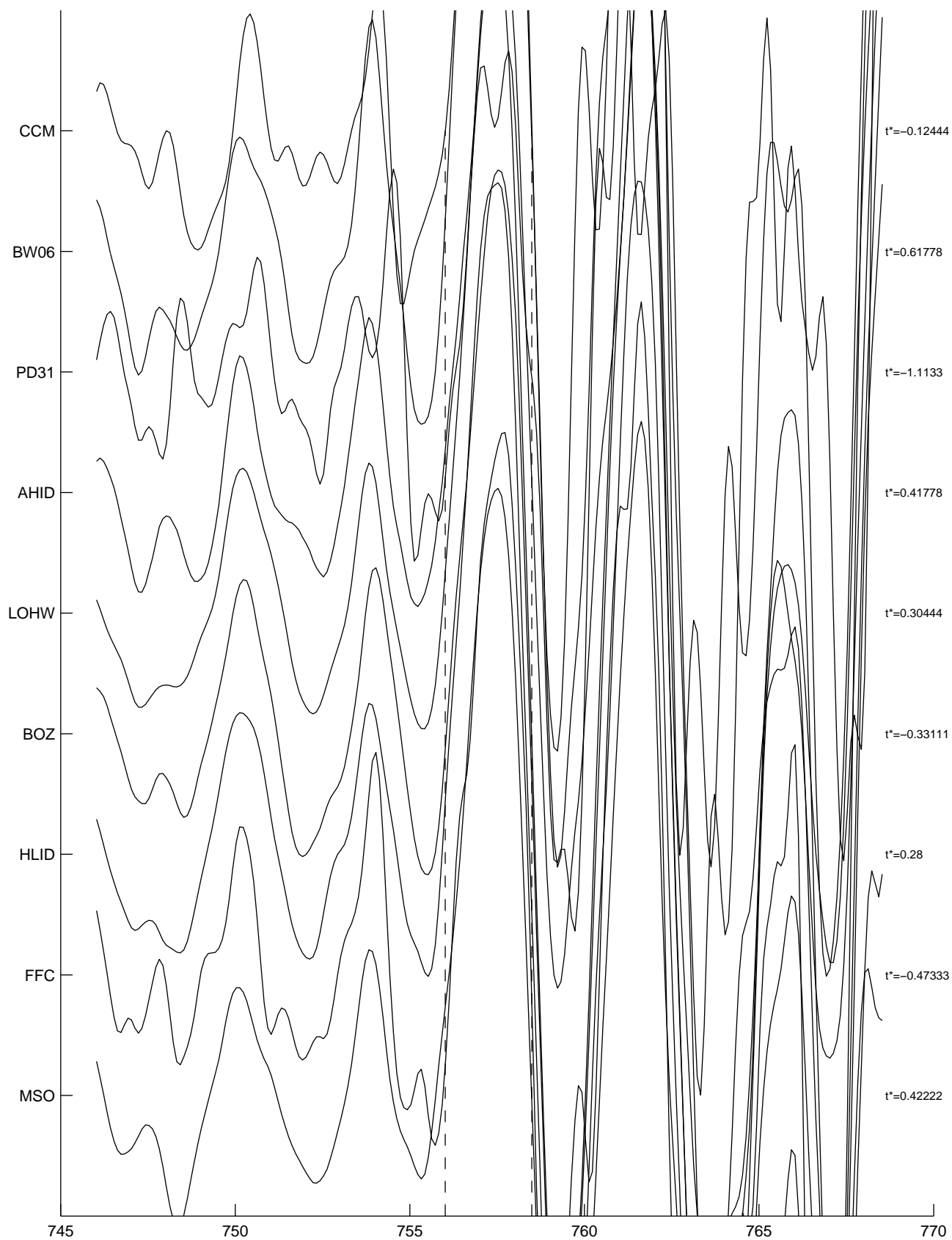
$t^*$  values



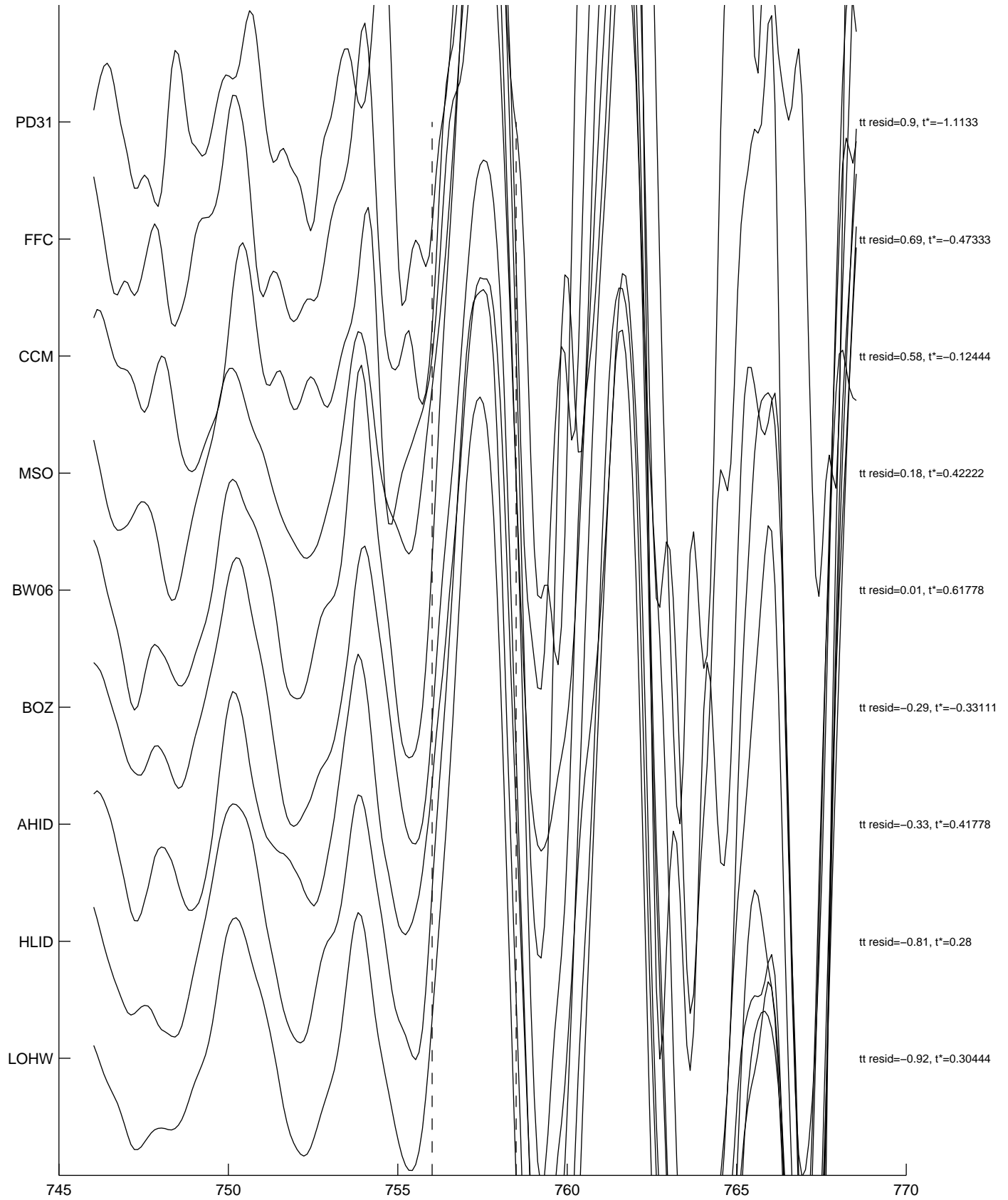
Event\_2004\_249\_14\_57\_18



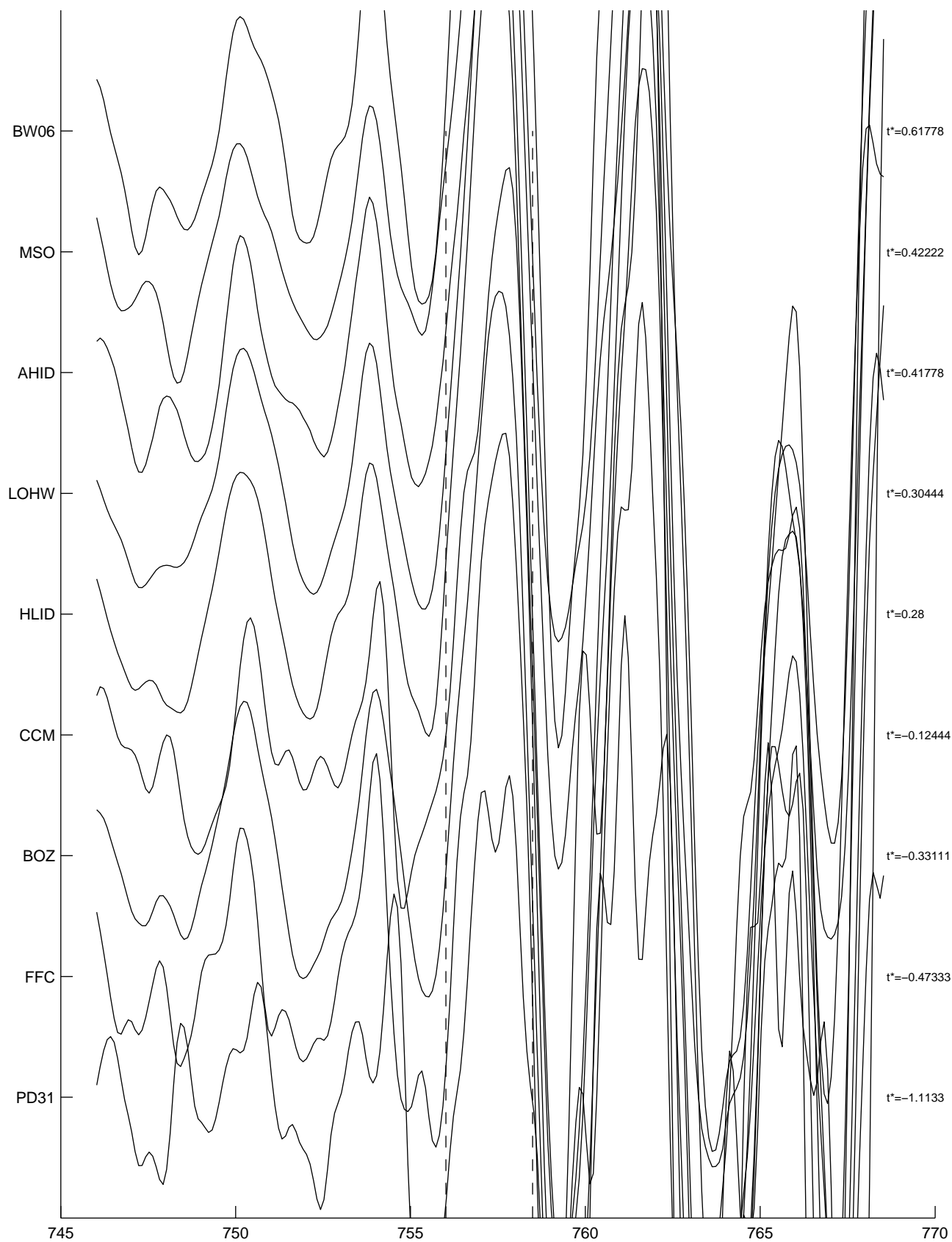
# Sorted by Delta:Event\_2004\_249\_14\_57\_18



# Sorted by travel time:Event\_2004\_249\_14\_57\_18

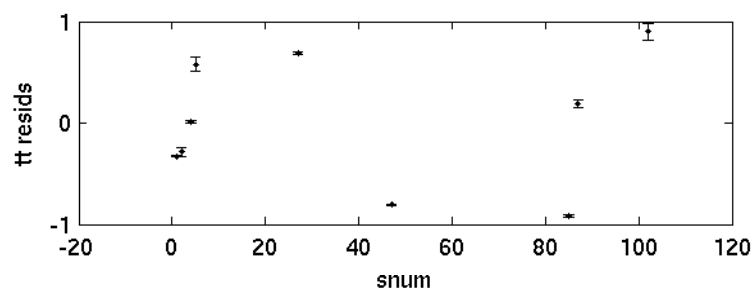
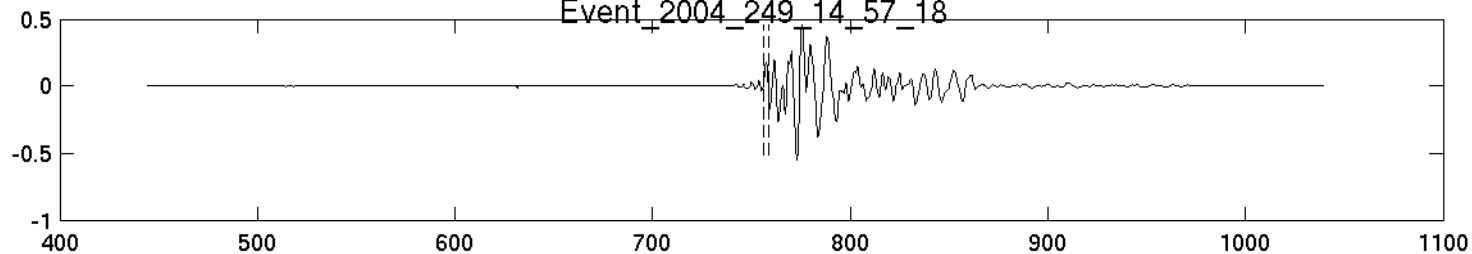


Sorted by t\*:Event\_2004\_249\_14\_57\_18

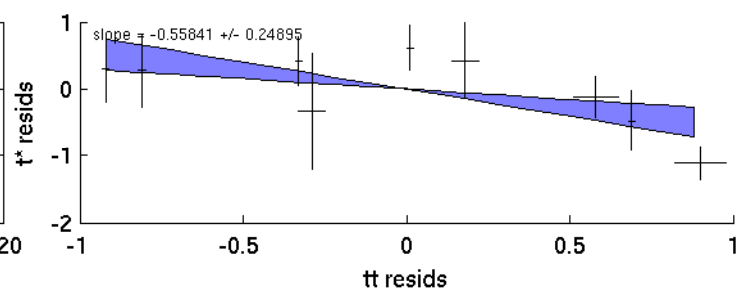
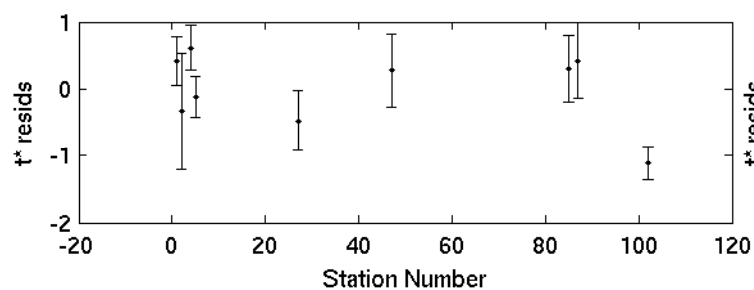


Event\_2004\_249\_14\_57\_18

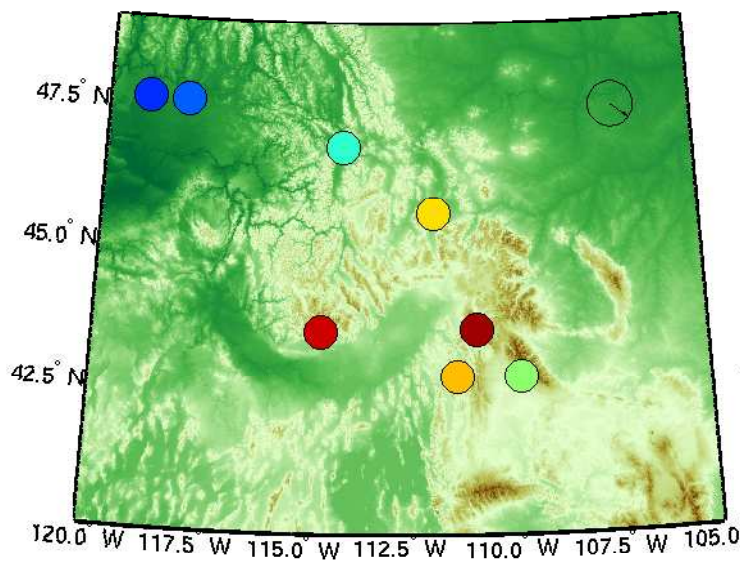
Stack



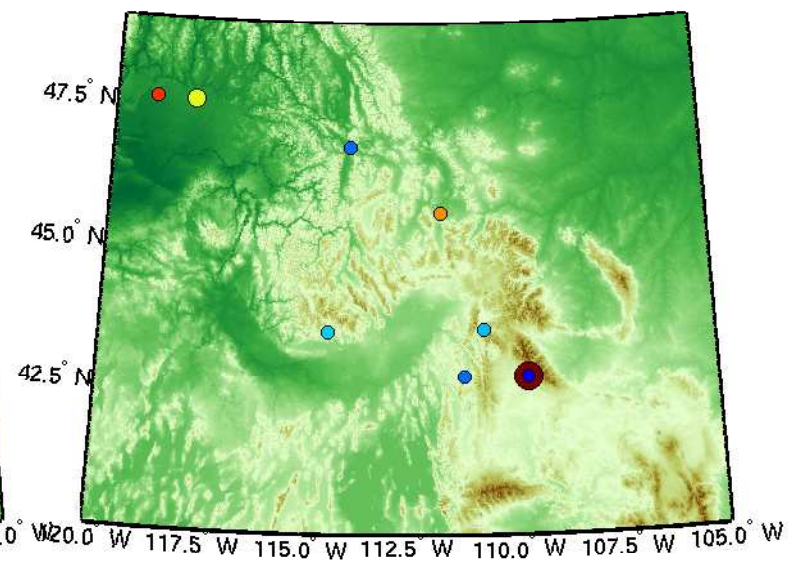
Baz = 309.8741  
 Mean xcor value = 0.83111  
 Range of  $t^*$  values is 1.7311  
 Median  $t^*$  err is 0.45345  
 Slope = -0.55841 +/- 0.24895



travel time residuals

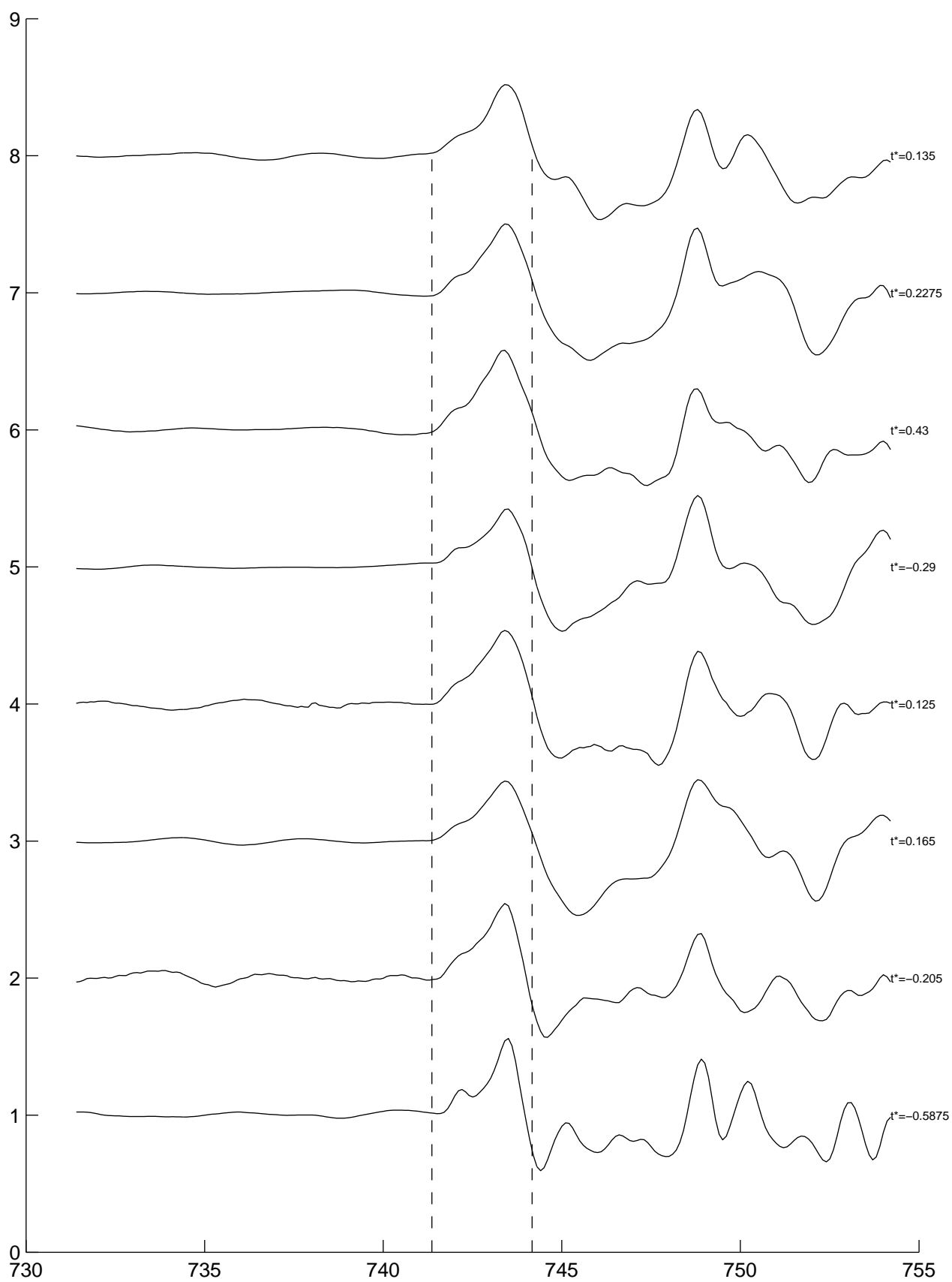


$t^*$  values

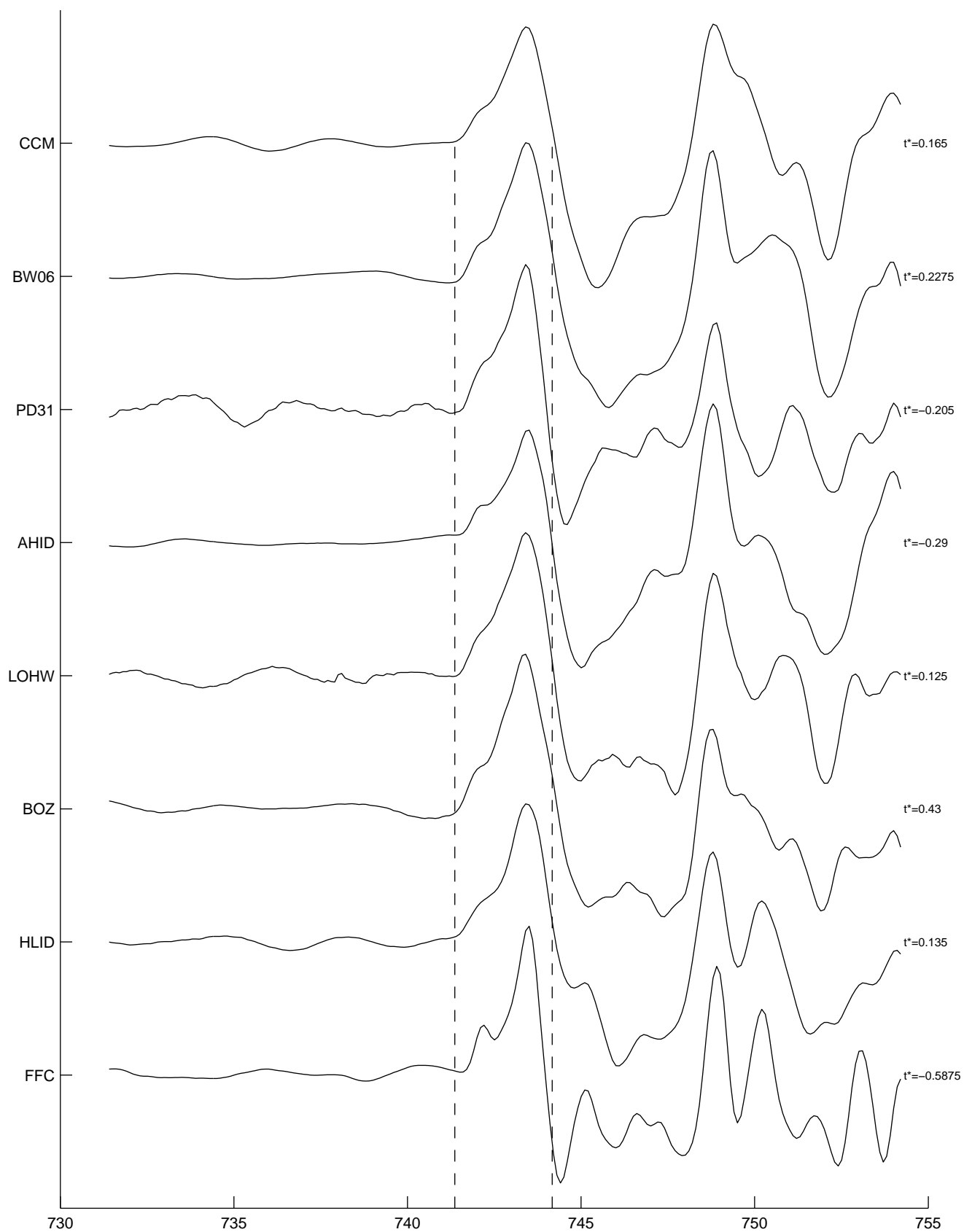




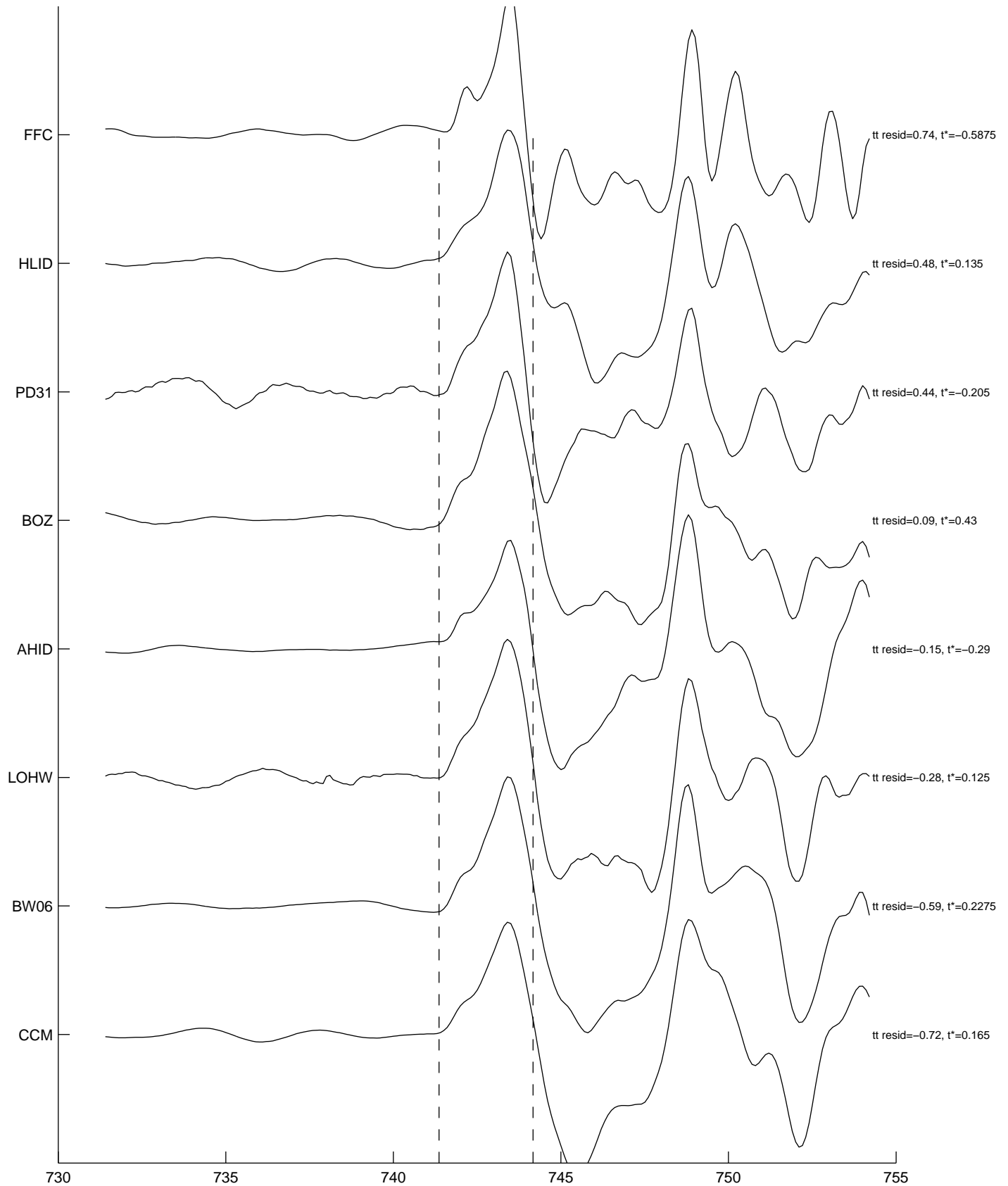
# Event\_2004\_250\_23\_29\_35



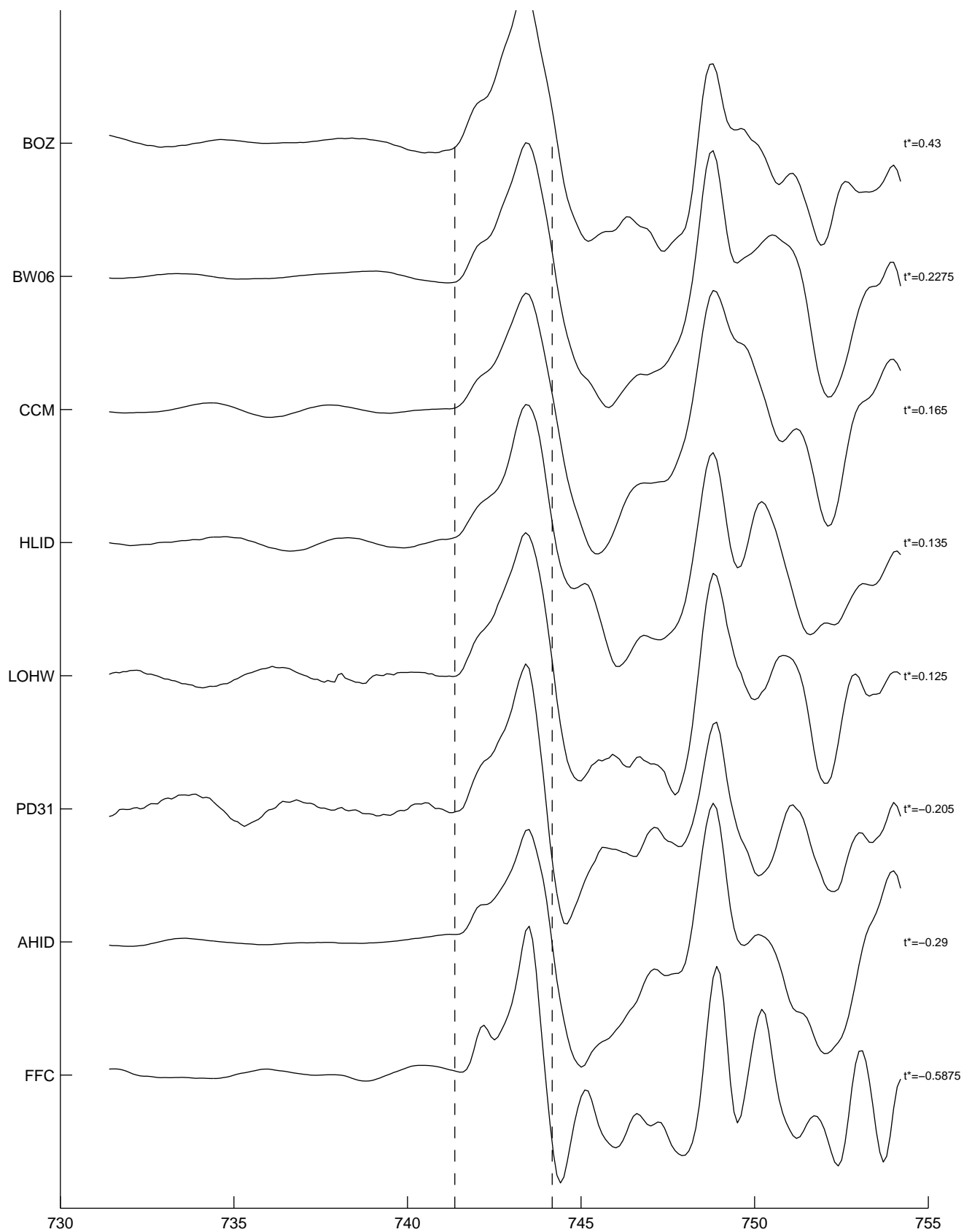
# Sorted by Delta:Event\_2004\_250\_23\_29\_35



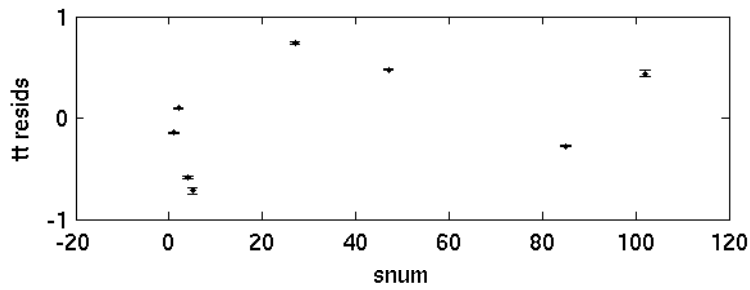
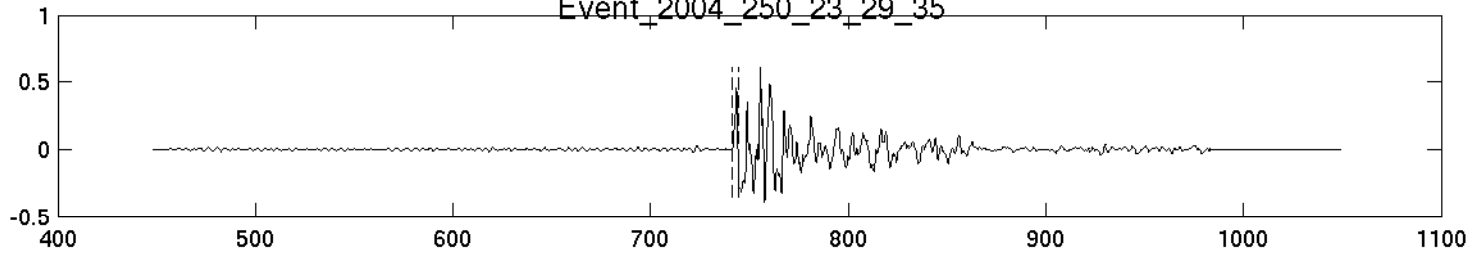
# Sorted by travel time:Event\_2004\_250\_23\_29\_35



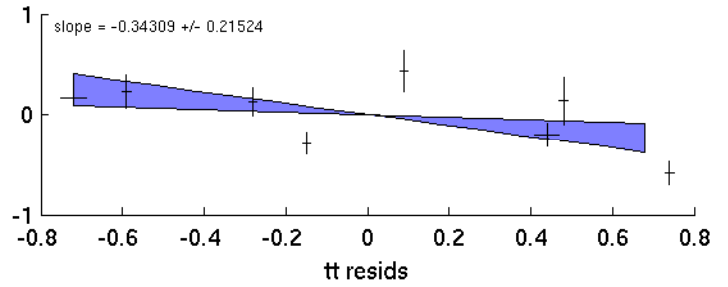
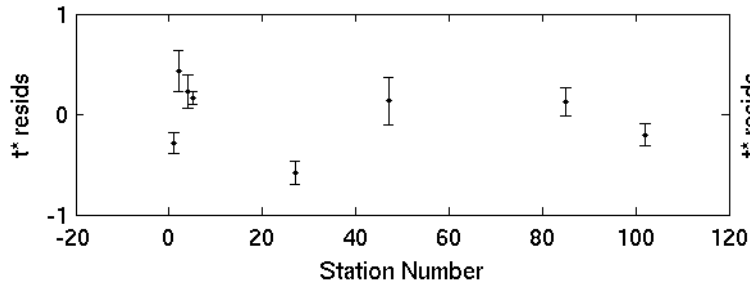
Sorted by  $t^*$ :Event\_2004\_250\_23\_29\_35



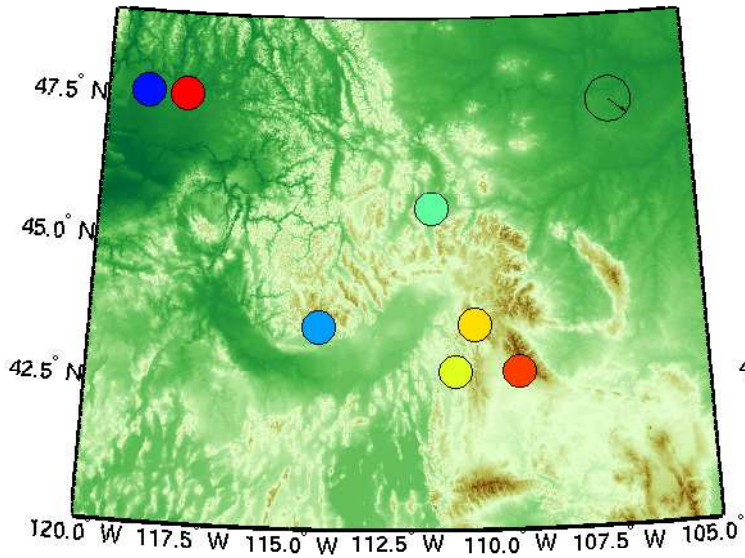
Stack  
Event\_2004\_250\_23\_29\_35



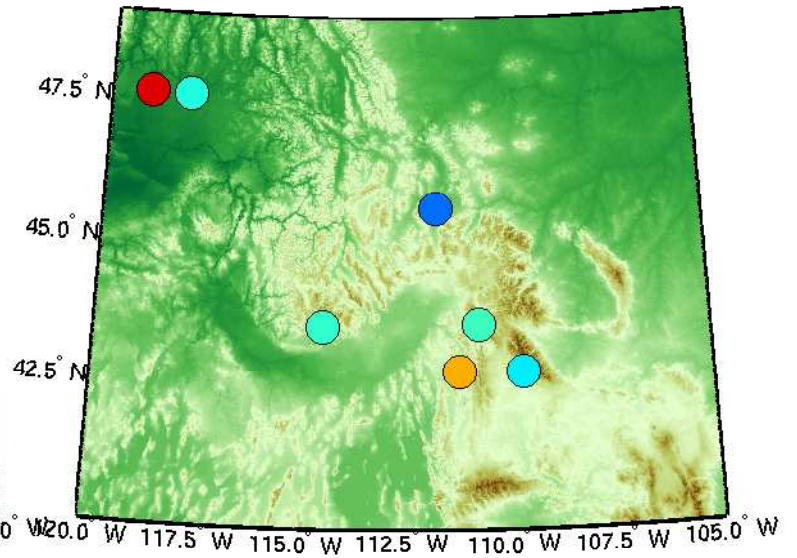
Baz = 309.7878  
Mean xcor value = 0.79875  
Range of  $t^*$  values is 1.0175  
Median  $t^*$  err is 0.12814  
Slope =  $-0.34309 \pm 0.21524$



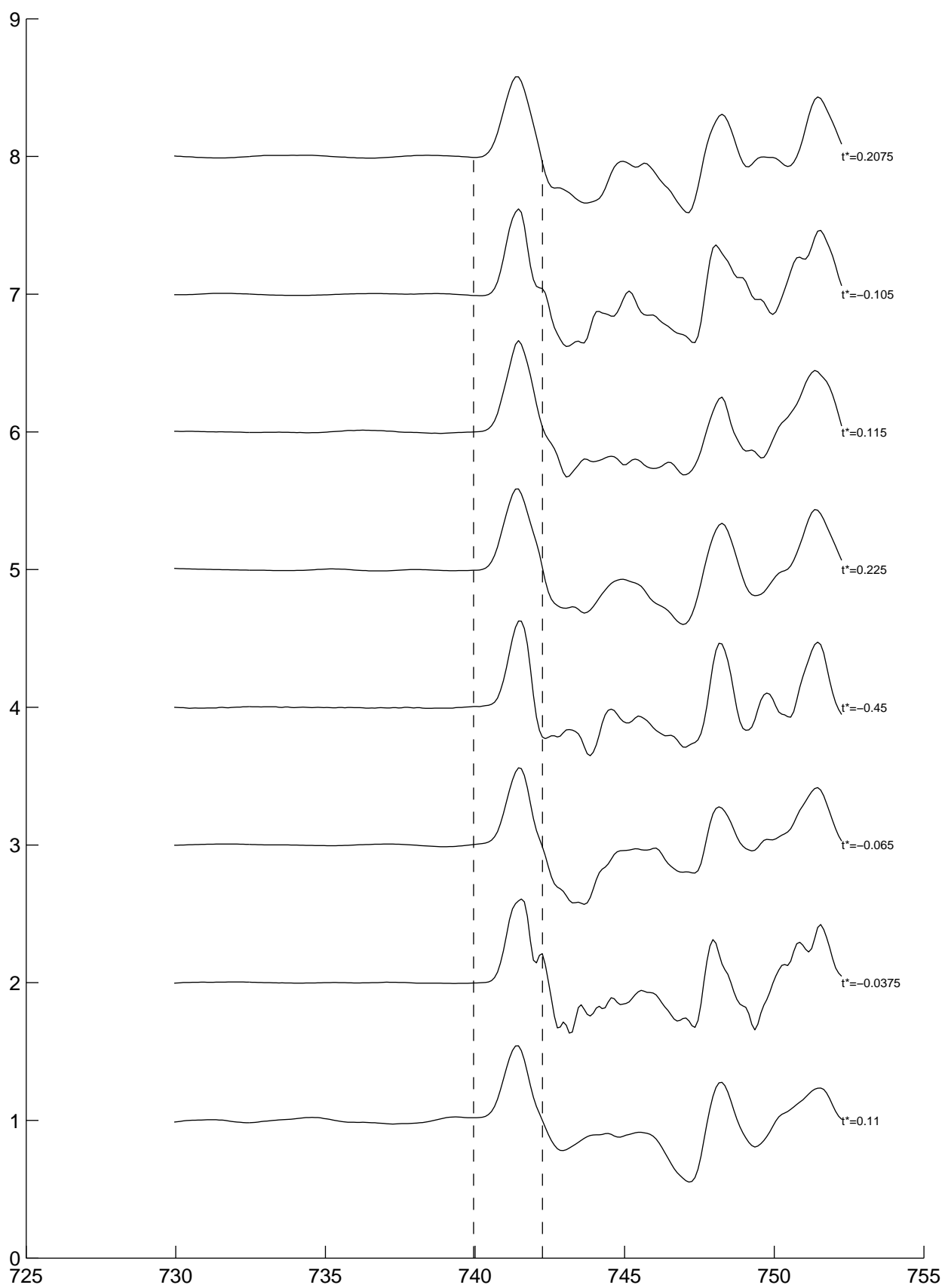
travel time residuals



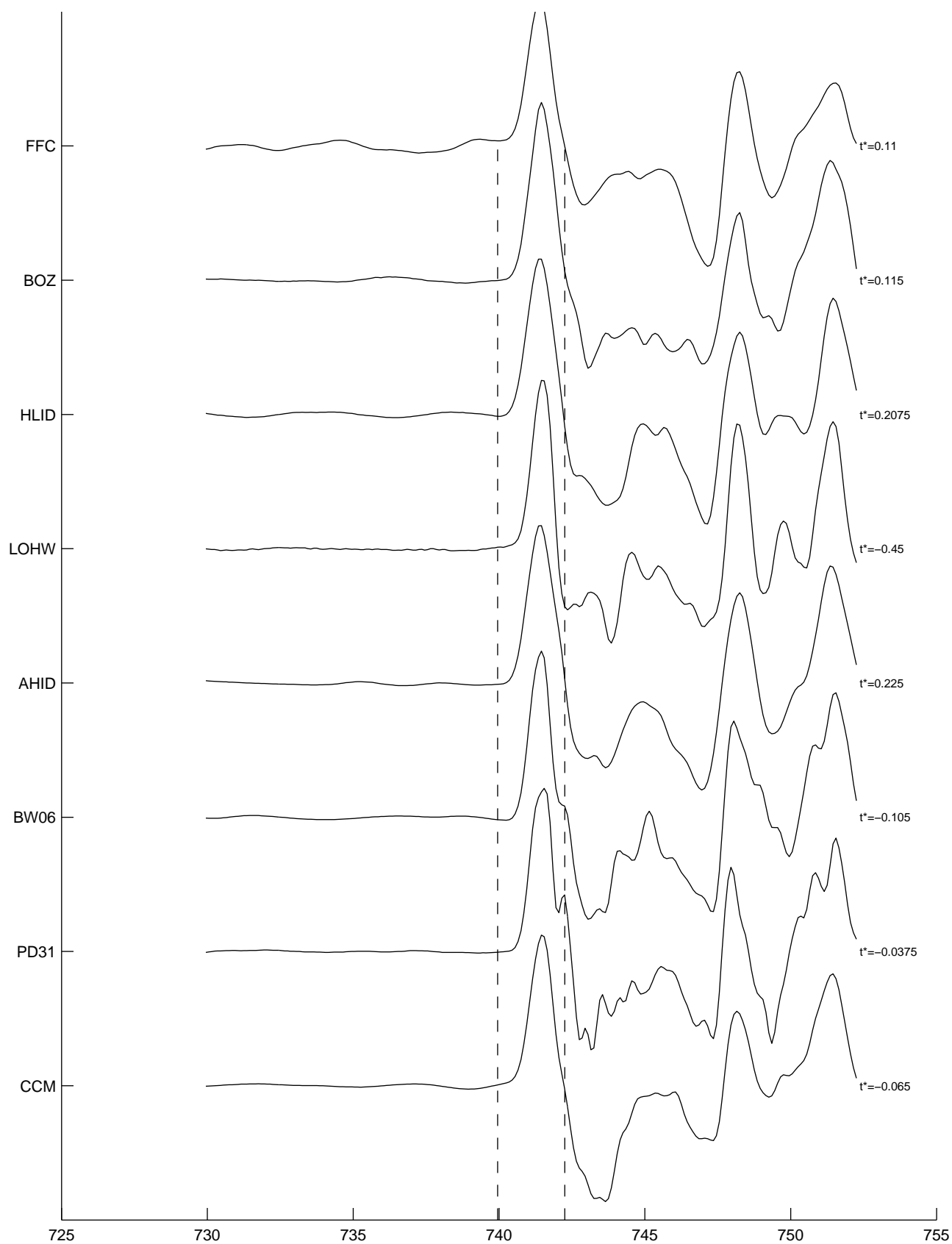
$t^*$  values



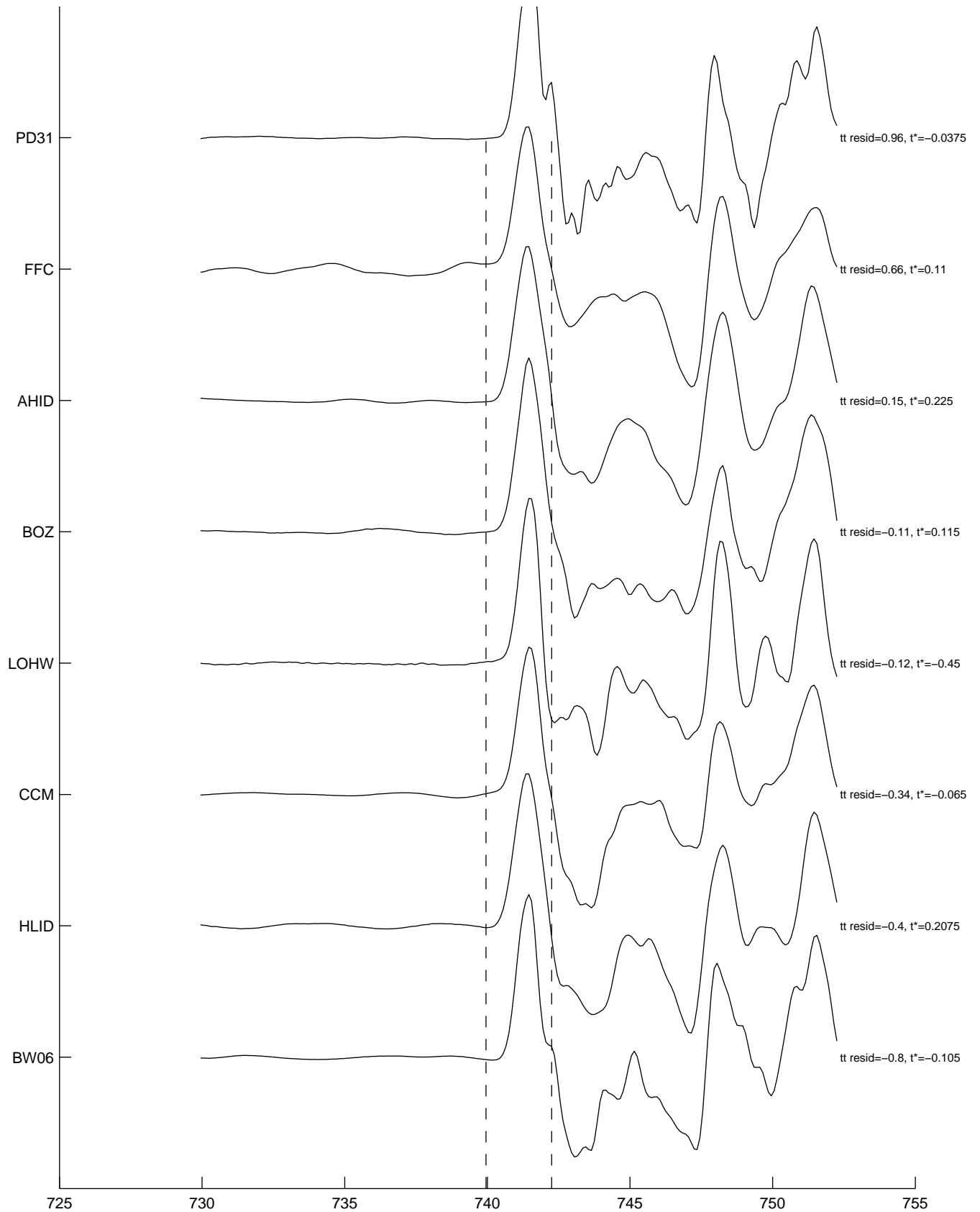
# Event\_2004\_251\_11\_53\_06



Sorted by Delta:Event\_2004\_251\_11\_53\_06

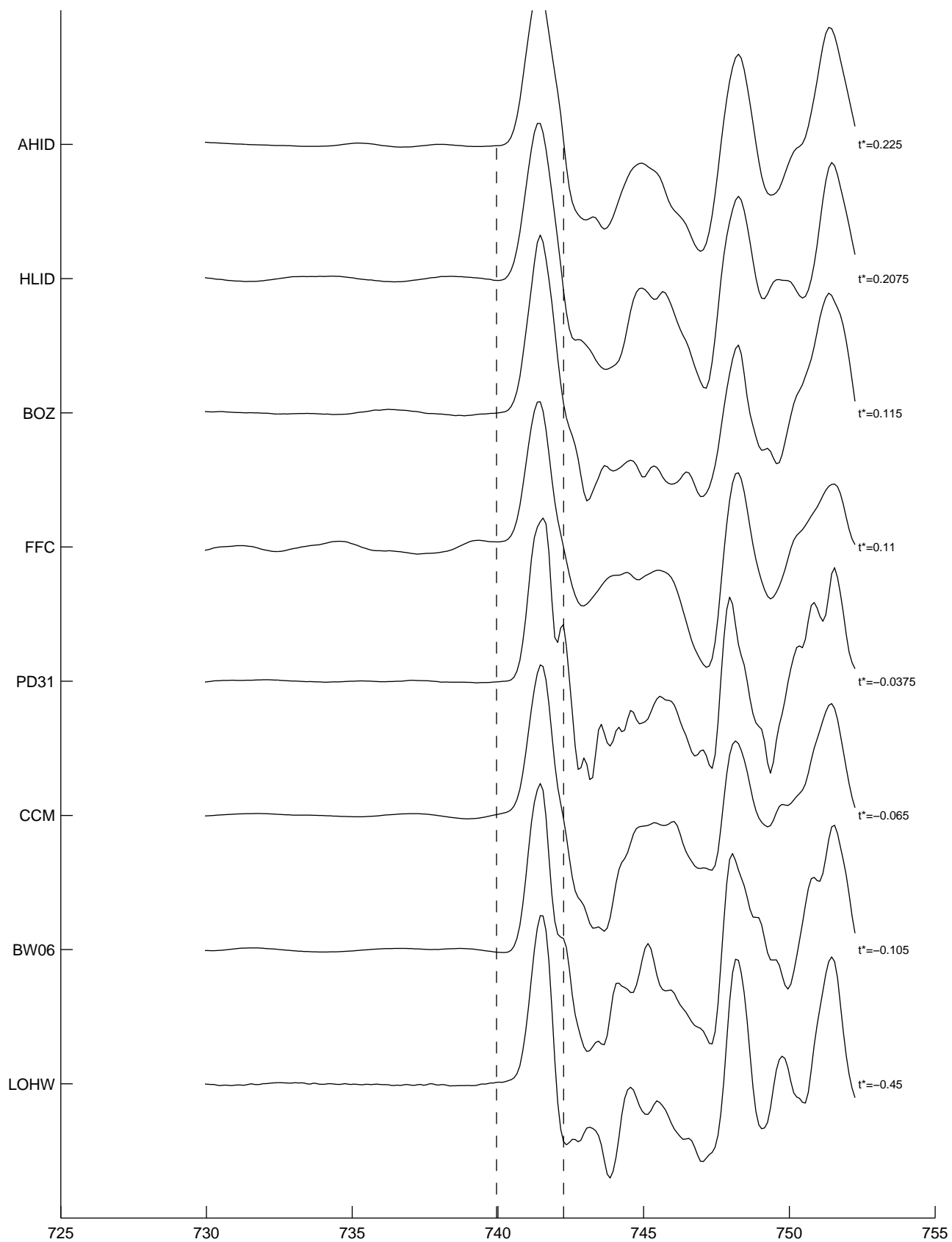


# Sorted by travel time:Event\_2004\_251\_11\_53\_06



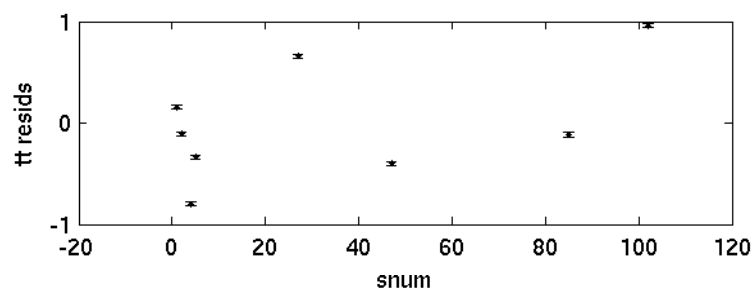
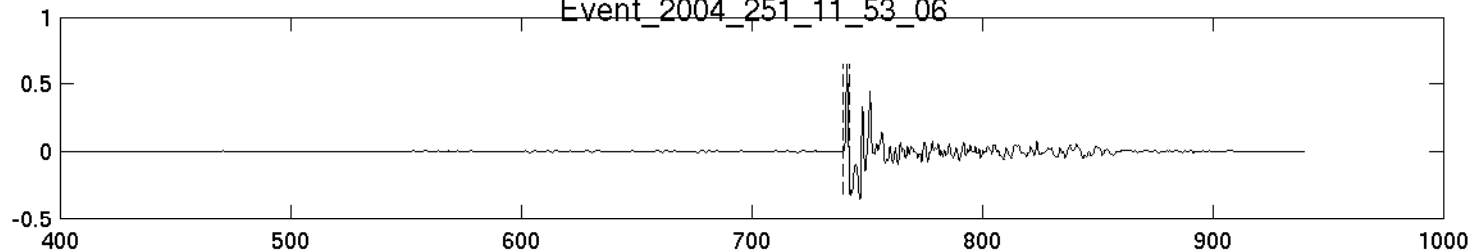


Sorted by  $t^*$ :Event\_2004\_251\_11\_53\_06

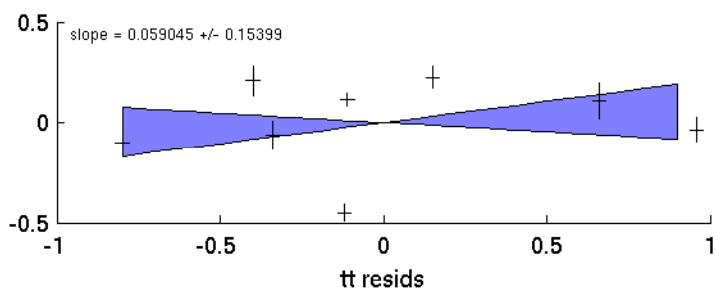
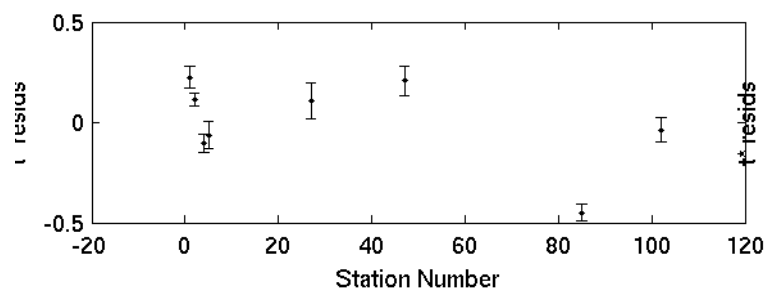


# Event\_2004\_251\_11\_53\_06

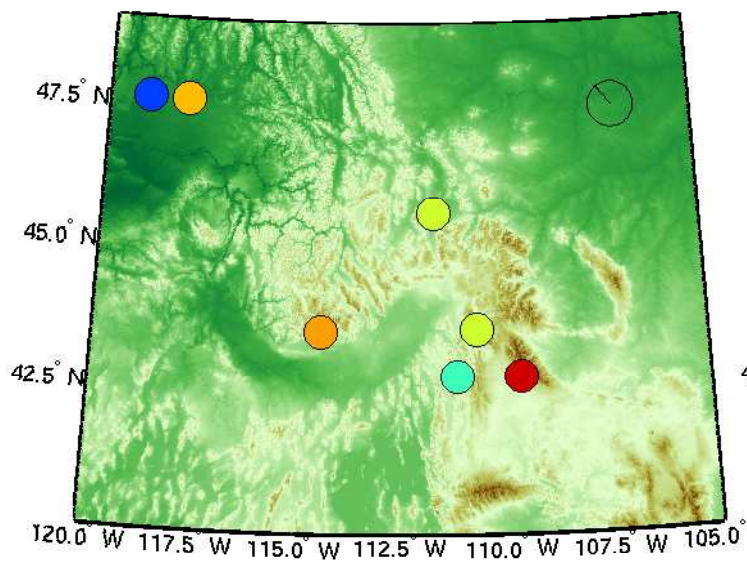
Stack



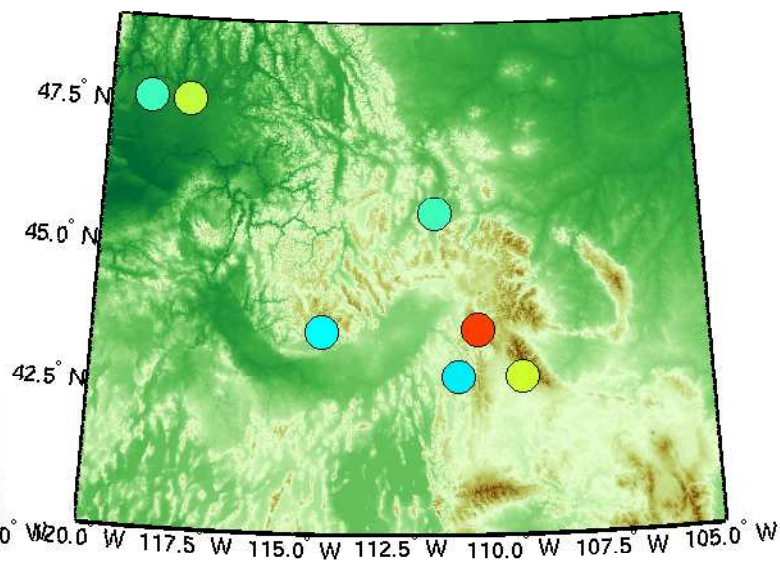
Baz = 143.4074  
Mean xcor value = 0.8425  
Range of  $t^*$  values is 0.675  
Median  $t^*$  err is 0.058451  
Slope = 0.059045 +/- 0.15399



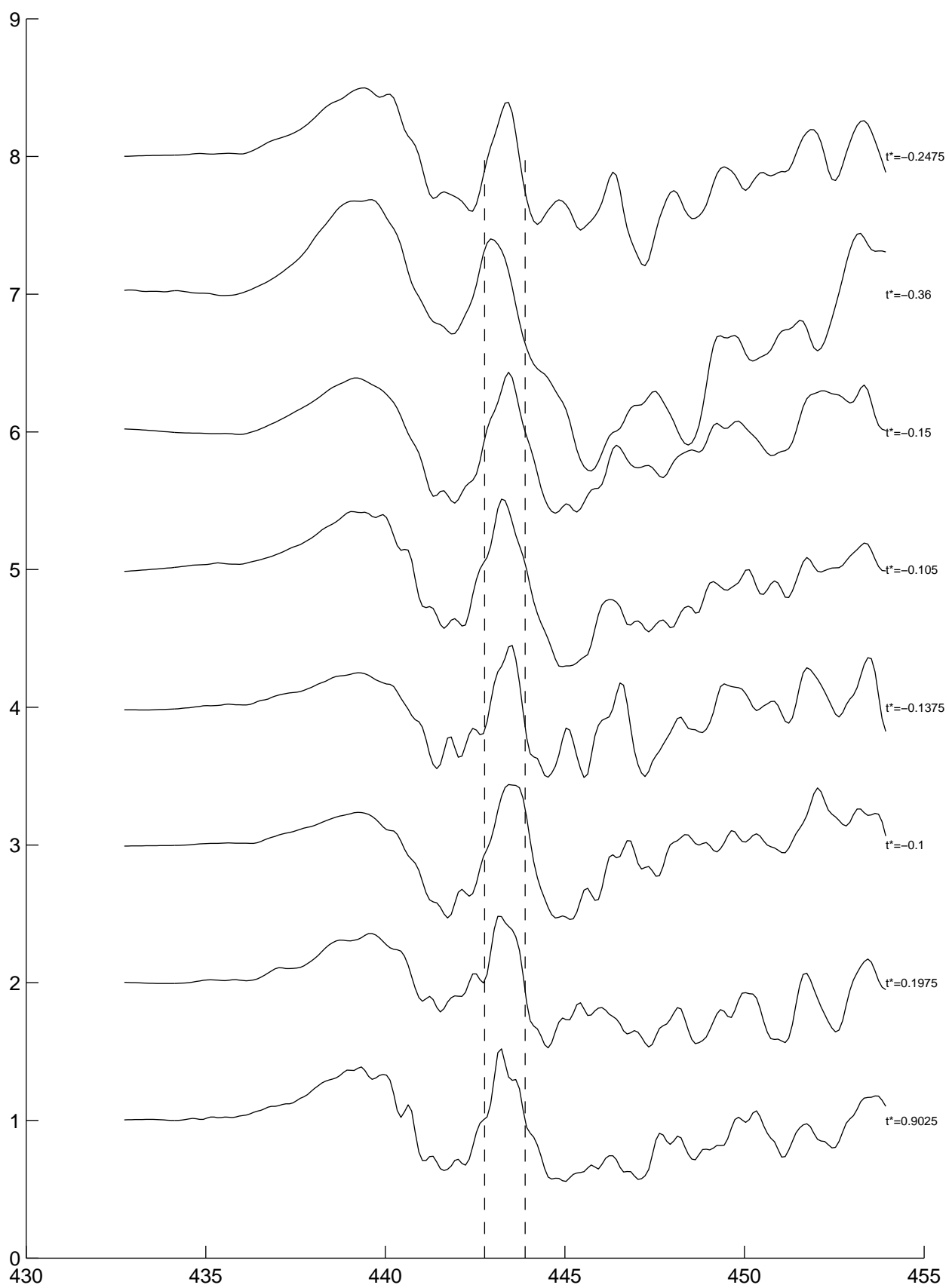
travel time residuals



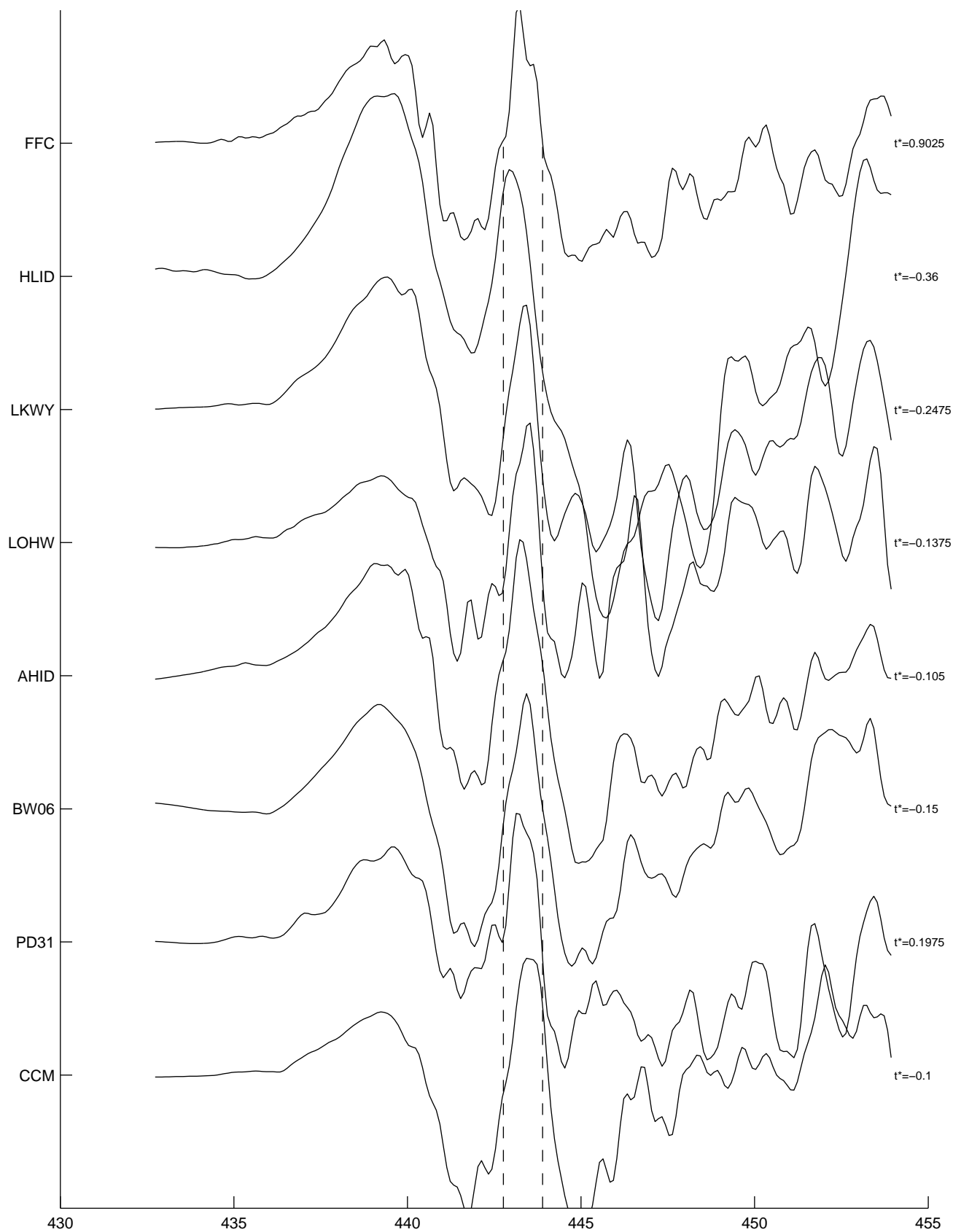
$t^*$  values



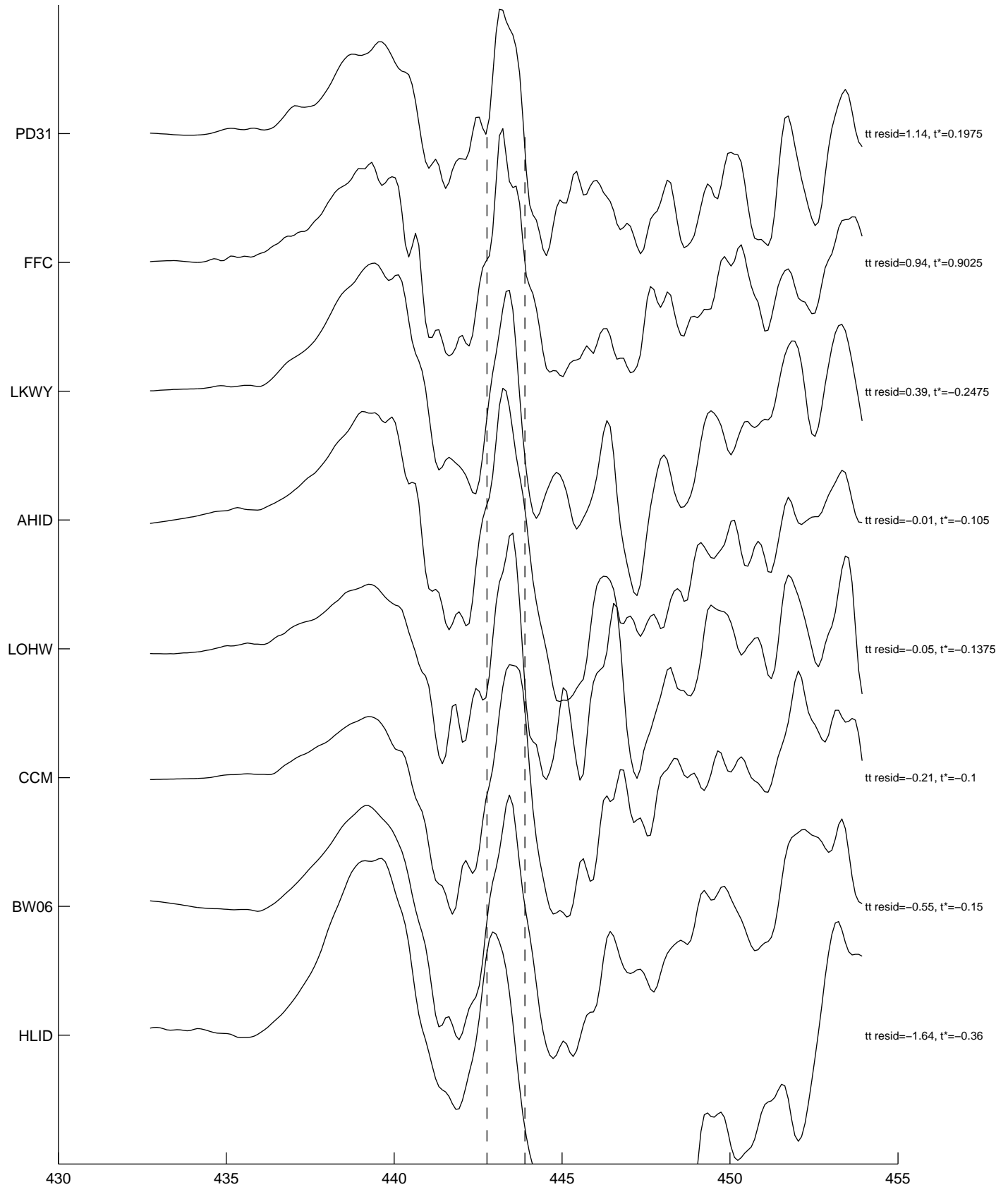
# Event\_2004\_283\_21\_26\_53



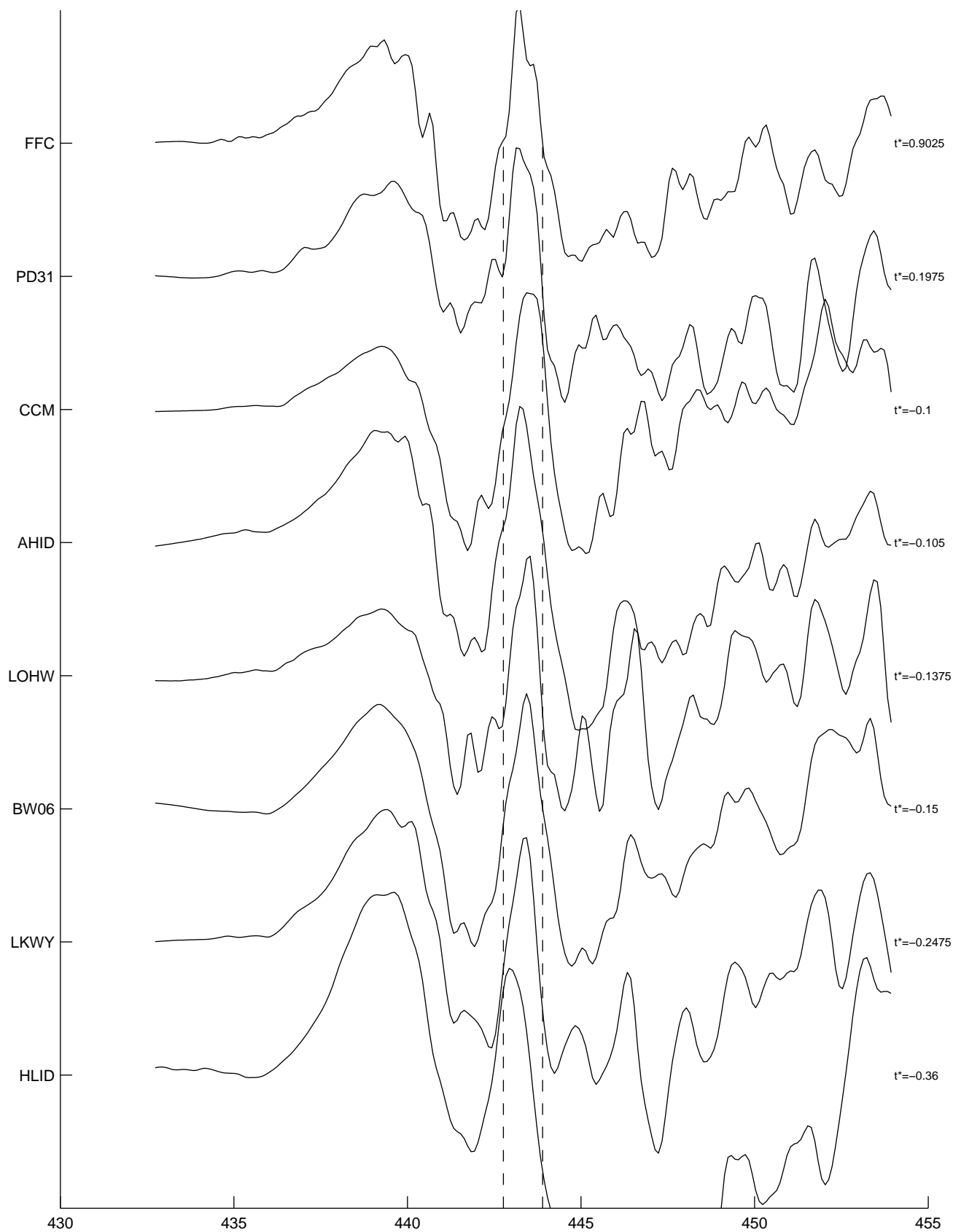
# Sorted by Delta:Event\_2004\_283\_21\_26\_53



# Sorted by travel time:Event\_2004\_283\_21\_26\_53

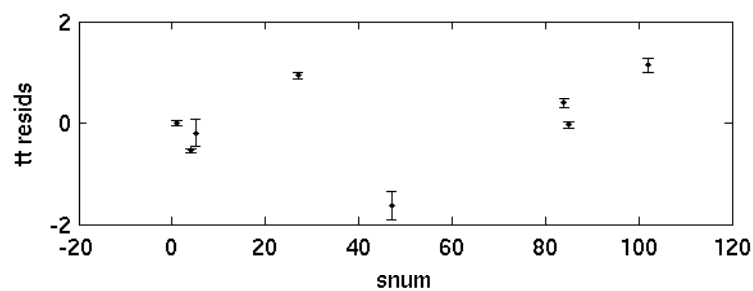
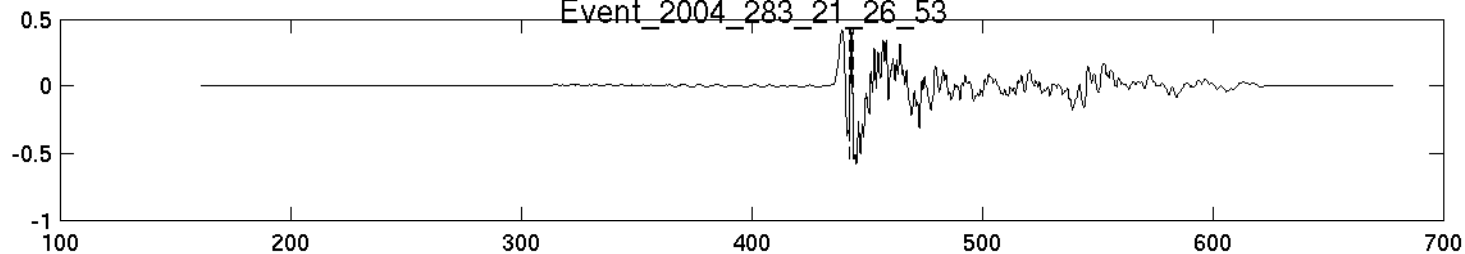


Sorted by  $t^*$ :Event\_2004\_283\_21\_26\_53

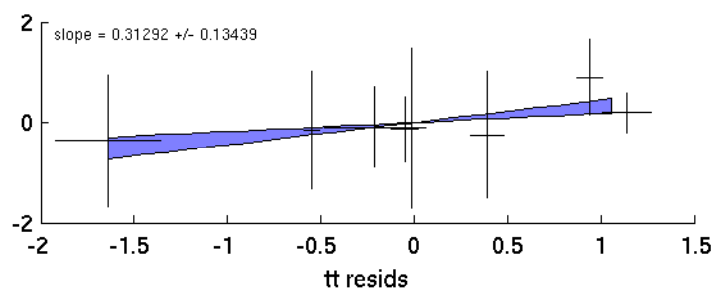
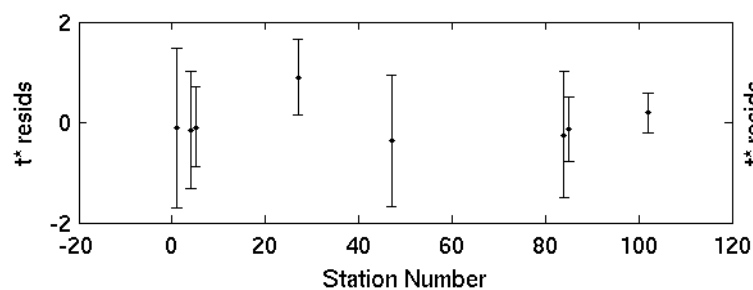


Event\_2004\_283\_21\_26\_53

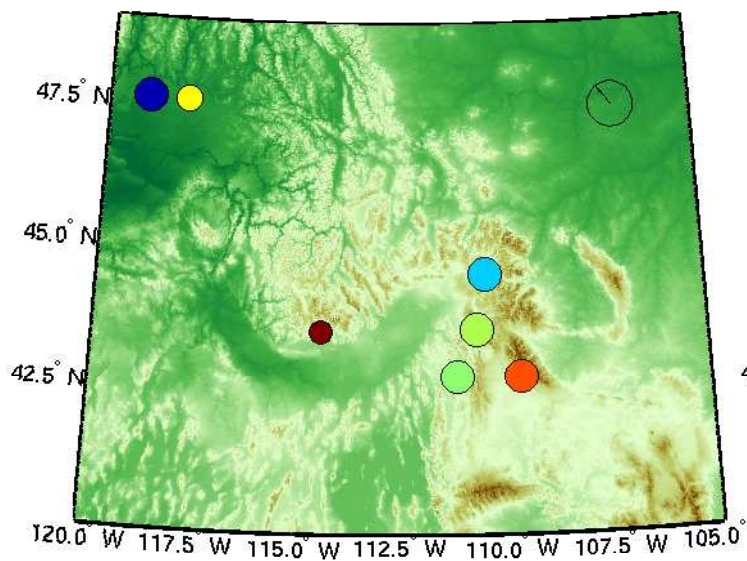
Stack



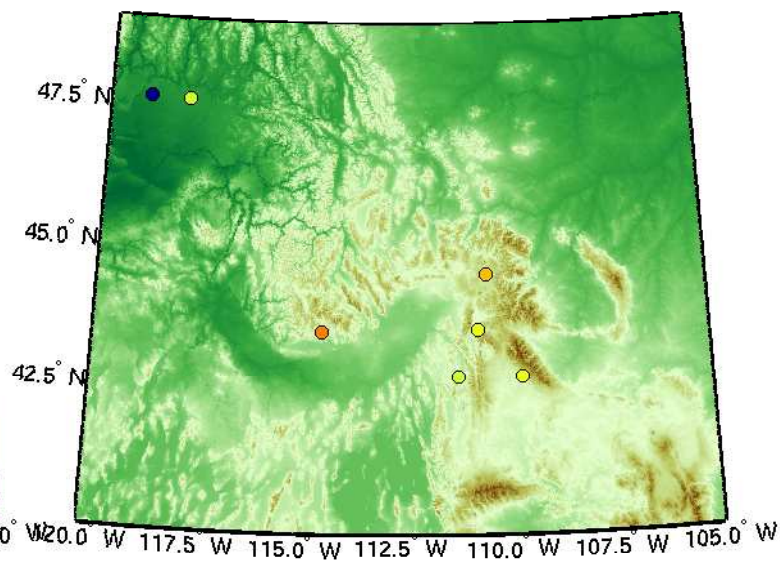
Baz = 144.7634  
Mean xcor value = 0.74375  
Range of  $t^*$  values is 1.2625  
Median  $t^*$  err is 0.99192  
Slope = 0.31292 +/- 0.13439



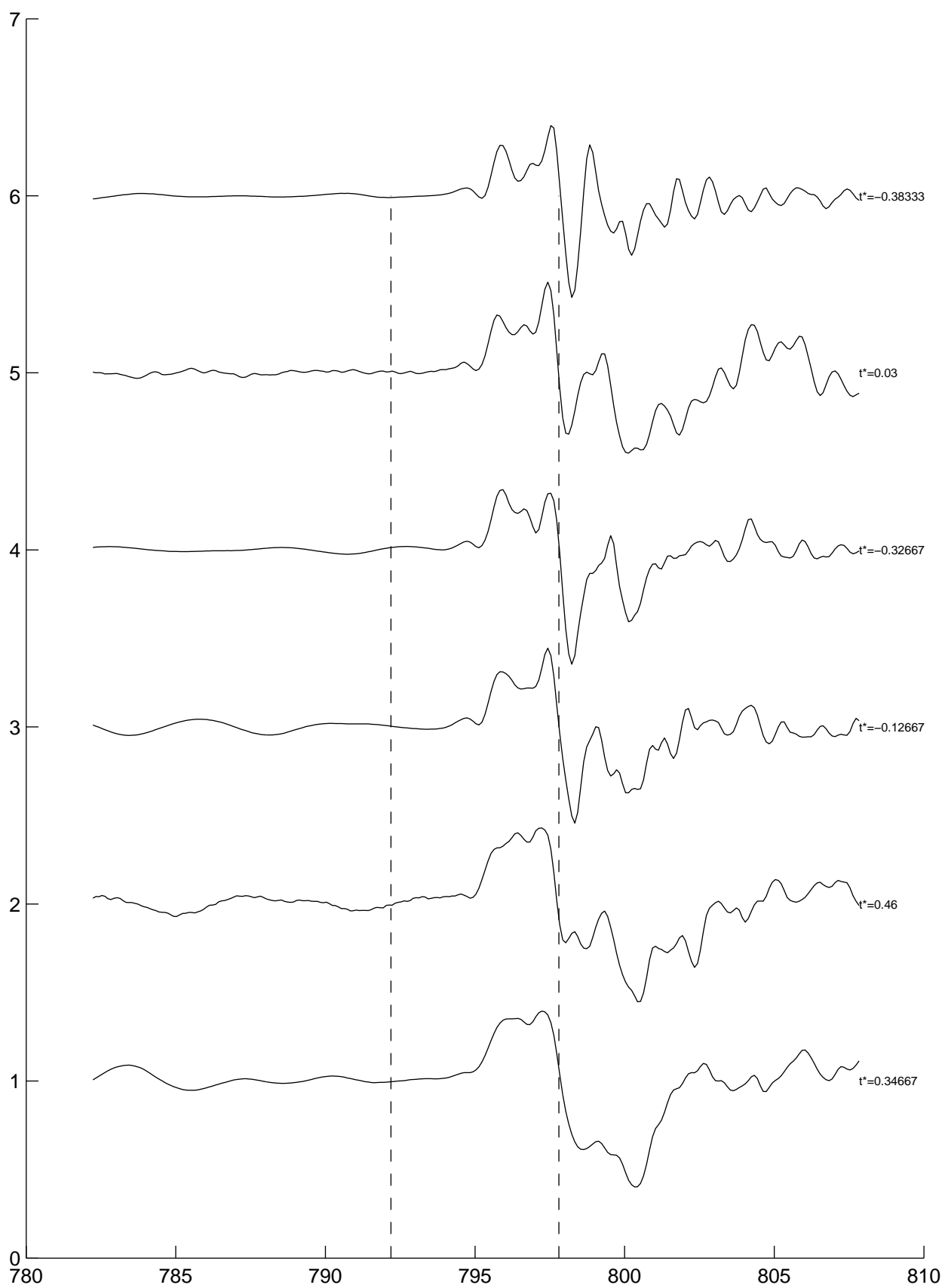
travel time residuals



$t^*$  values

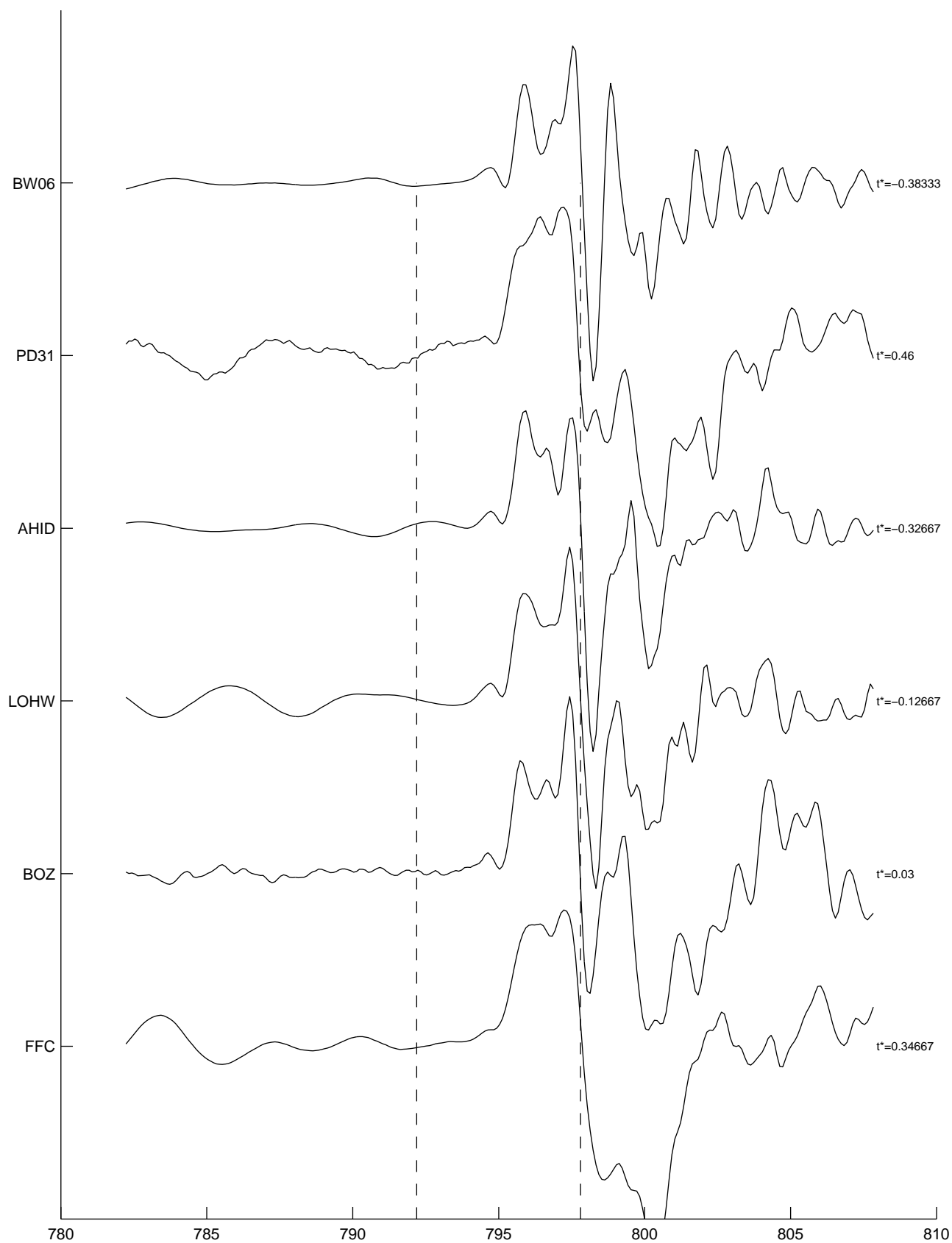


# Event\_2004\_289\_04\_08\_50

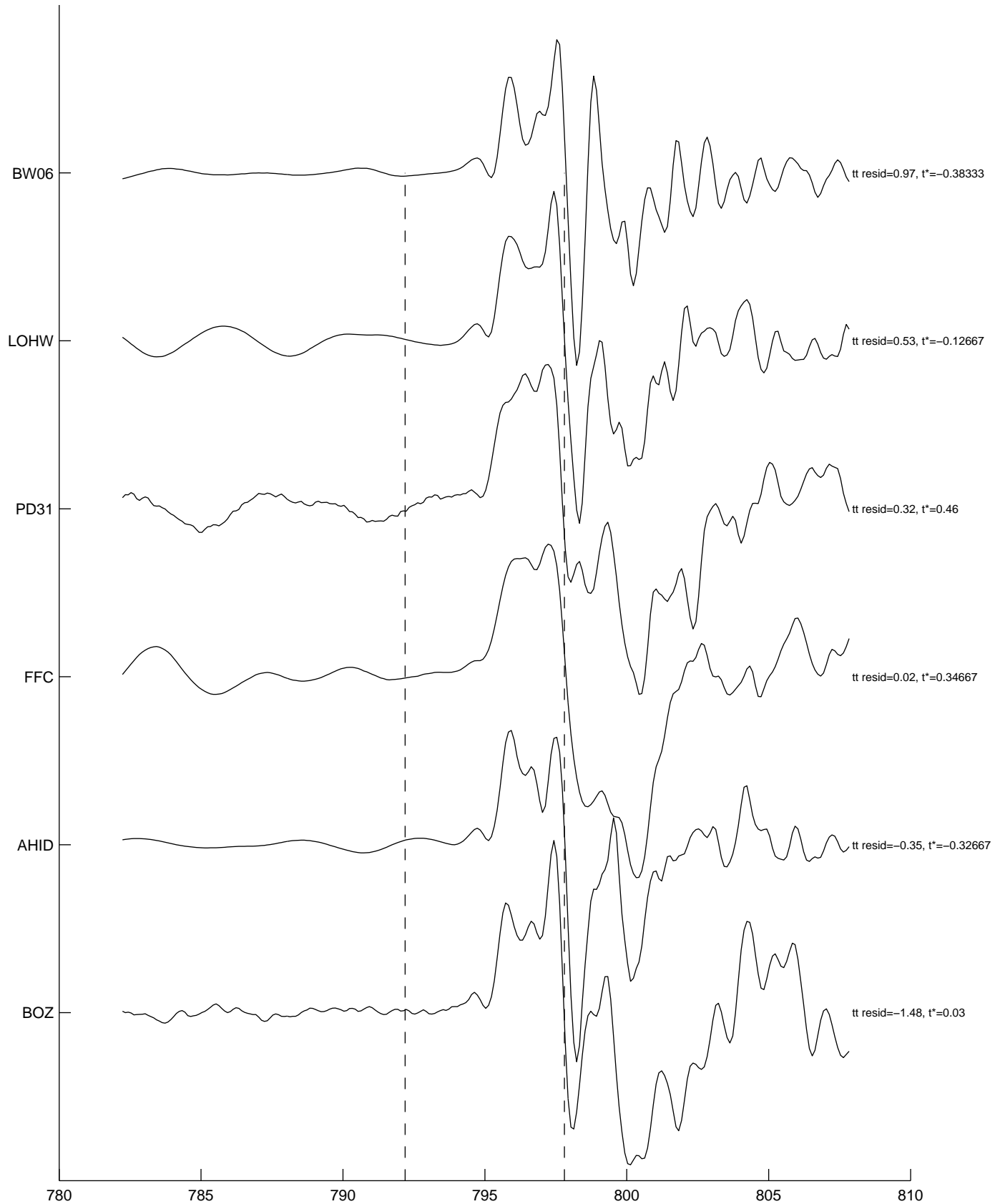




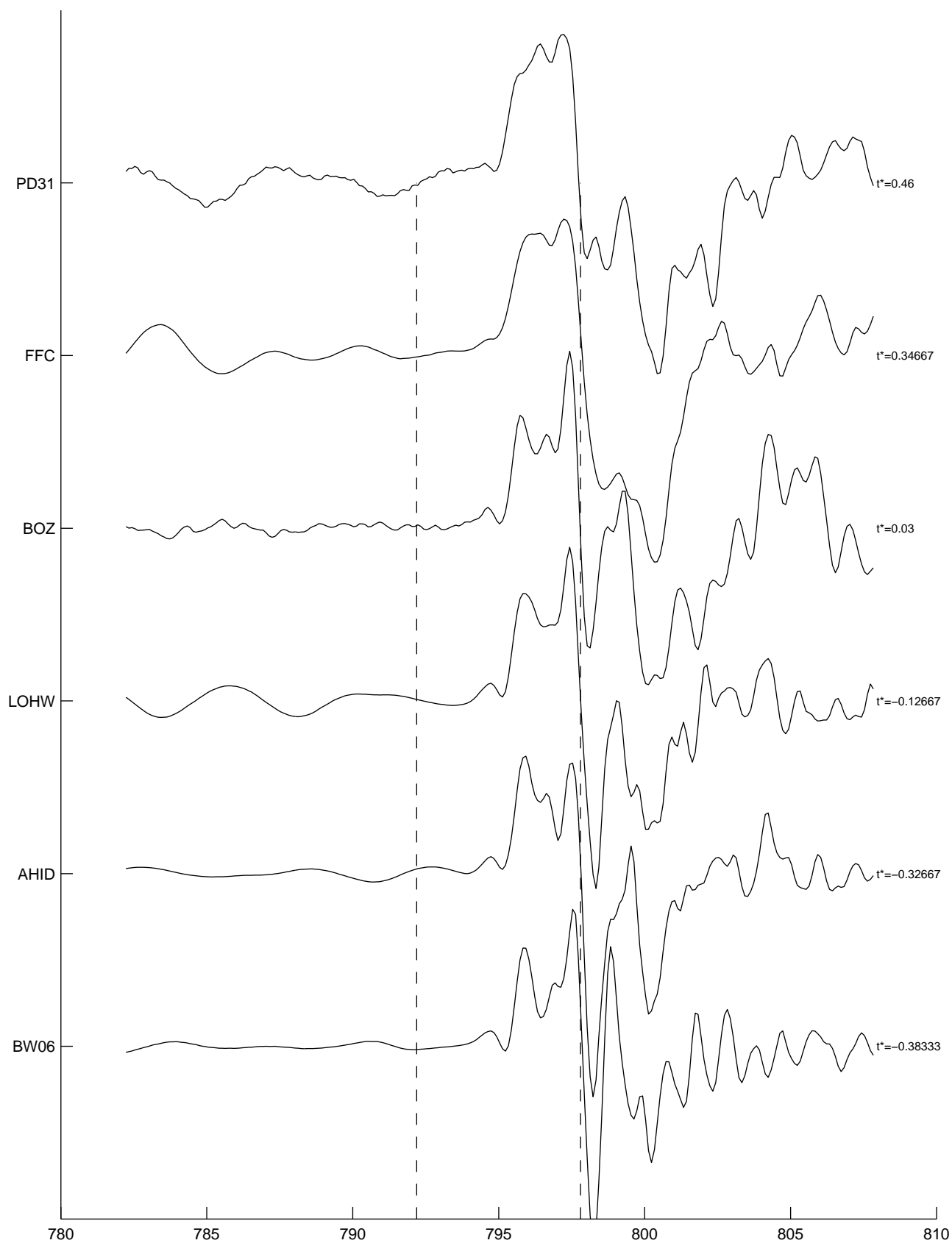
# Sorted by Delta:Event\_2004\_289\_04\_08\_50



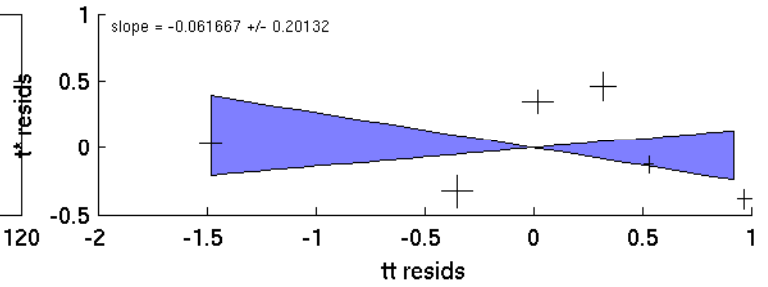
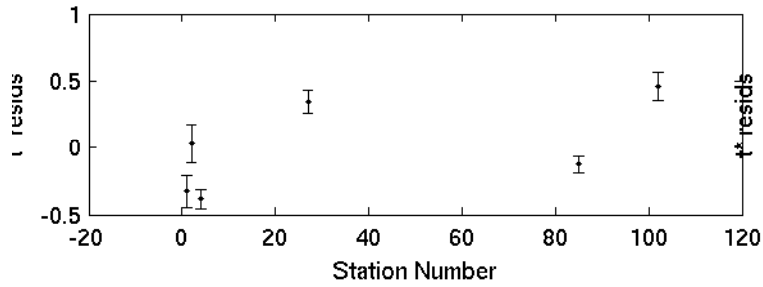
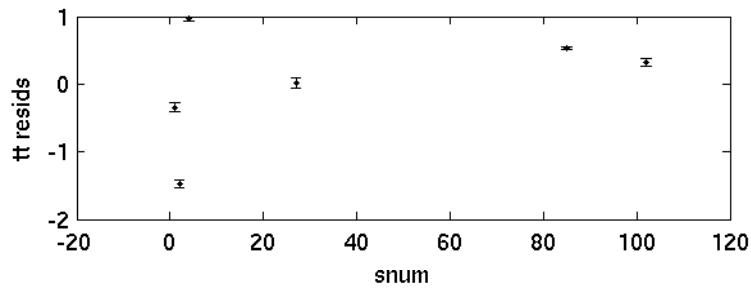
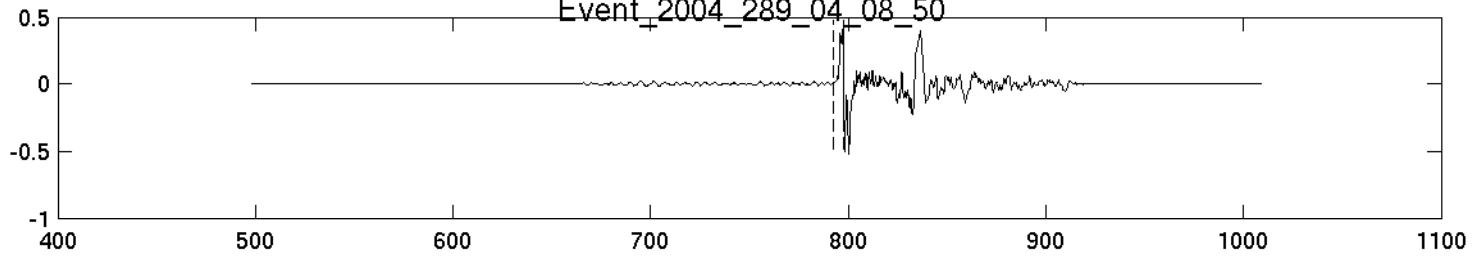
# Sorted by travel time:Event\_2004\_289\_04\_08\_50



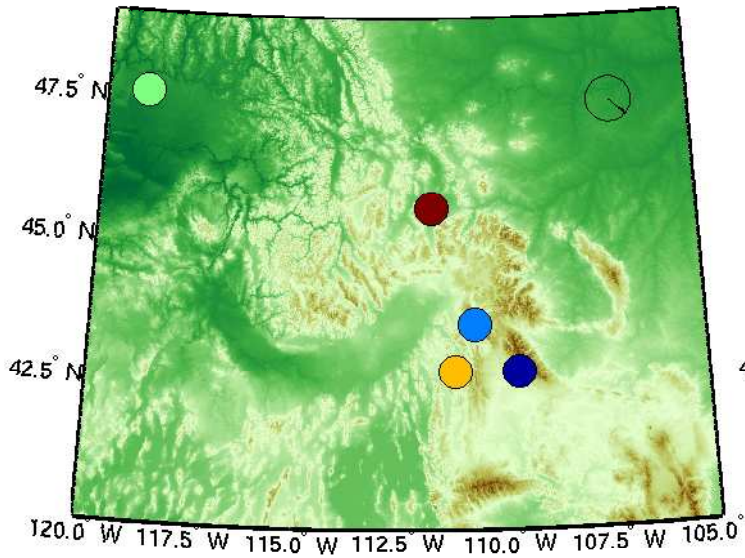
Sorted by t\*:Event\_2004\_289\_04\_08\_50



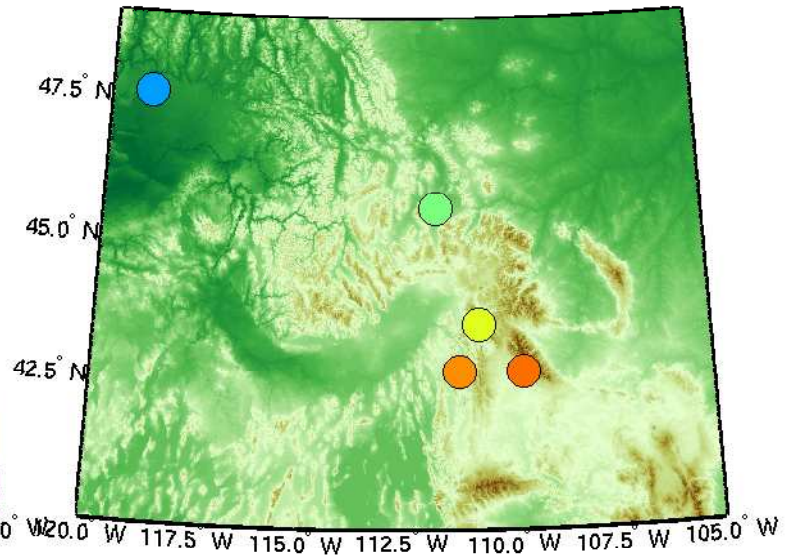
Stack  
Event\_2004\_289\_04\_08\_50



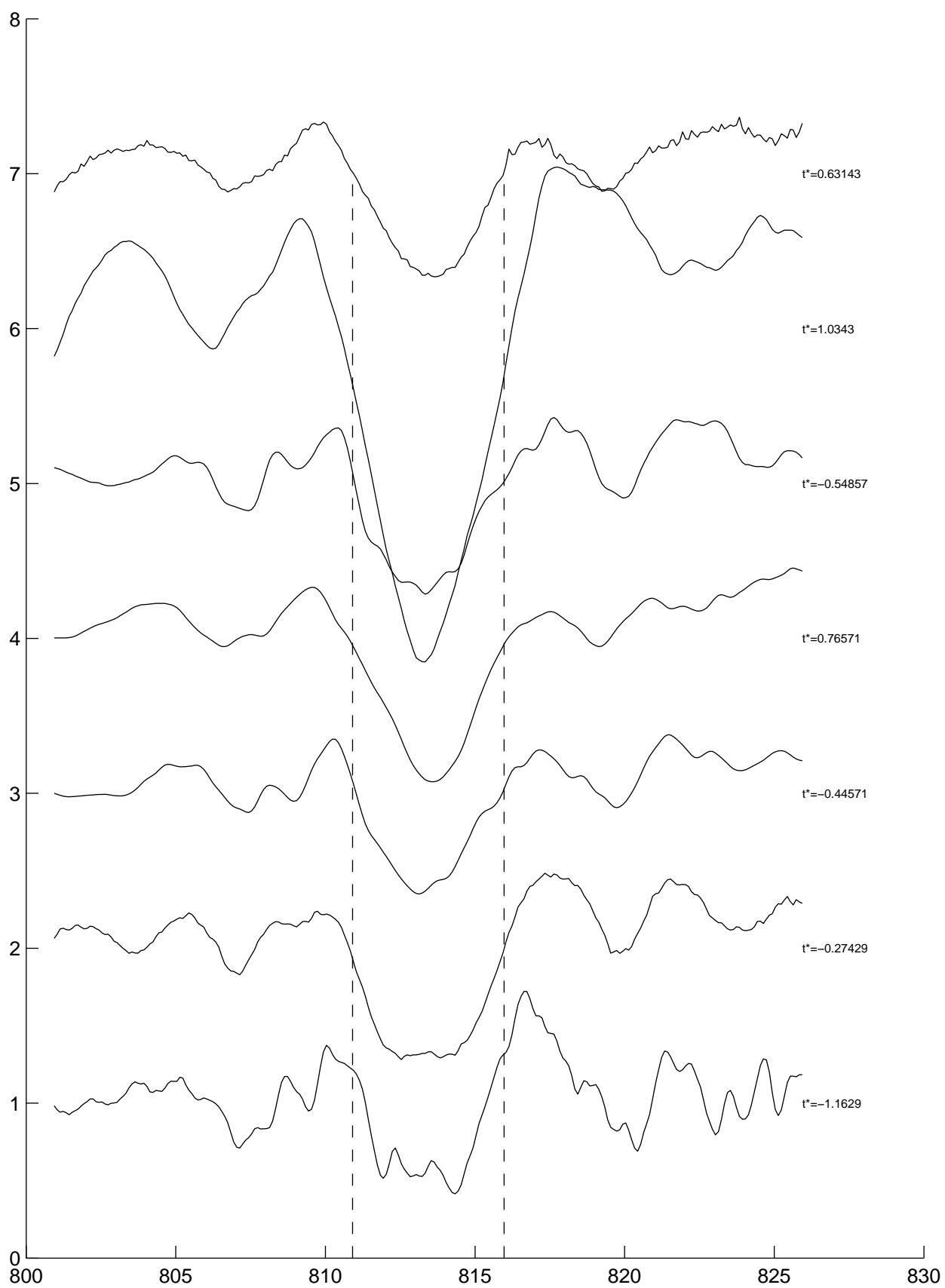
travel time residuals



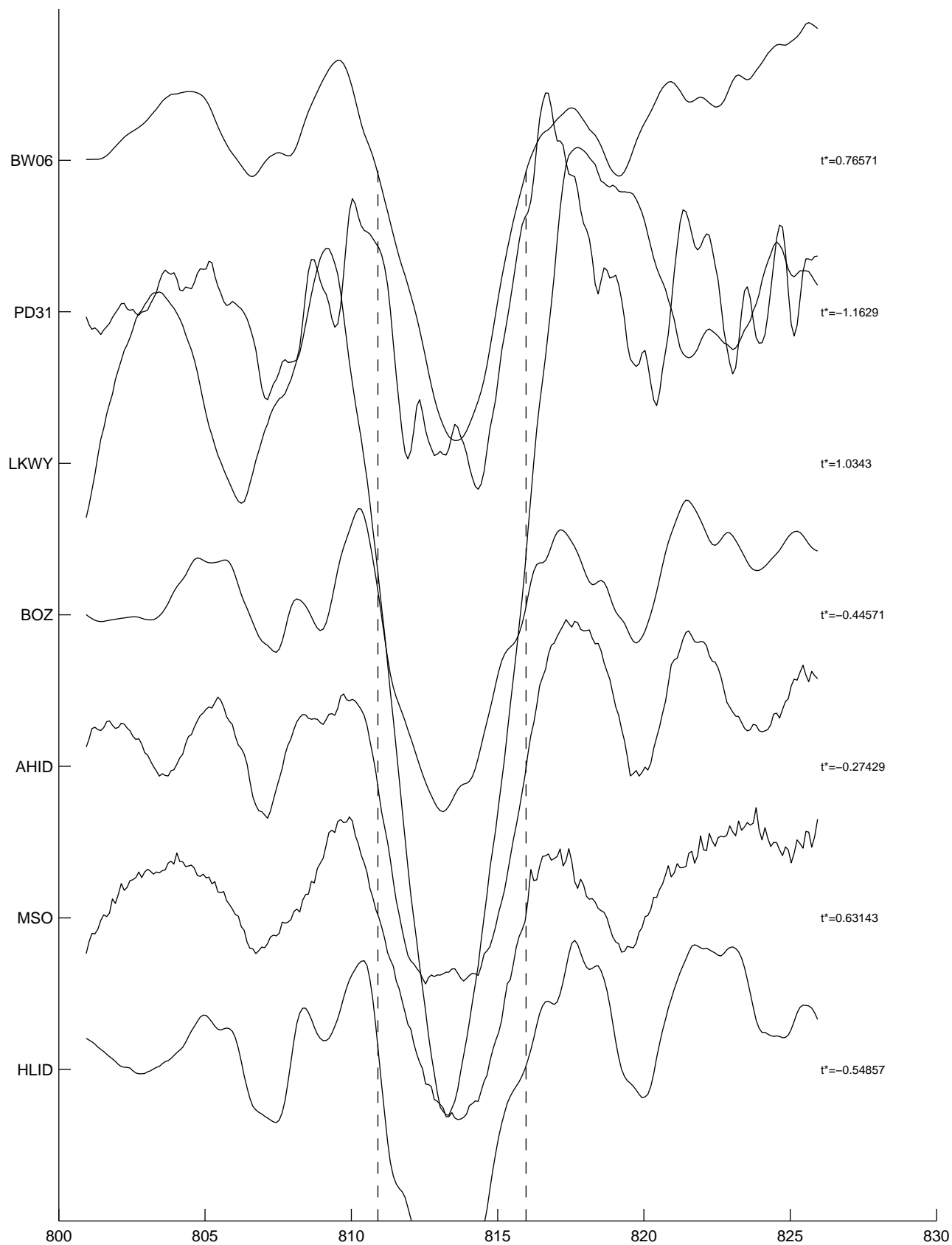
$t^*$  values



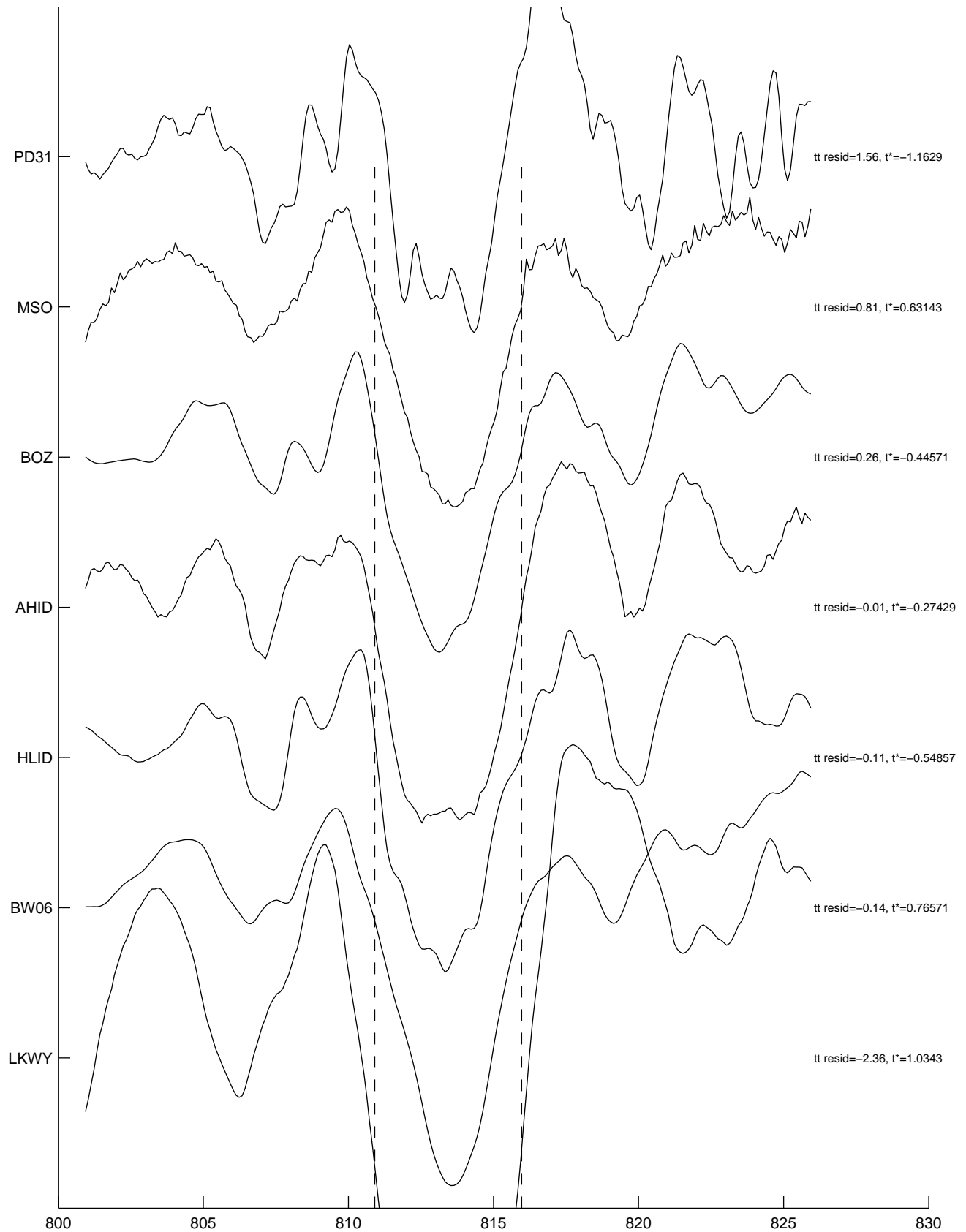
# Event\_2004\_316\_17\_34\_52



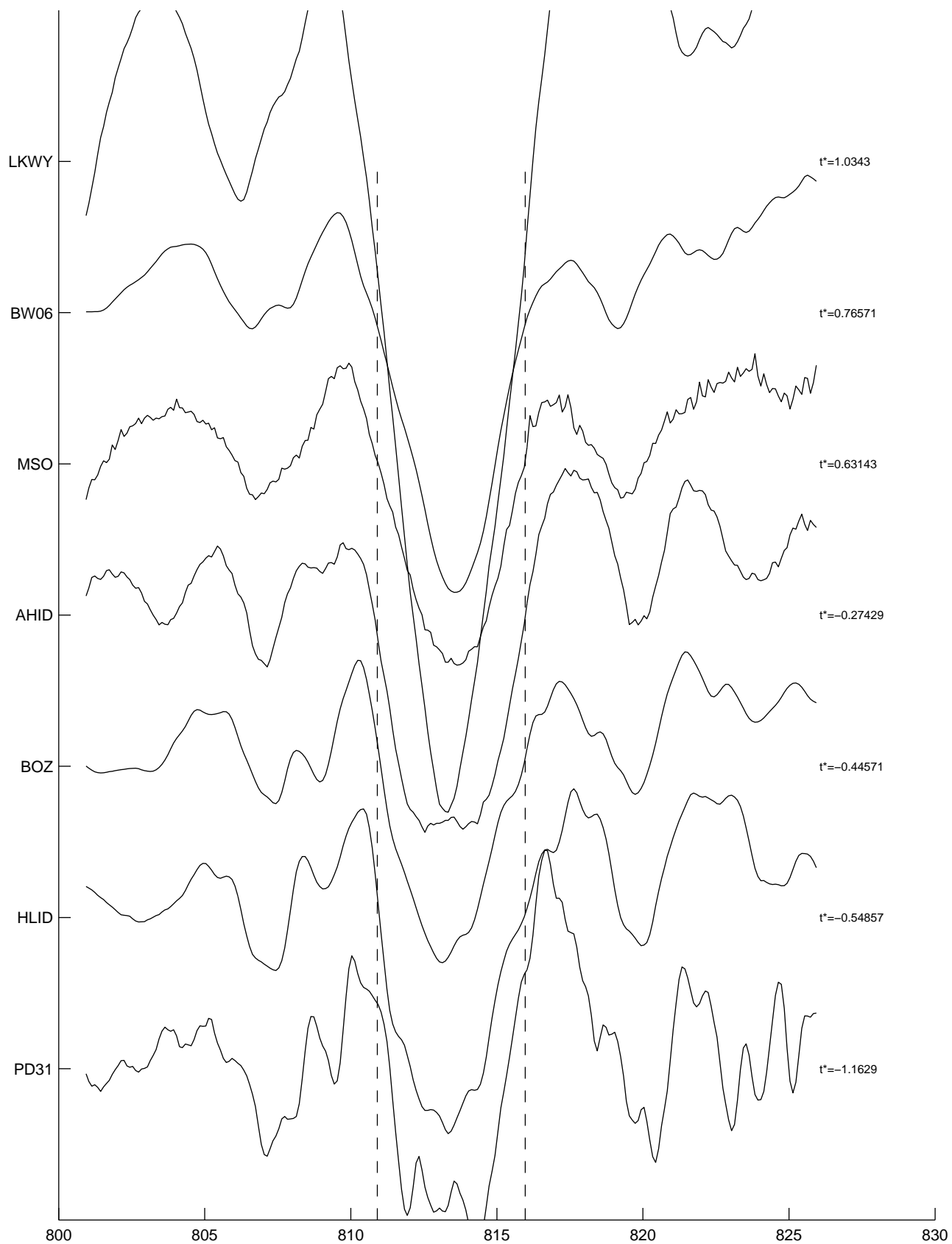
# Sorted by Delta:Event\_2004\_316\_17\_34\_52



# Sorted by travel time:Event\_2004\_316\_17\_34\_52



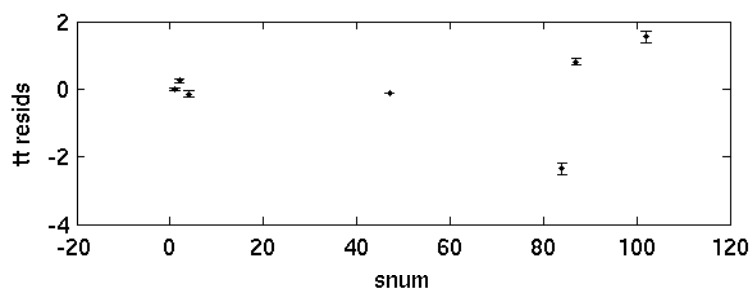
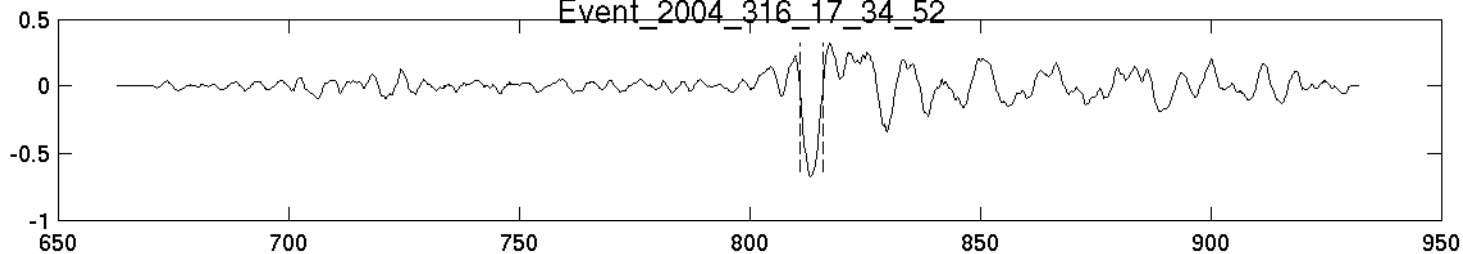
Sorted by  $t^*$ :Event\_2004\_316\_17\_34\_52



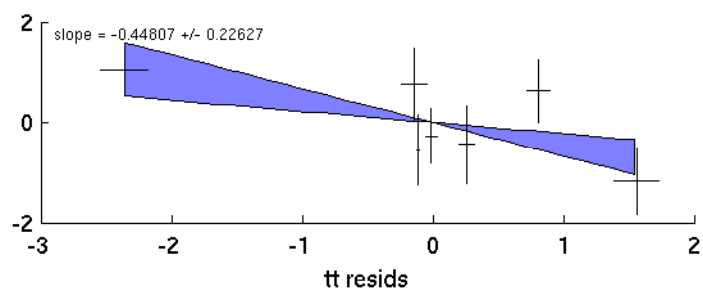
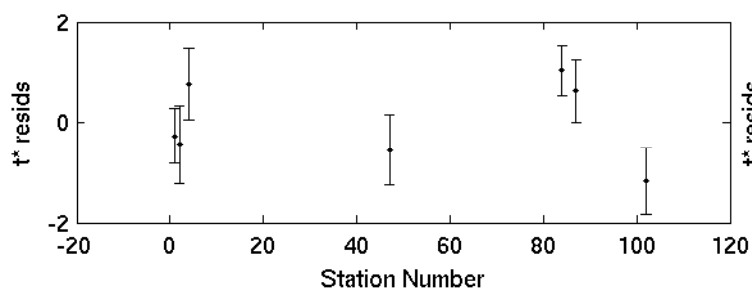


Event\_2004\_316\_17\_34\_52

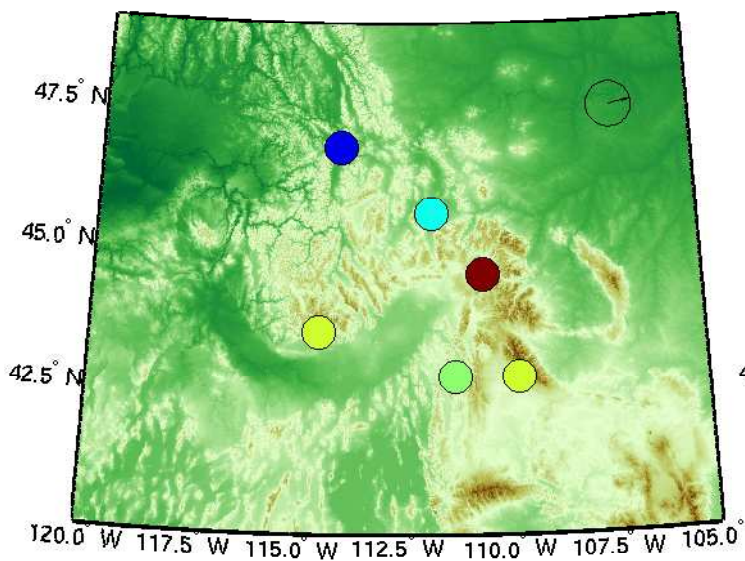
Stack



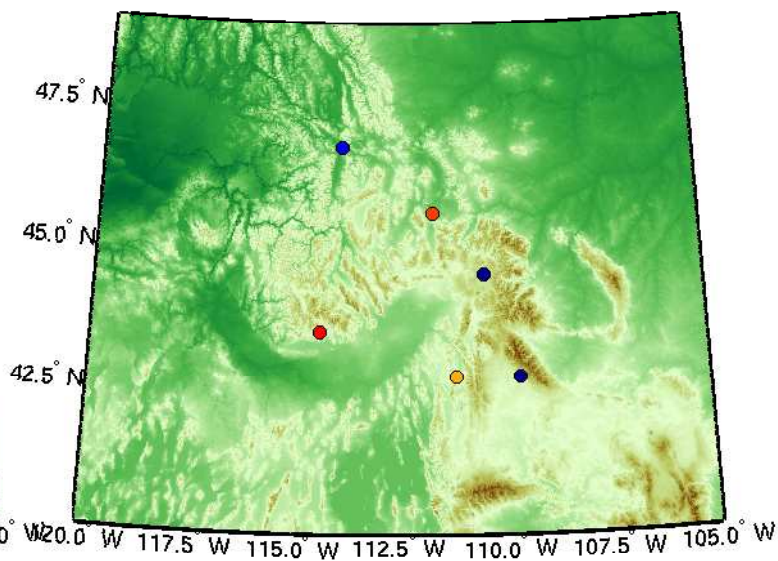
Baz = 259.4036  
Mean xcor value = 0.83857  
Range of  $t^*$  values is 2.1971  
Median  $t^*$  err is 0.66301  
Slope = -0.44807 +/- 0.22627



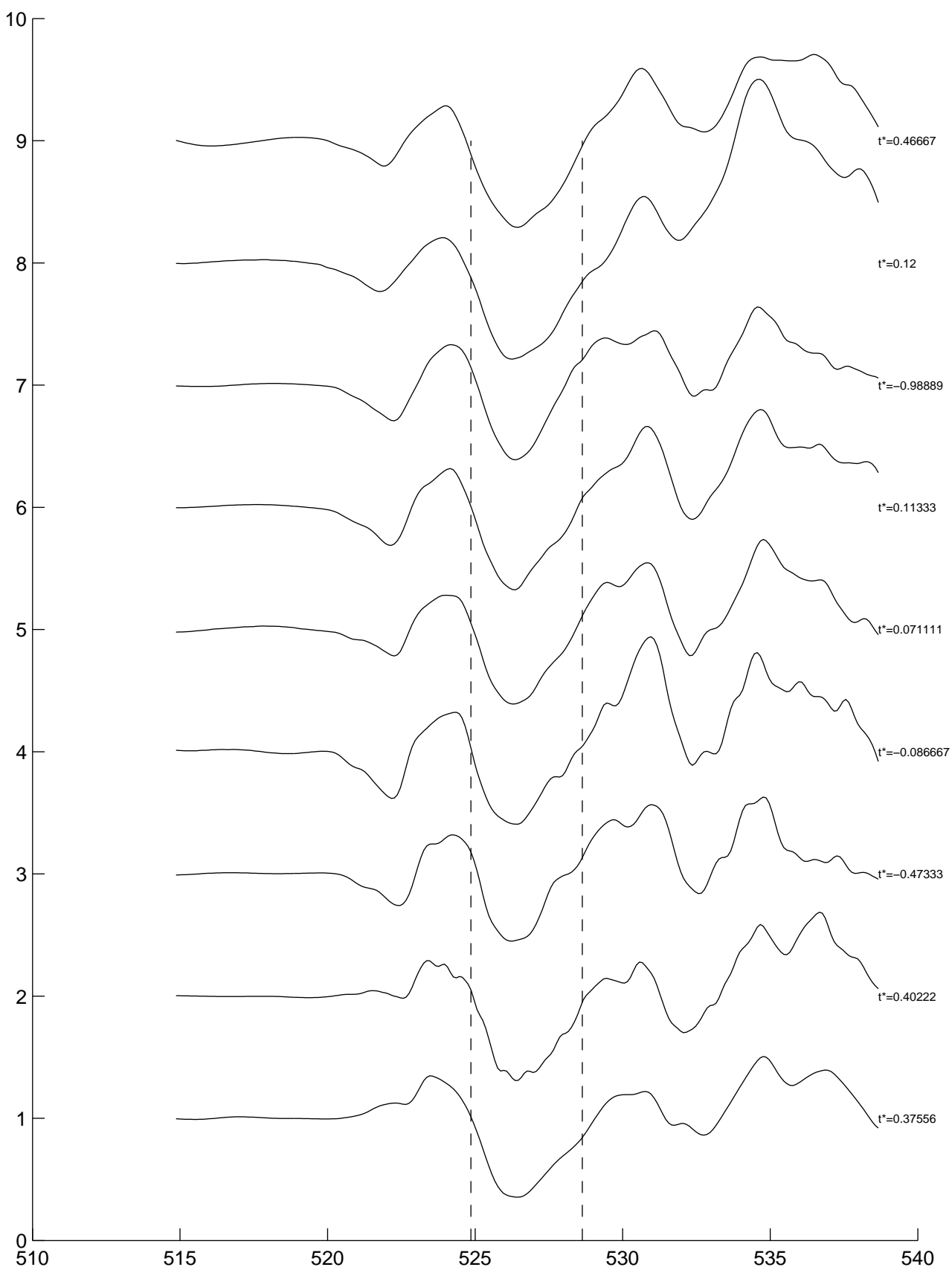
travel time residuals



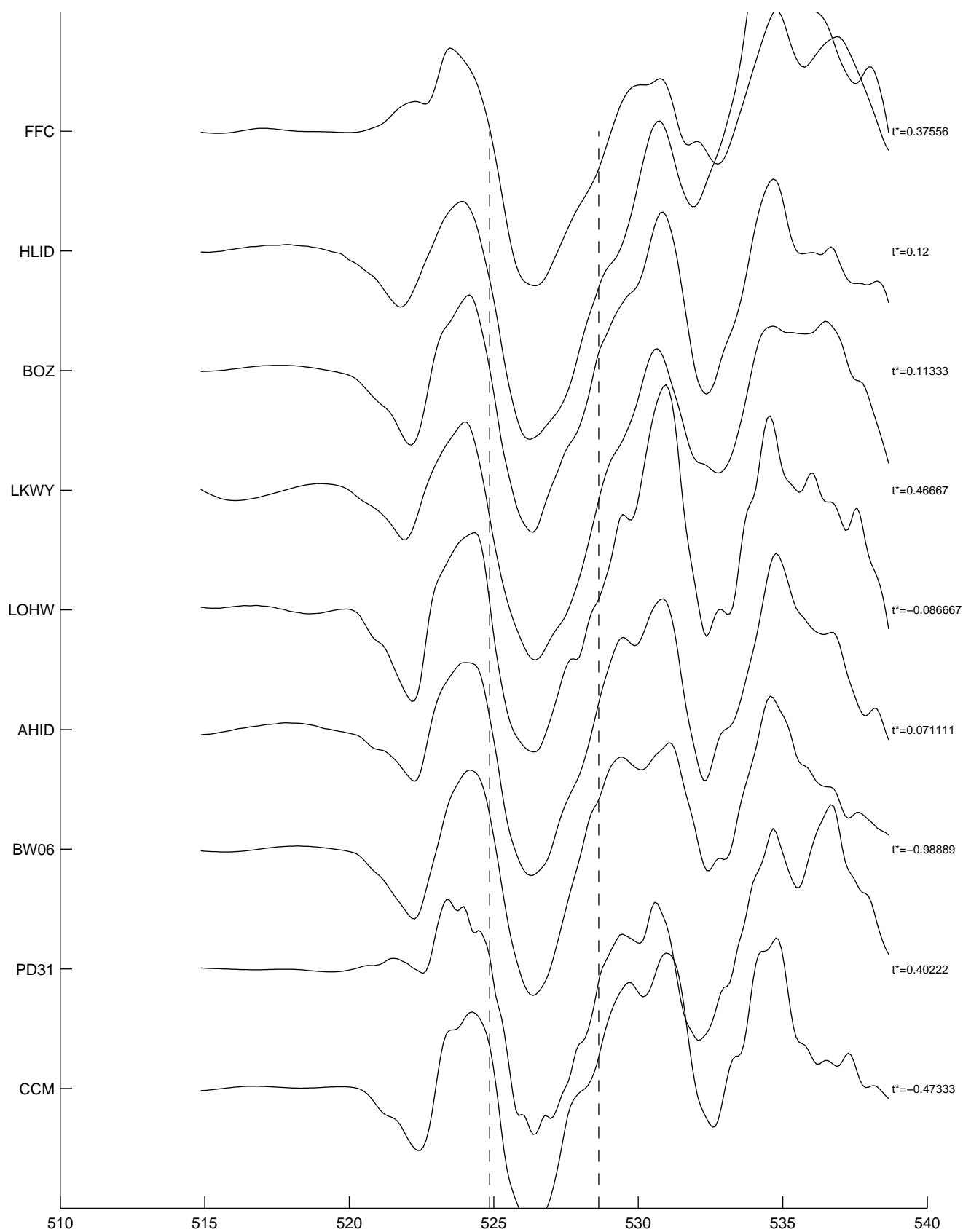
$t^*$  values



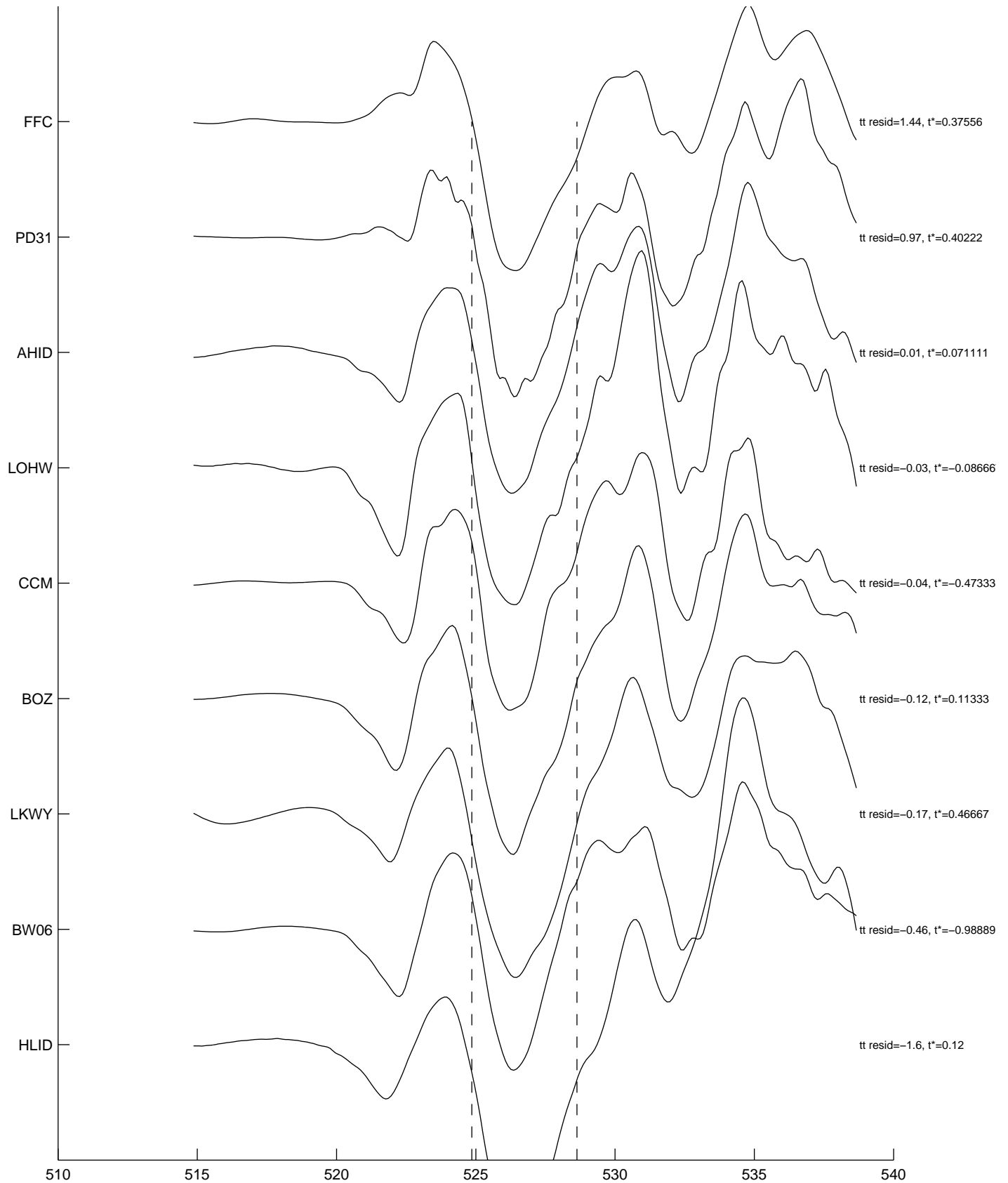
# Event\_2004\_320\_09\_06\_56



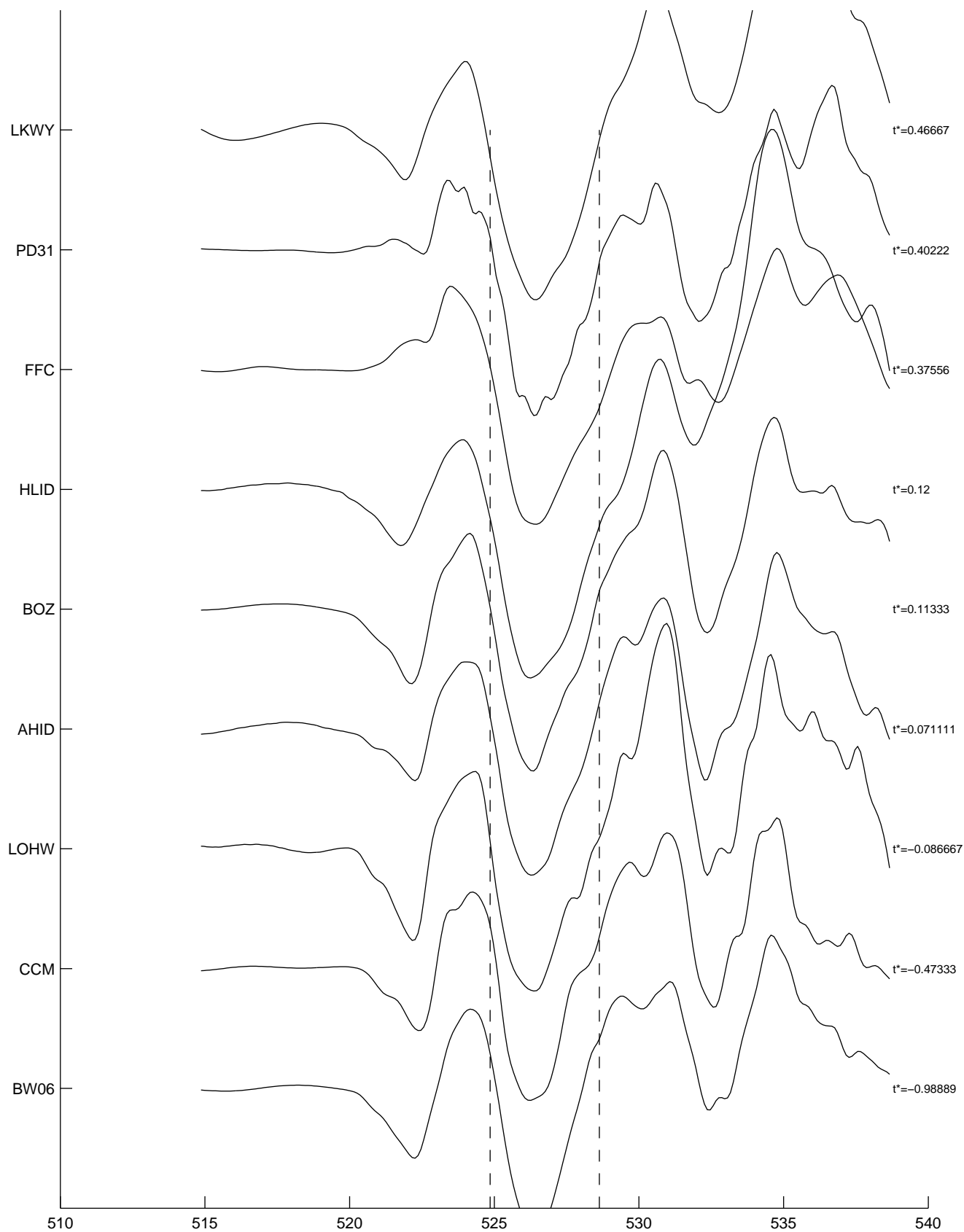
# Sorted by Delta:Event\_2004\_320\_09\_06\_56



# Sorted by travel time:Event\_2004\_320\_09\_06\_56

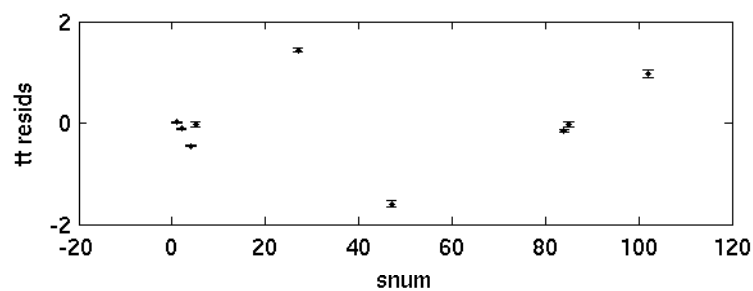
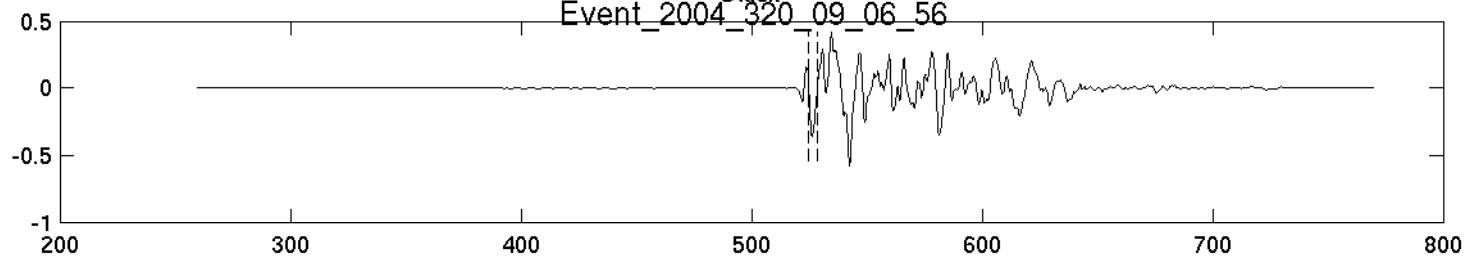


Sorted by  $t^*$ :Event\_2004\_320\_09\_06\_56

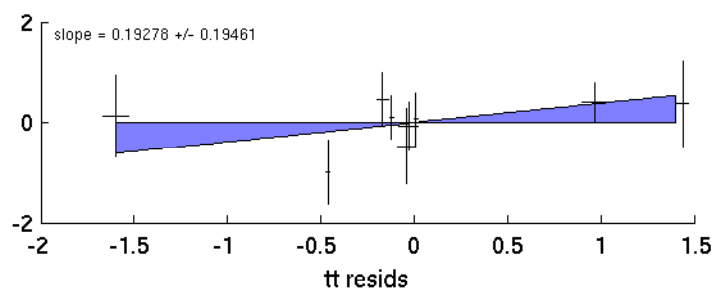
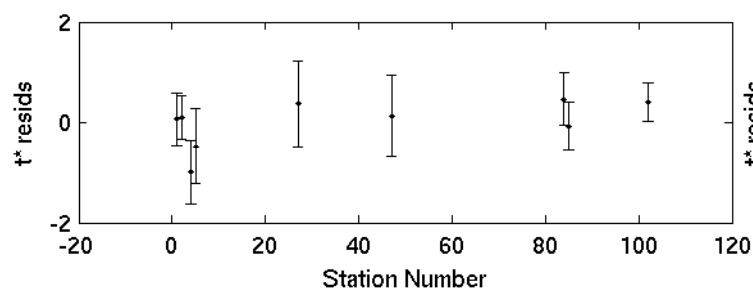


Event\_2004\_320\_09\_06\_56

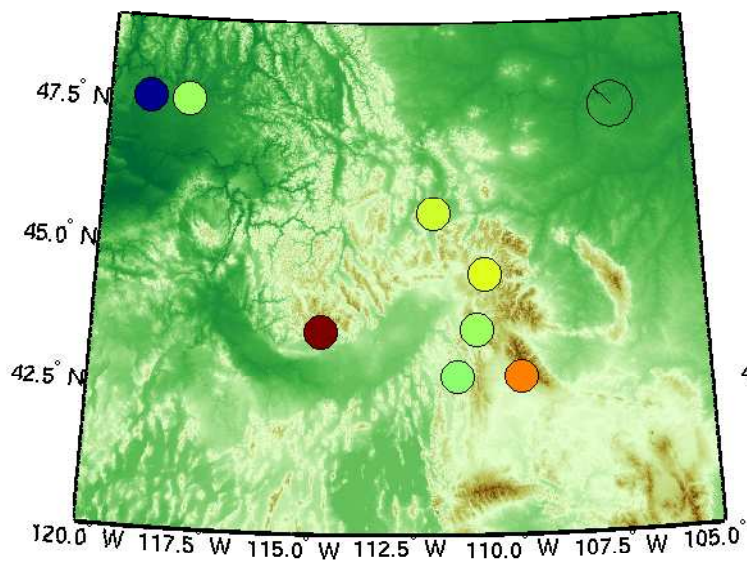
Stack



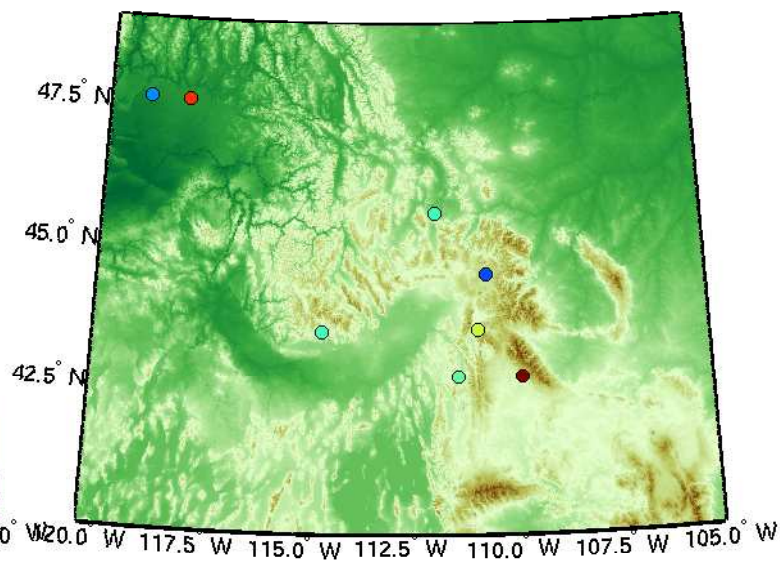
Baz = 136.8528  
Mean xcor value = 0.82444  
Range of  $t^*$  values is 1.4556  
Median  $t^*$  err is 0.51938  
Slope = 0.19278 +/- 0.19461



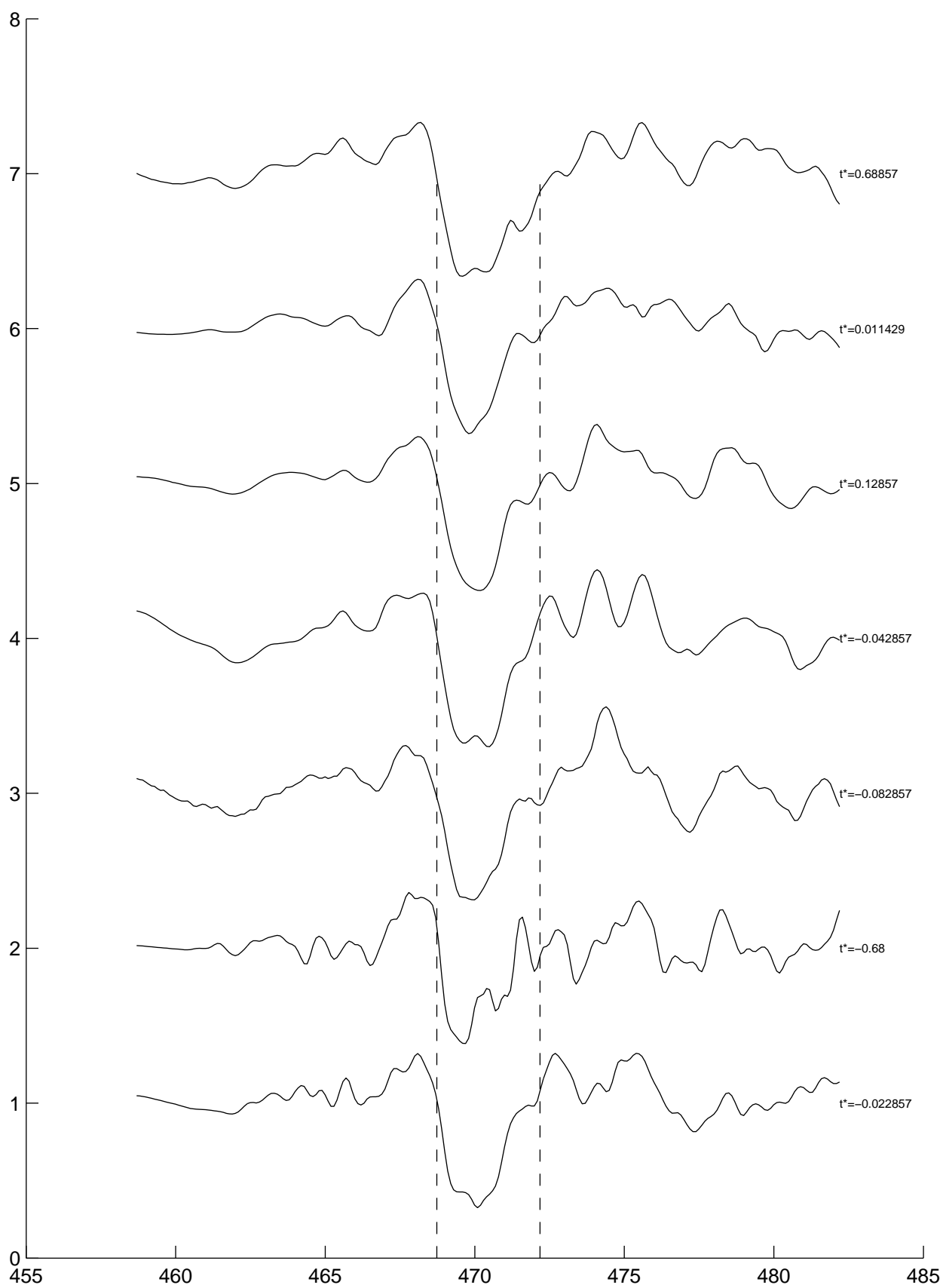
travel time residuals



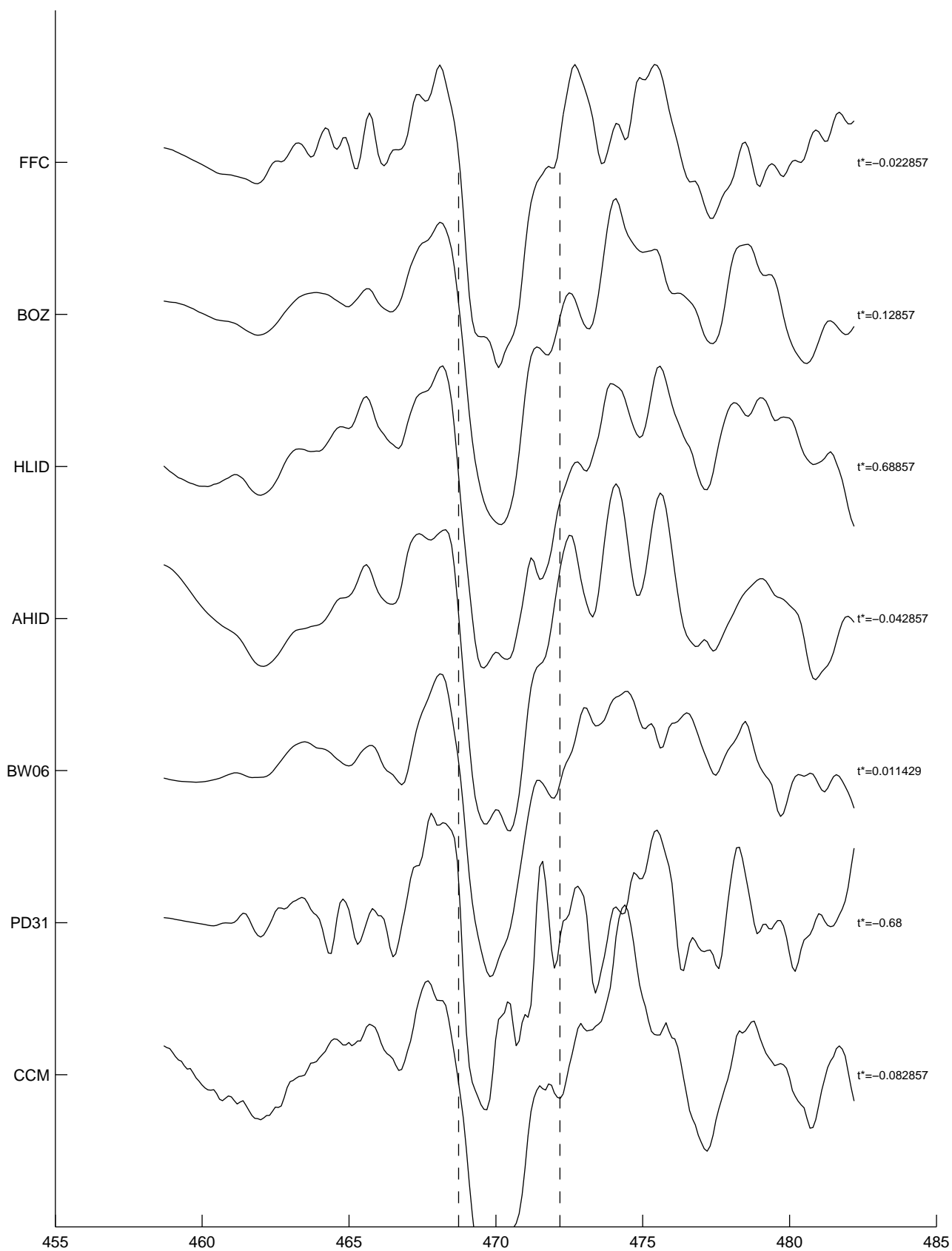
$t^*$  values



# Event\_2004\_325\_08\_07\_22

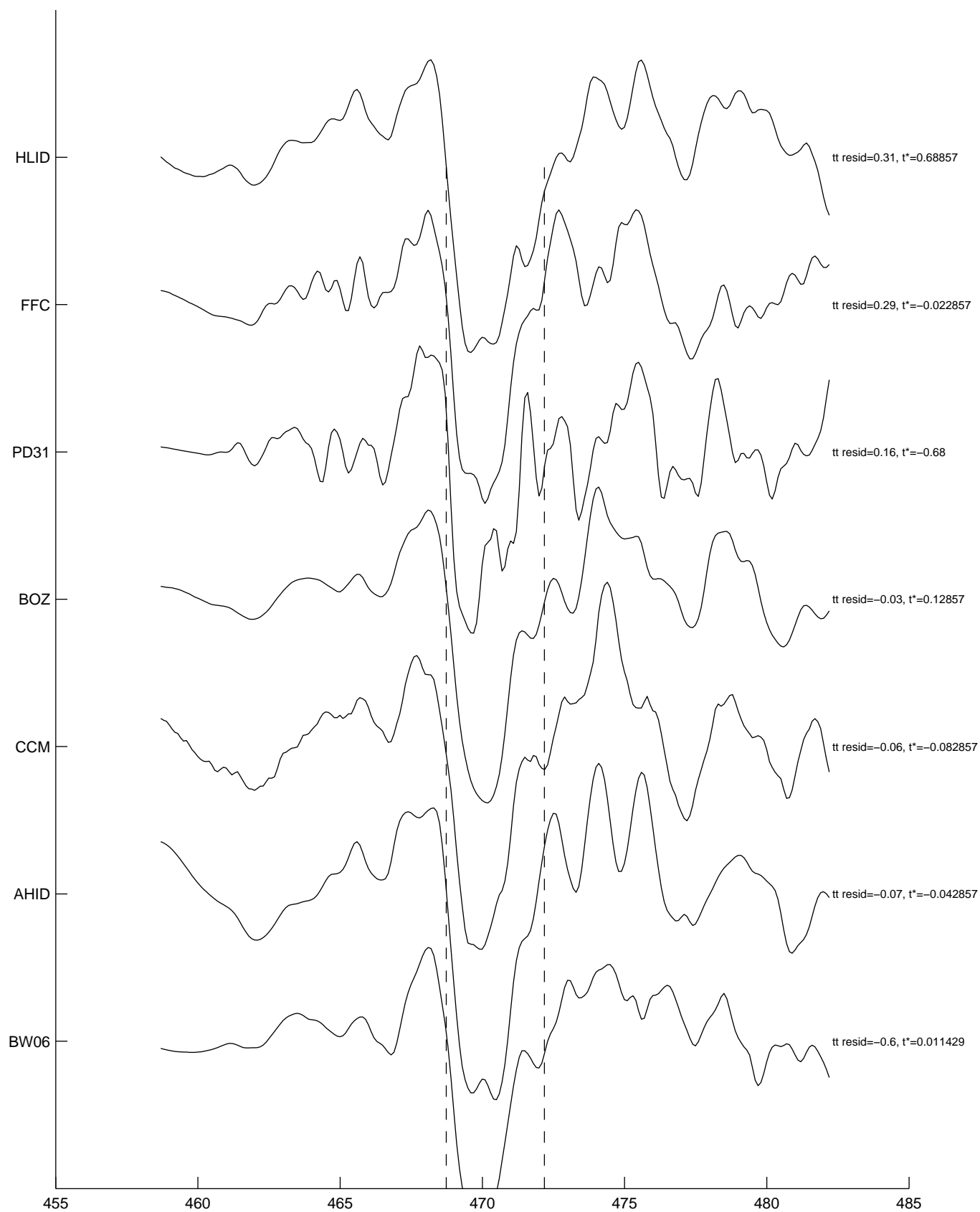


# Sorted by Delta:Event\_2004\_325\_08\_07\_22

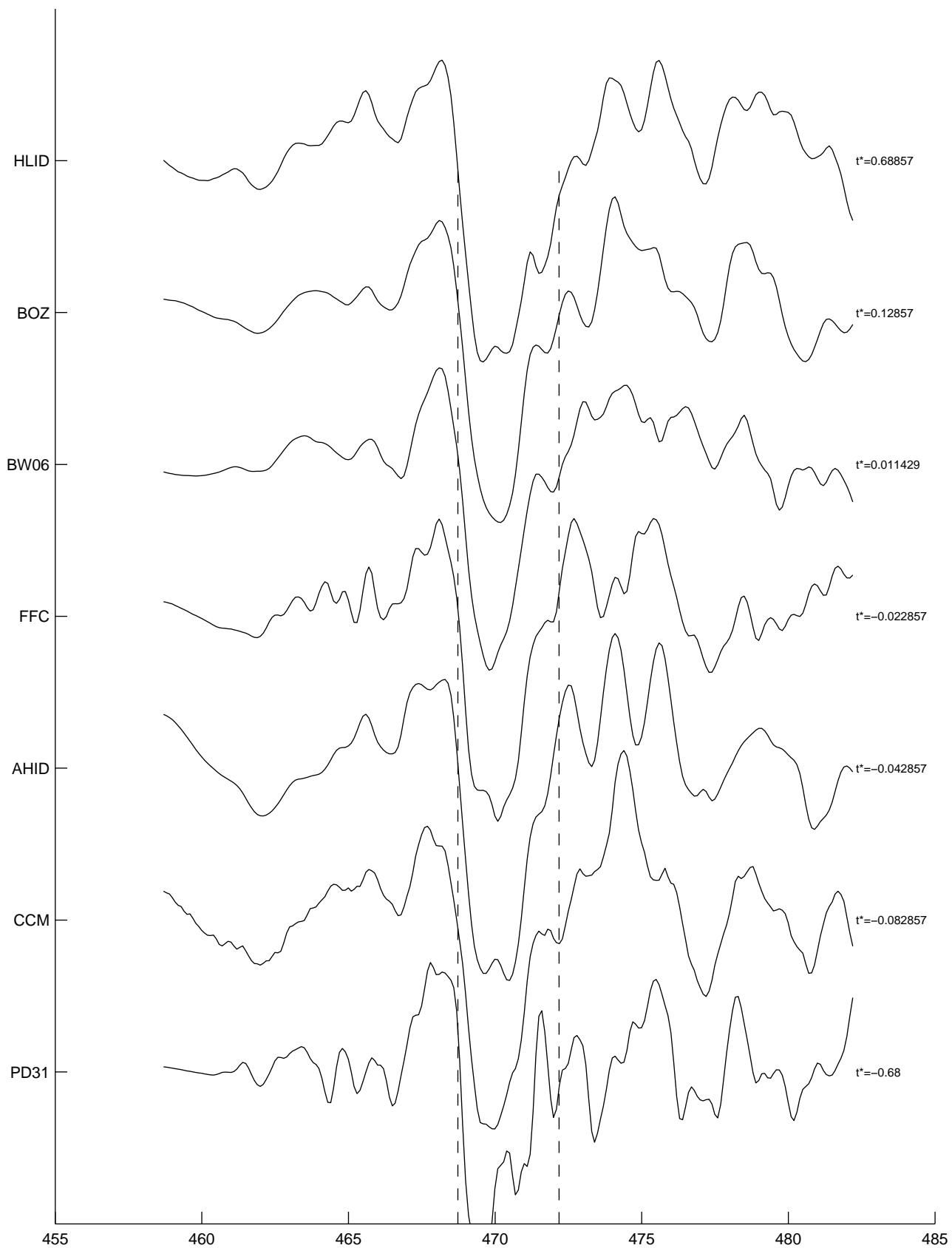




# Sorted by travel time: Event\_2004\_325\_08\_07\_22

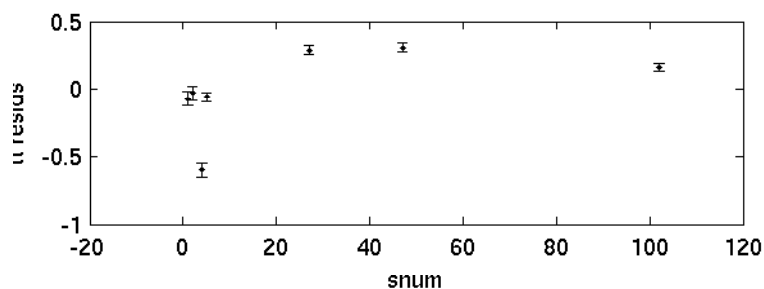
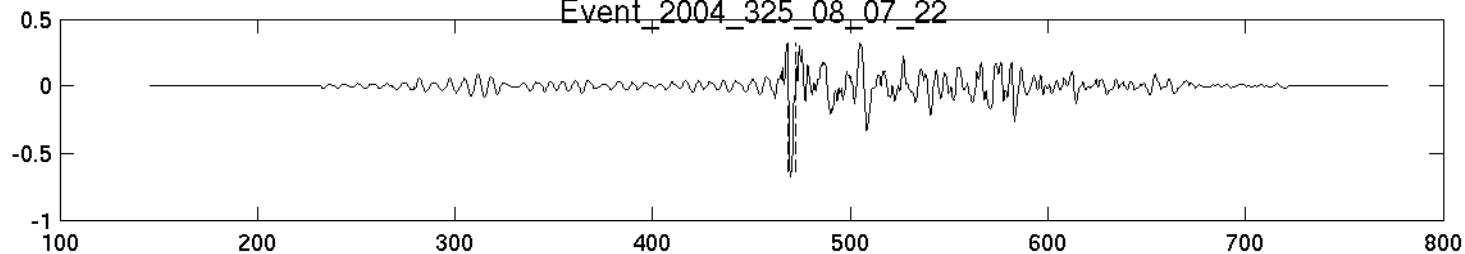


Sorted by t\*:Event\_2004\_325\_08\_07\_22

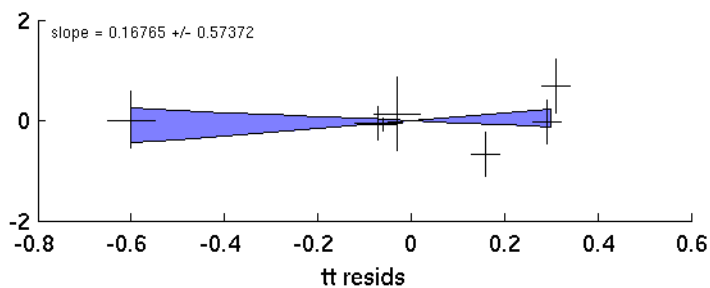
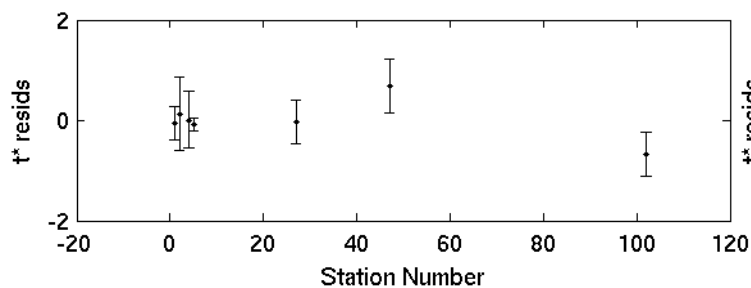


# Event\_2004\_325\_08\_07\_22

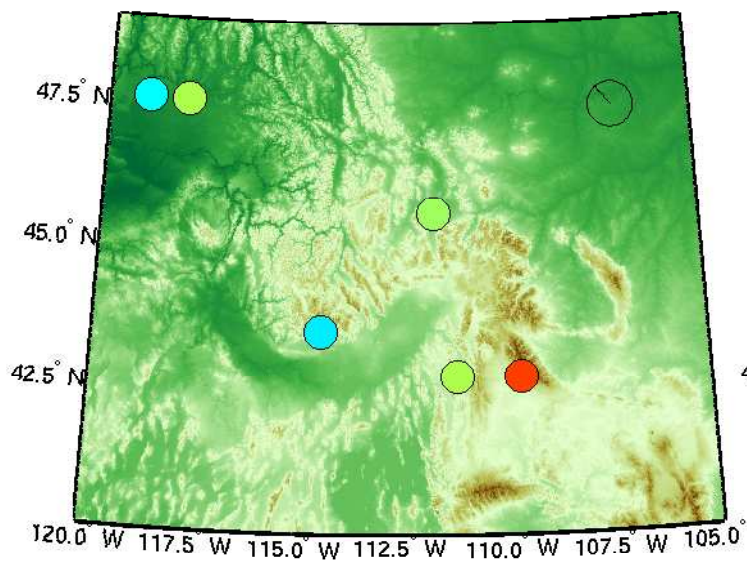
Stack



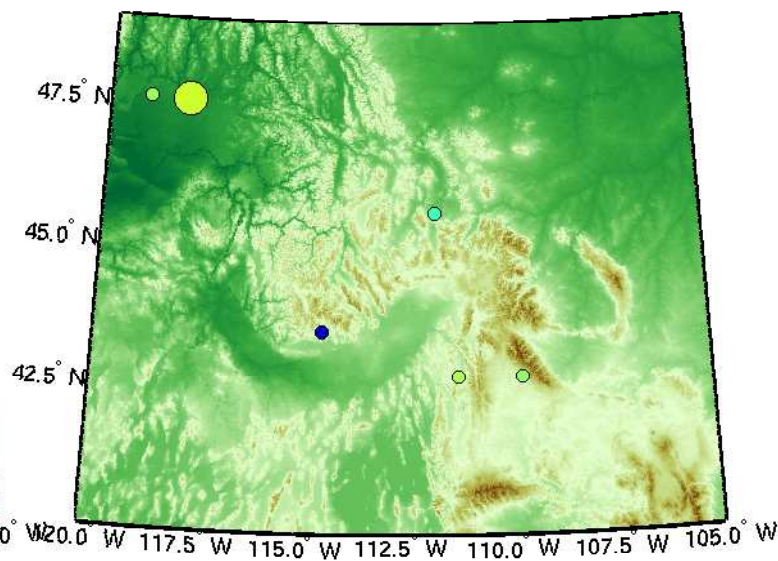
Baz = 142.4723  
Mean xcor value = 0.78286  
Range of  $t^*$  values is 1.3686  
Median  $t^*$  err is 0.44428  
Slope = 0.16765 +/- 0.57372



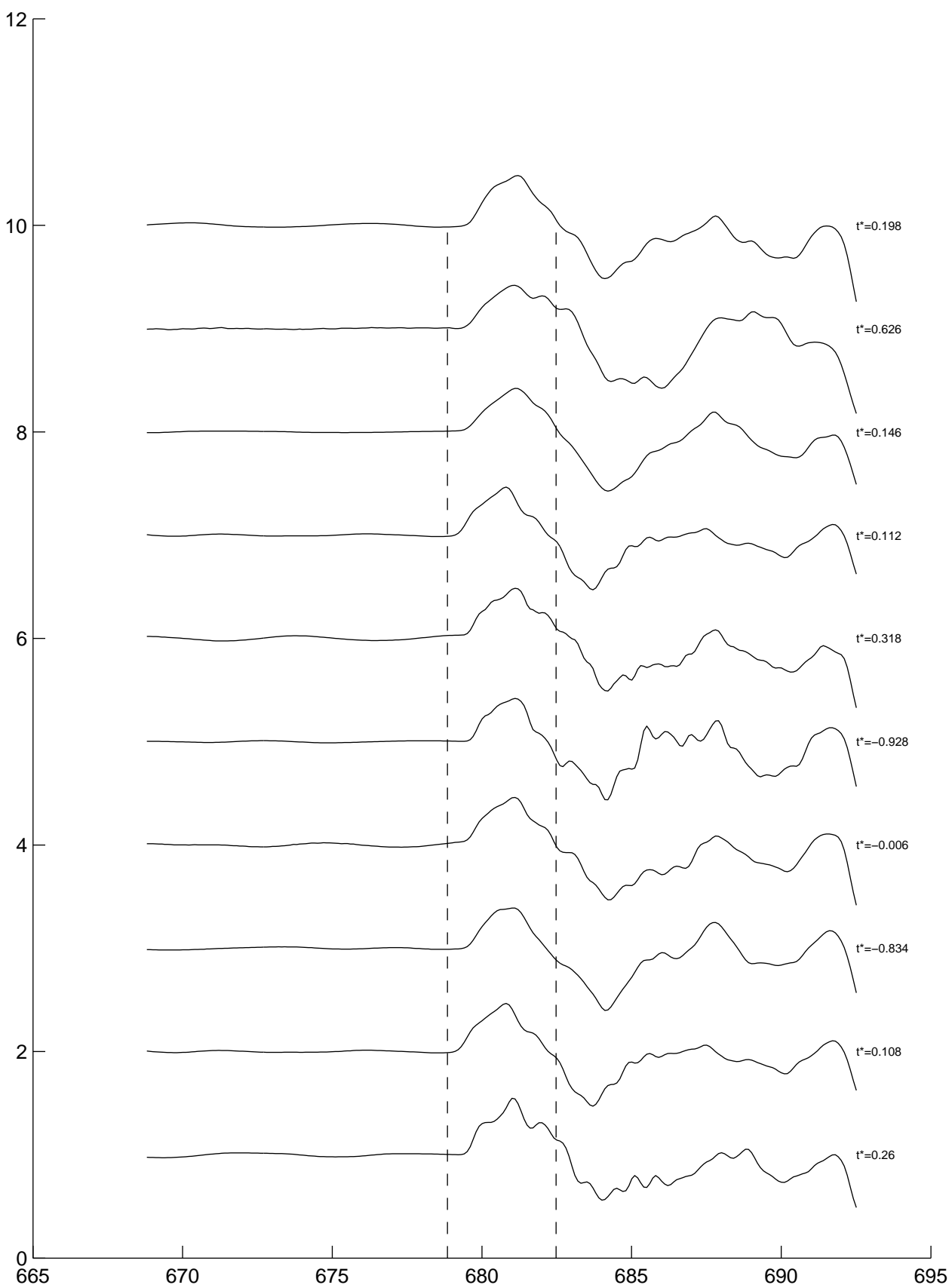
travel time residuals



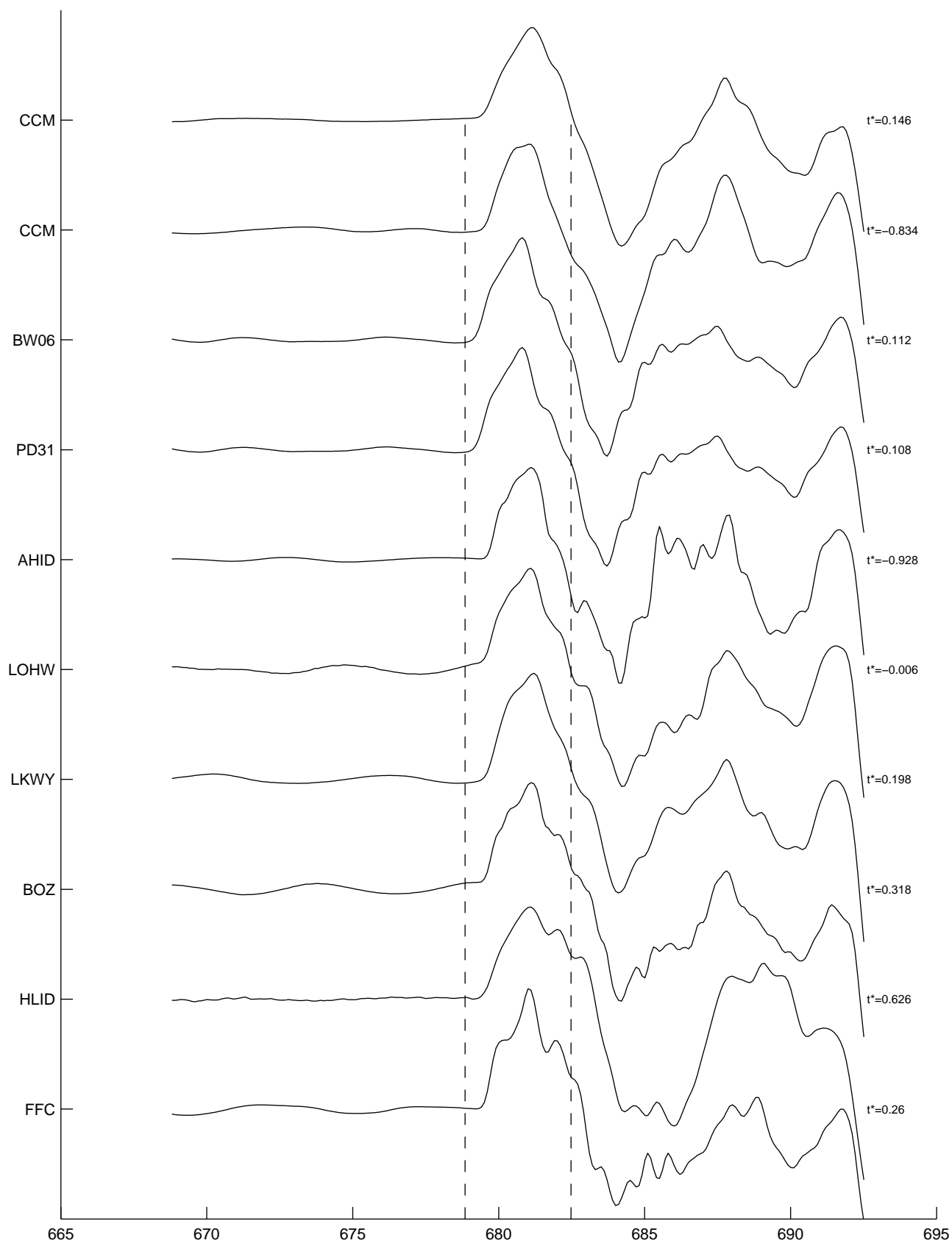
$t^*$  values



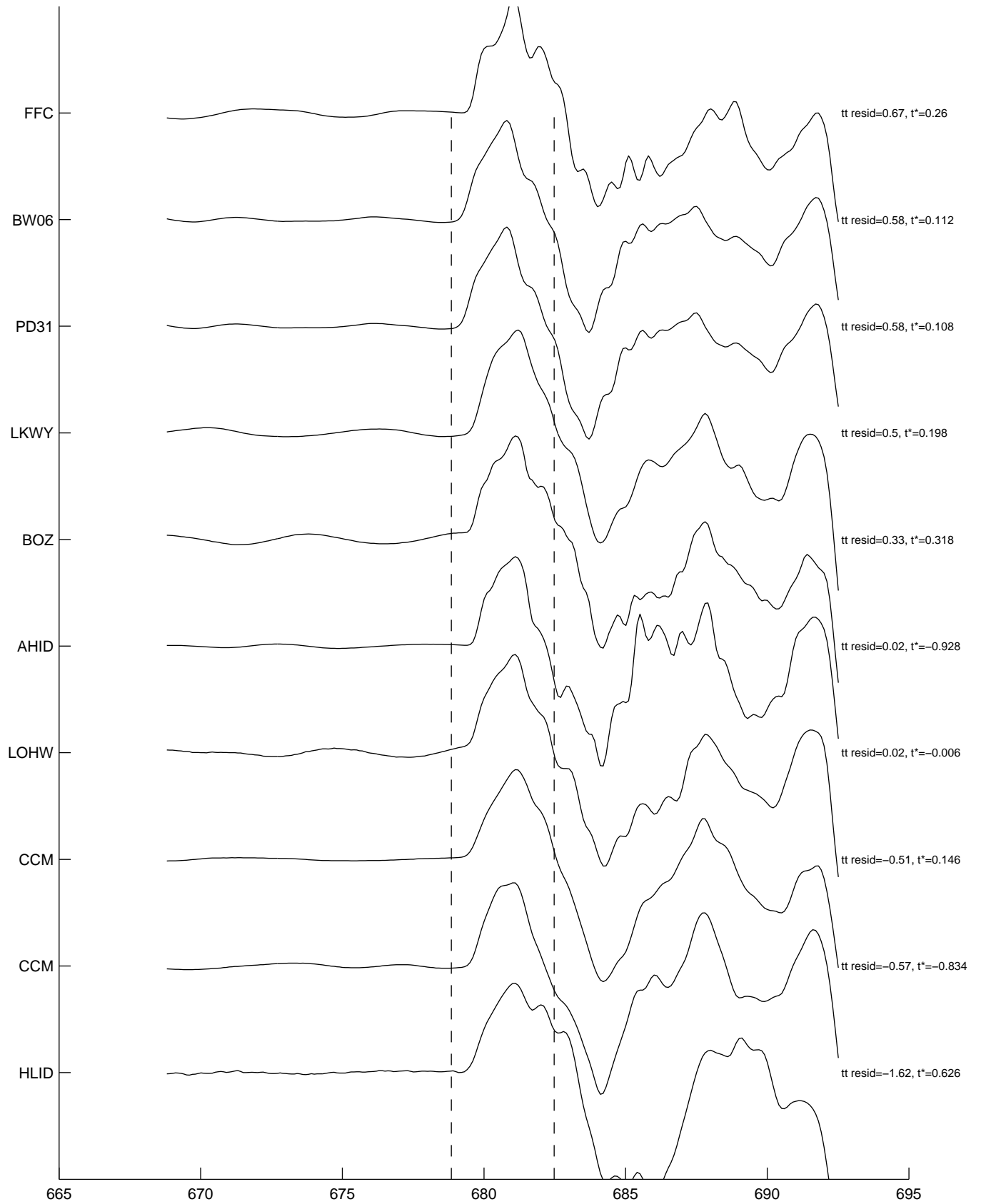
# Event\_2004\_333\_18\_32\_14



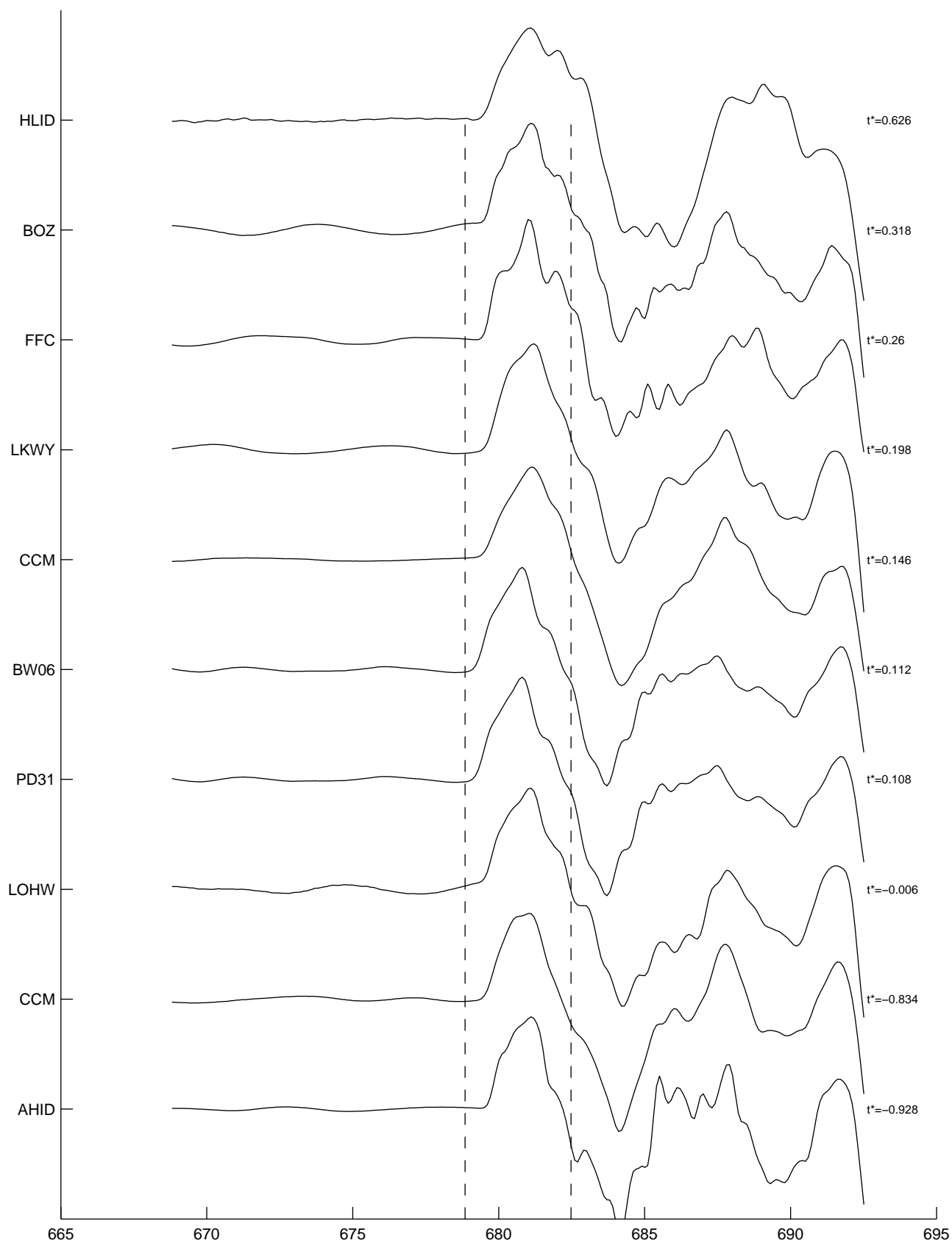
# Sorted by Delta:Event\_2004\_333\_18\_32\_14



# Sorted by travel time:Event\_2004\_333\_18\_32\_14

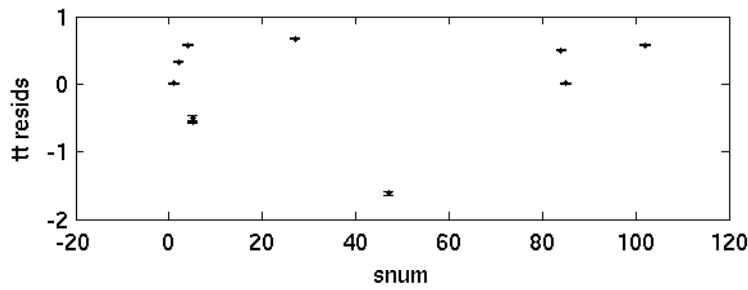
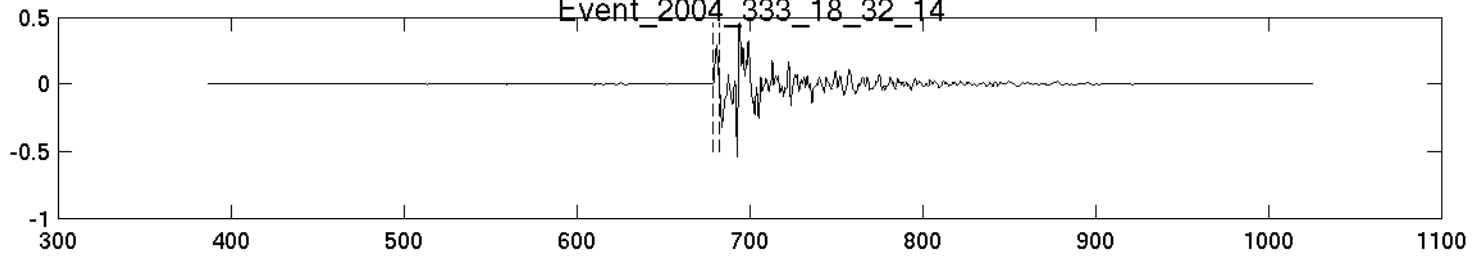


Sorted by  $t^*$ :Event\_2004\_333\_18\_32\_14

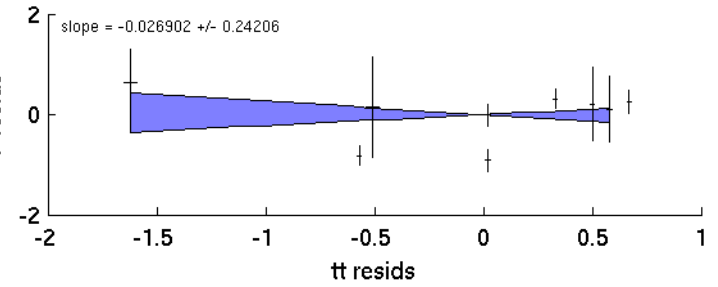
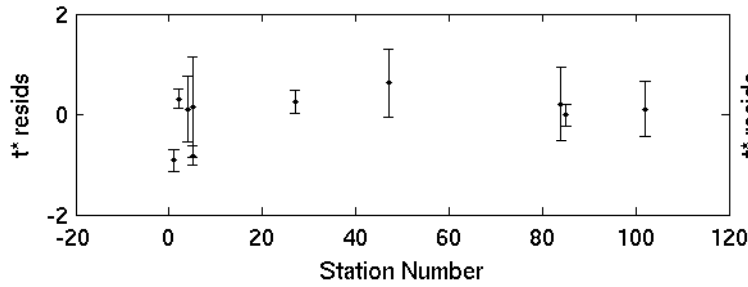


Event\_2004\_333\_18\_32\_14

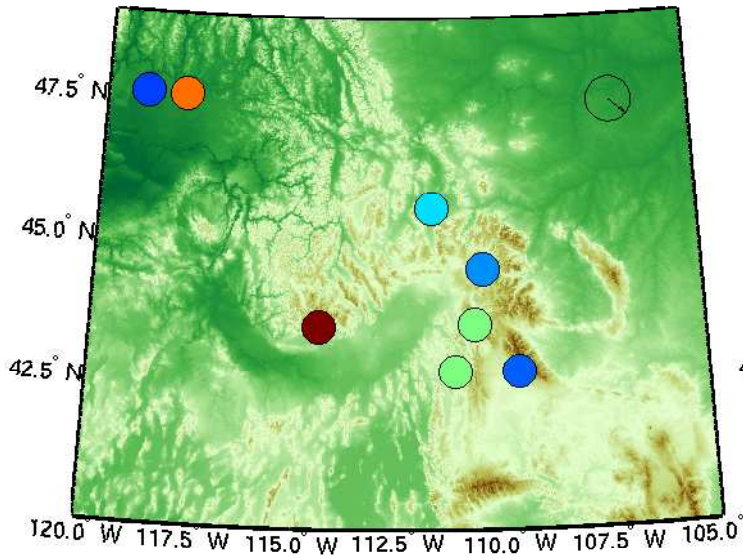
Stack



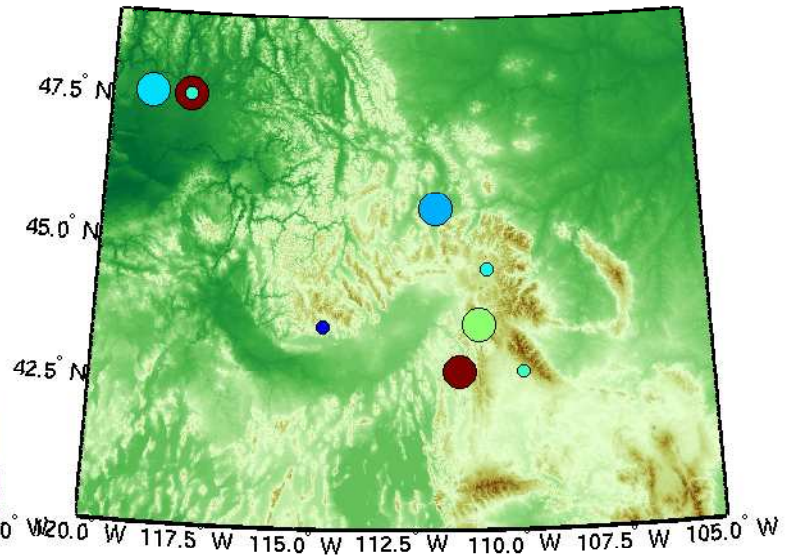
Baz = 312.8874  
Mean xcor value = 0.812  
Range of  $t^*$  values is 1.554  
Median  $t^*$  err is 0.38954  
Slope =  $-0.026902 \pm 0.24206$



travel time residuals

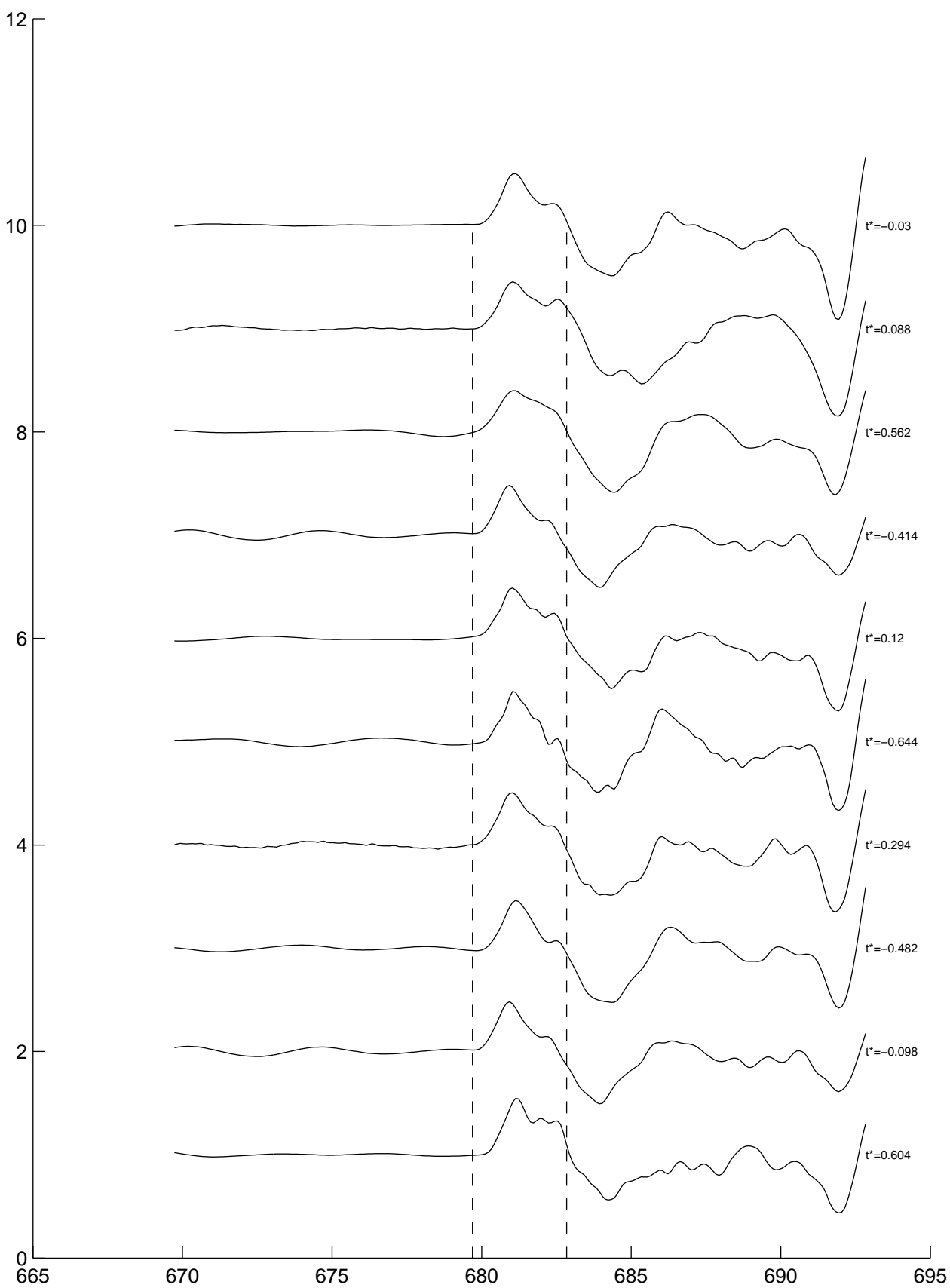


$t^*$  values

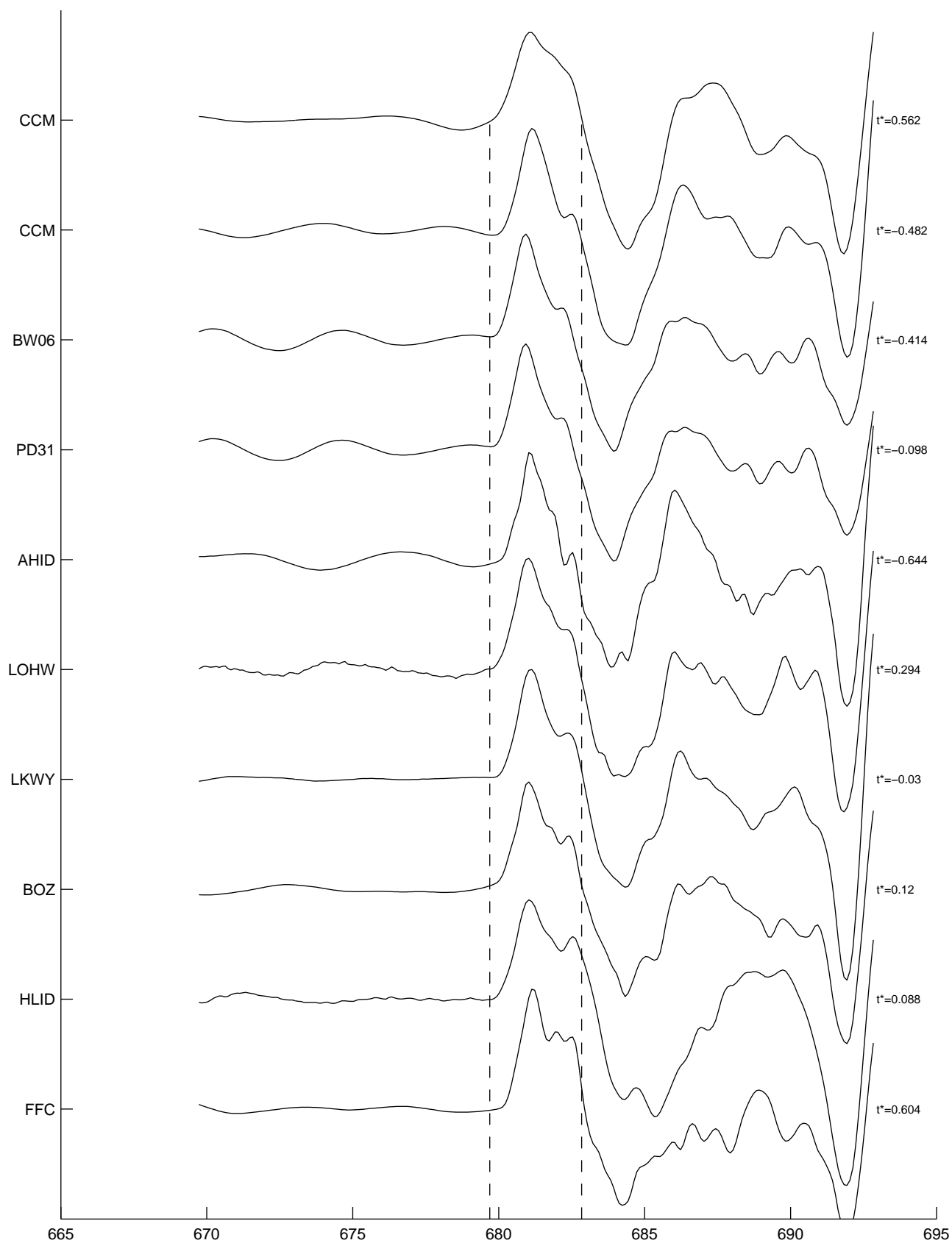




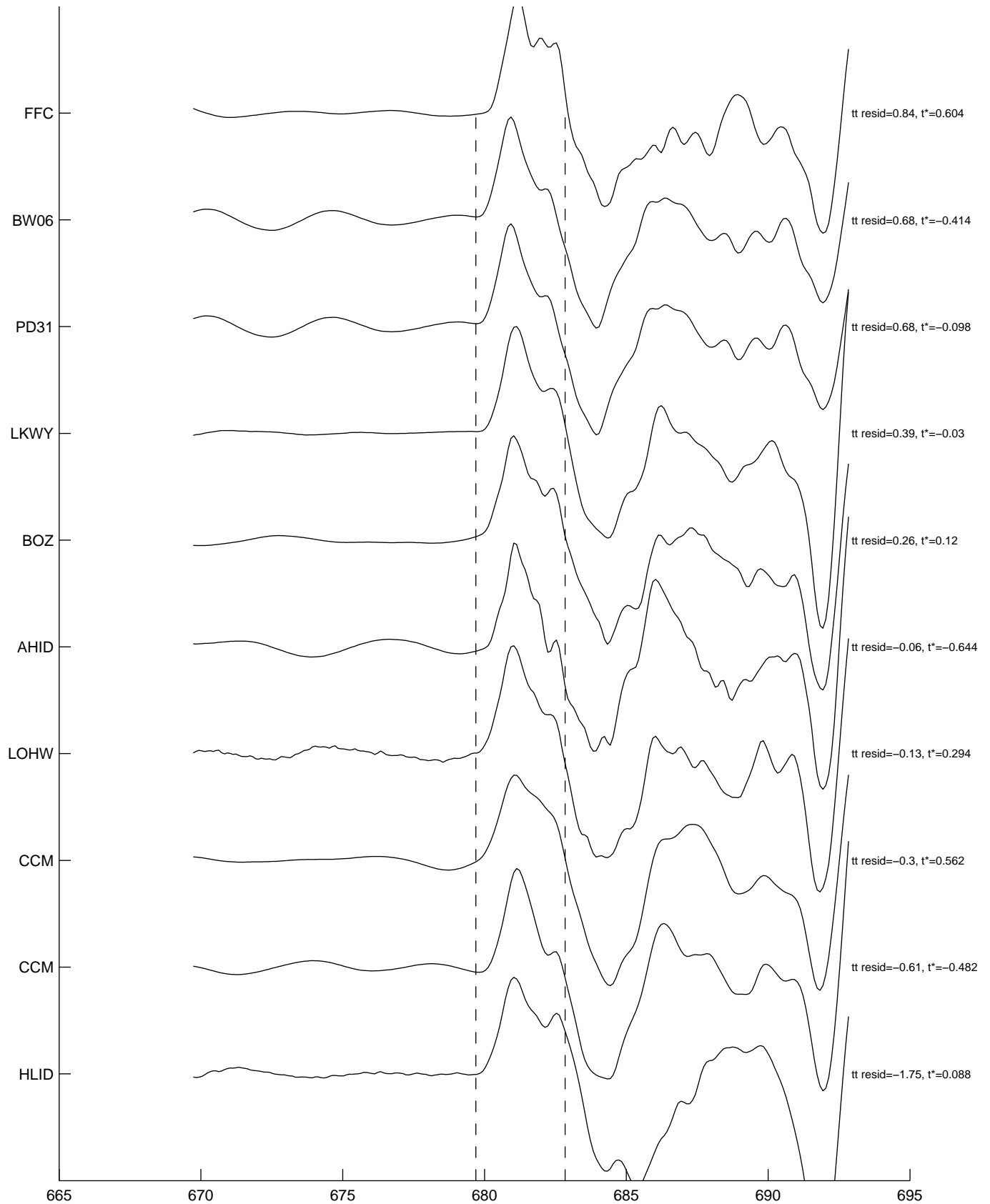
# Event\_2004\_341\_14\_15\_11



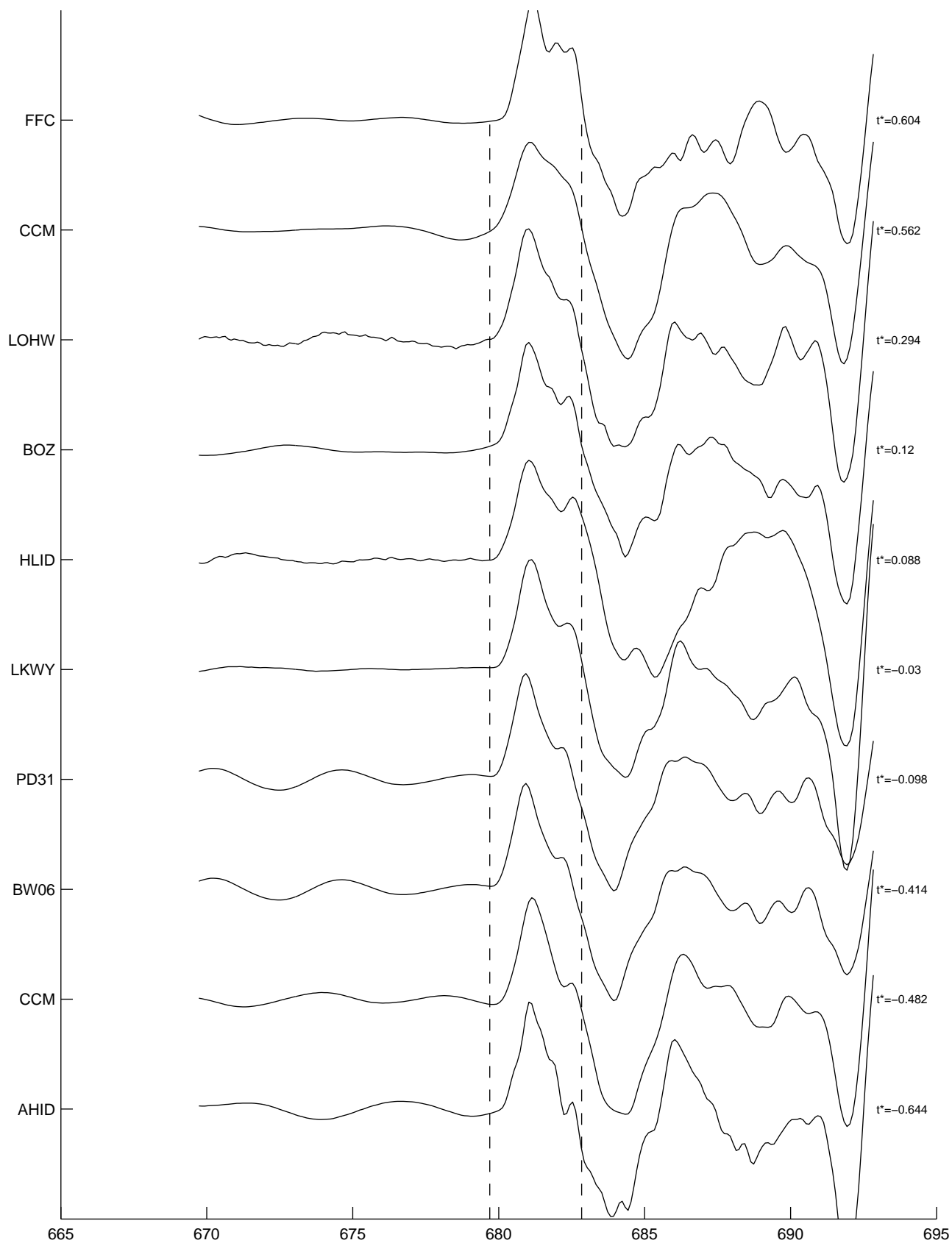
# Sorted by Delta:Event\_2004\_341\_14\_15\_11



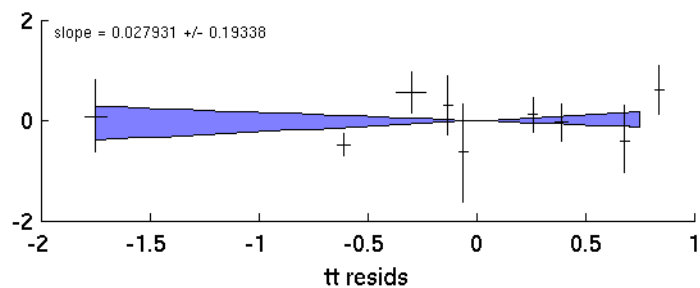
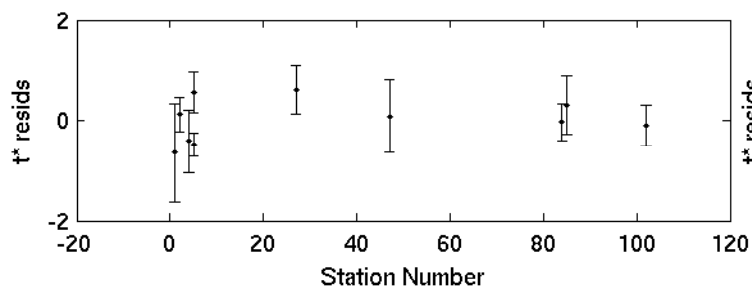
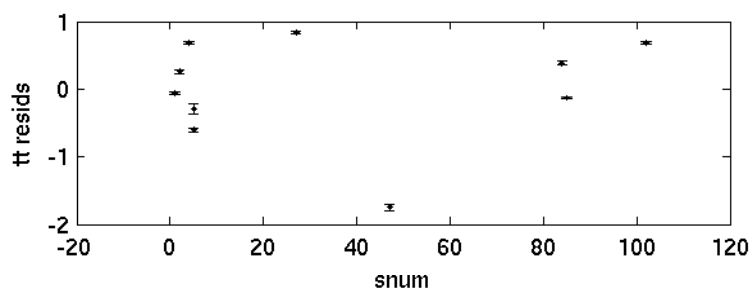
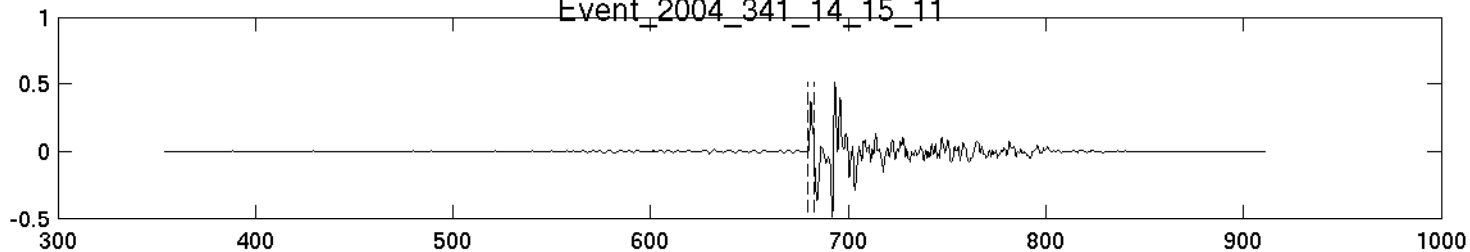
# Sorted by travel time:Event\_2004\_341\_14\_15\_11



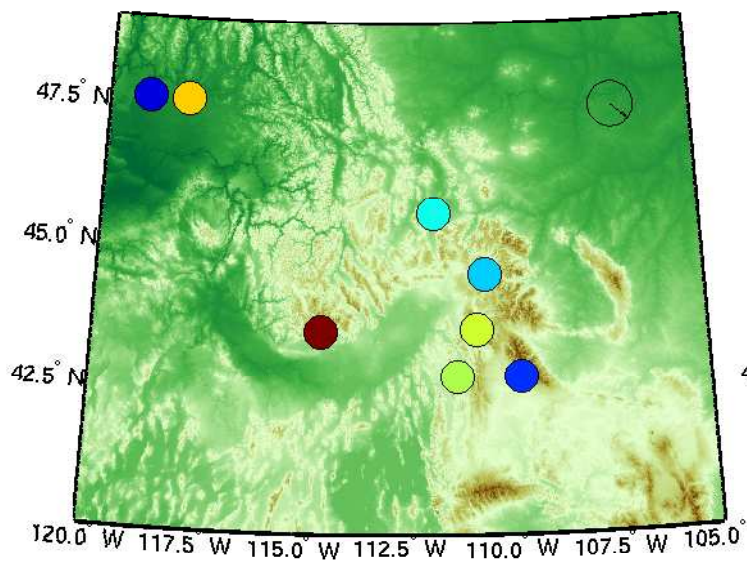
Sorted by  $t^*$ :Event\_2004\_341\_14\_15\_11



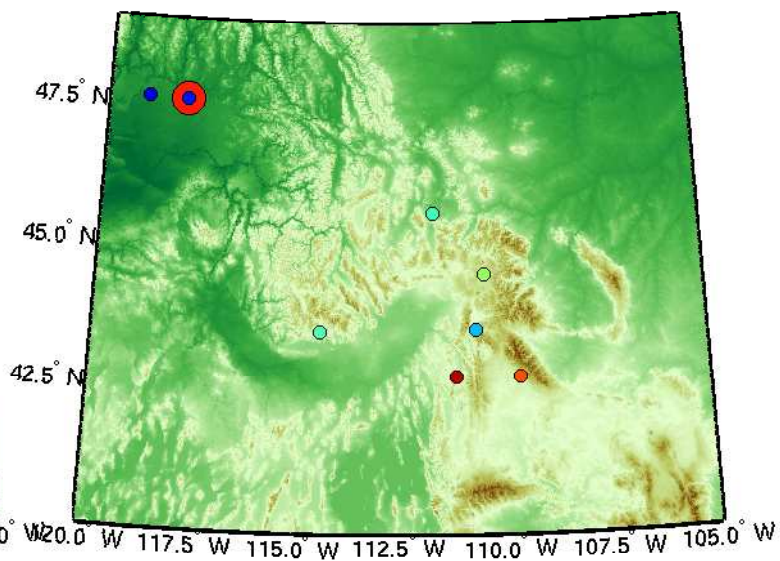
Stack  
Event\_2004\_341\_14\_15\_11



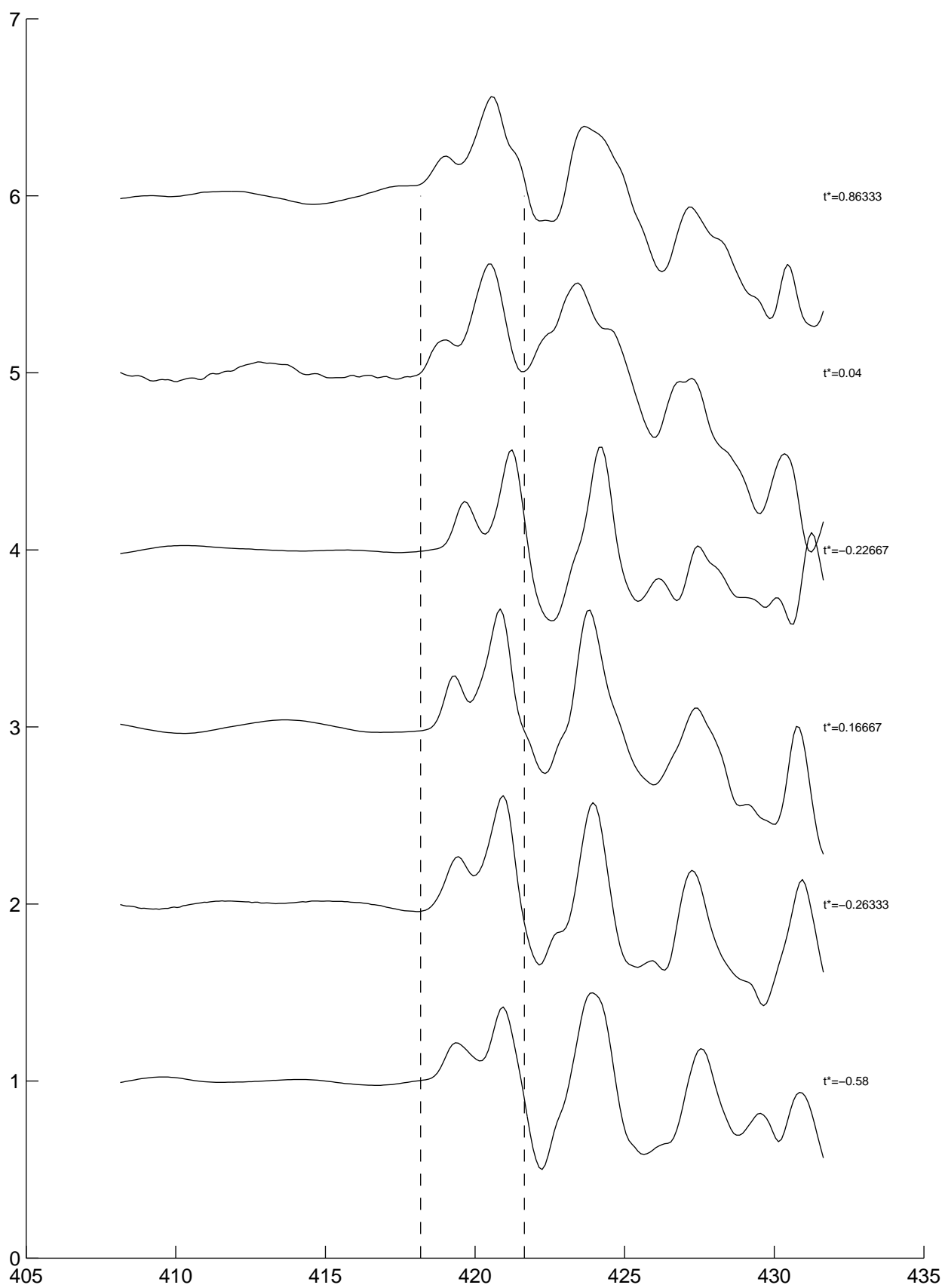
travel time residuals



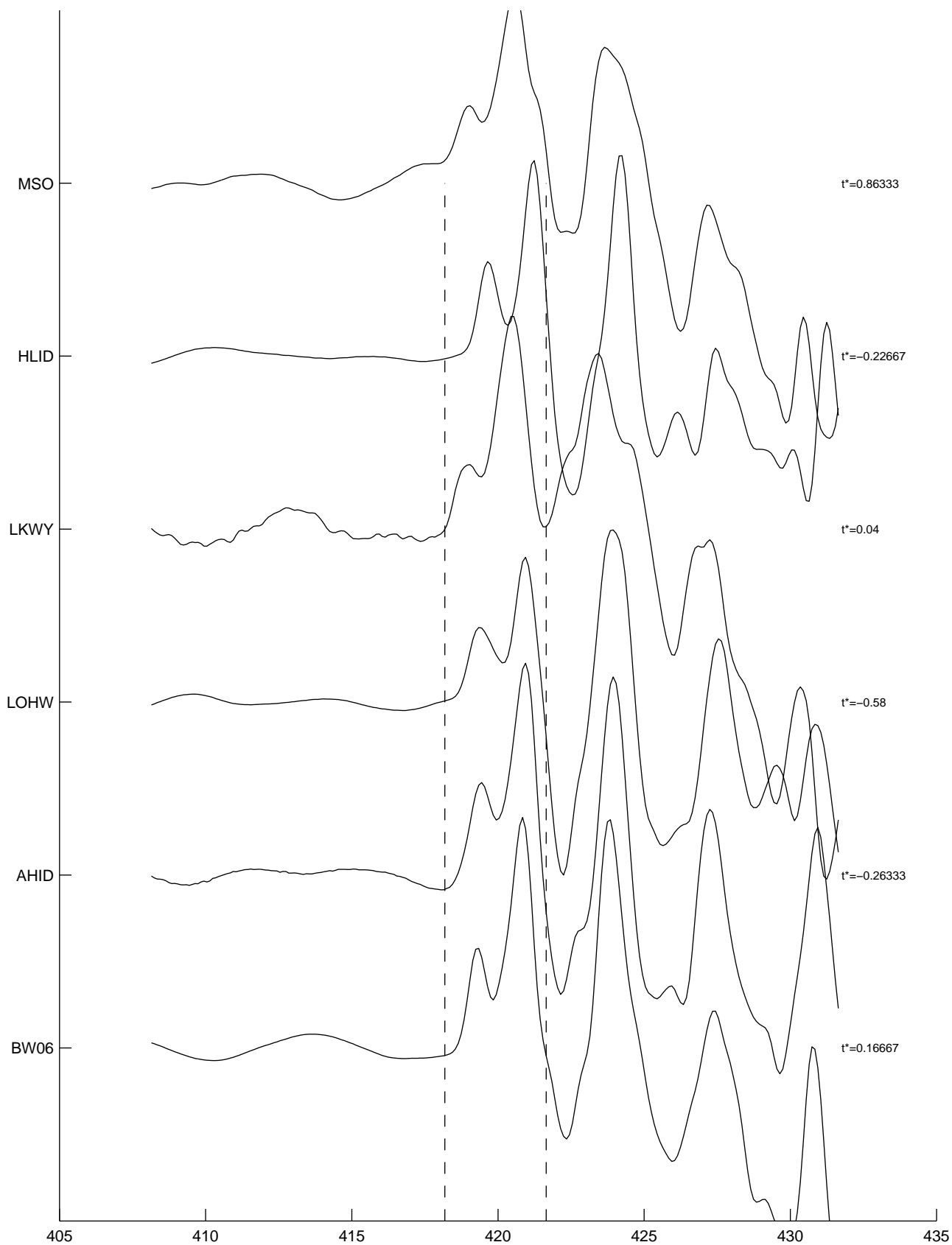
$t^*$  values



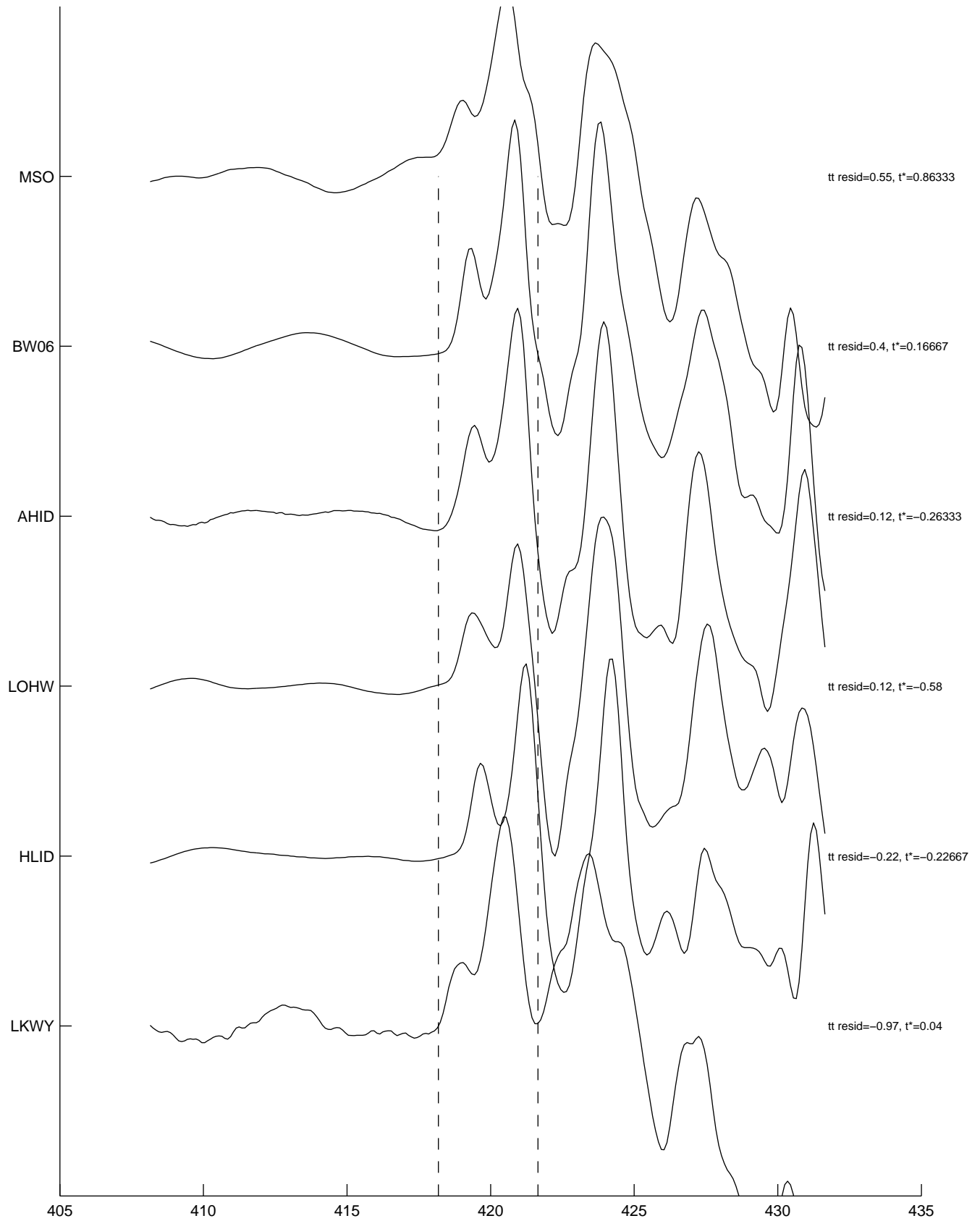
# Event\_2004\_349\_23\_20\_13



# Sorted by Delta:Event\_2004\_349\_23\_20\_13

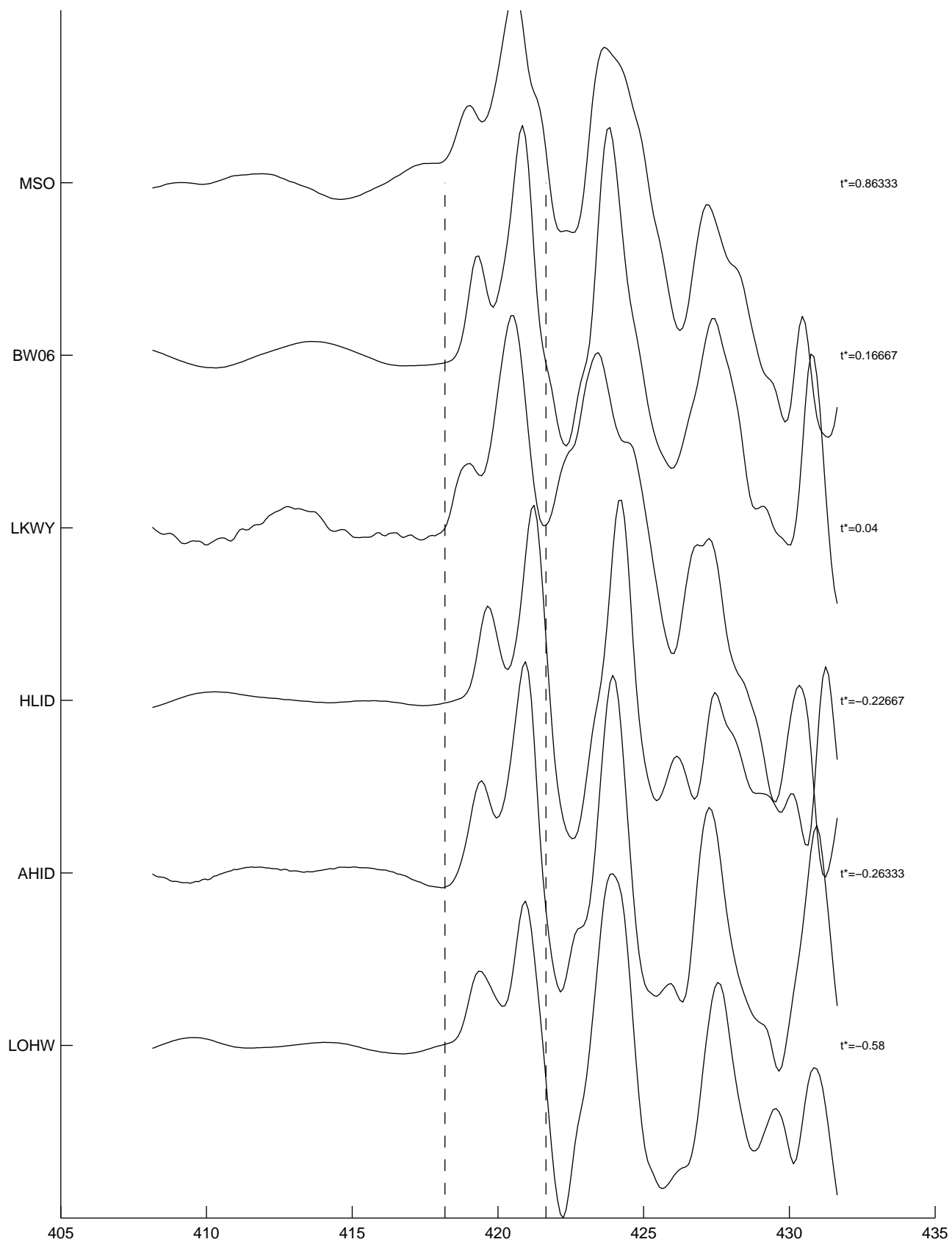


# Sorted by travel time:Event\_2004\_349\_23\_20\_13



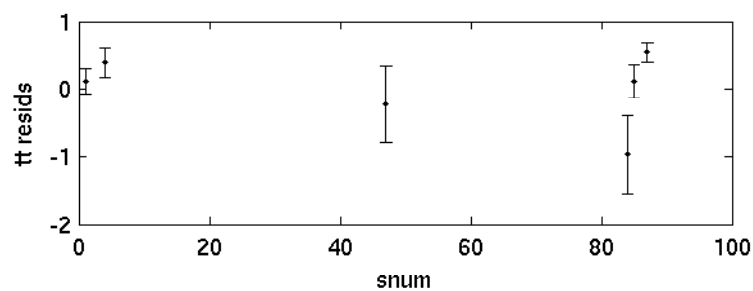
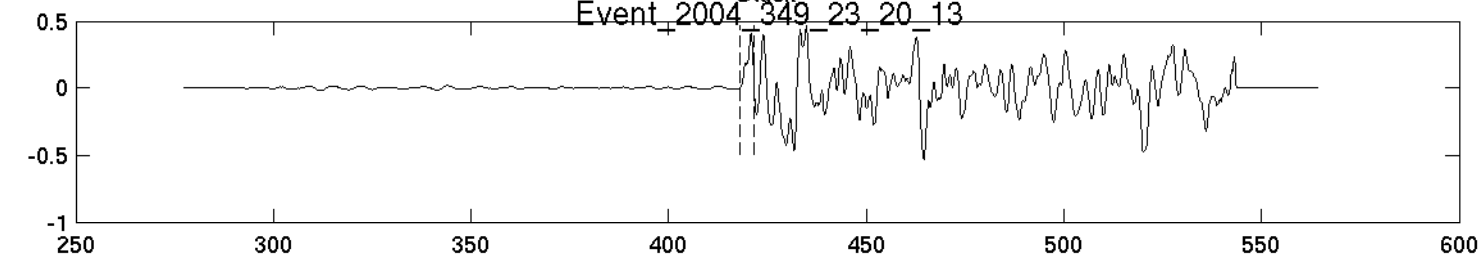


Sorted by  $t^*$ :Event\_2004\_349\_23\_20\_13

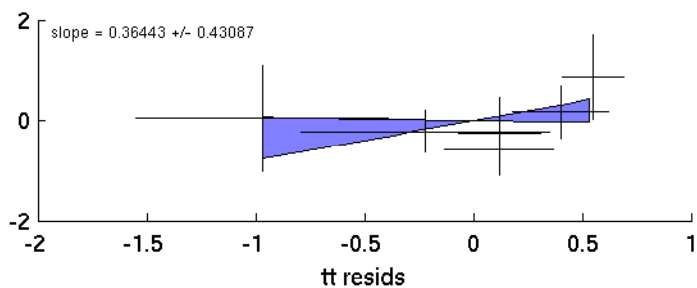
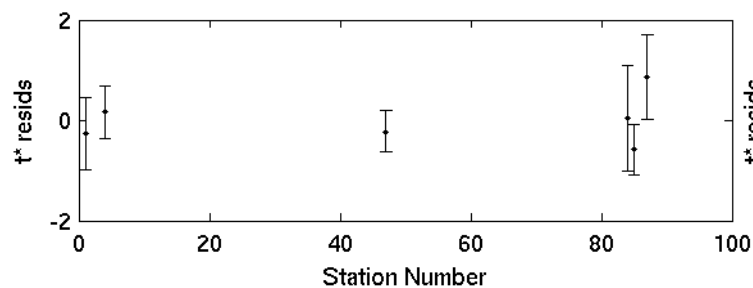


Event 2004\_349\_23\_20\_13

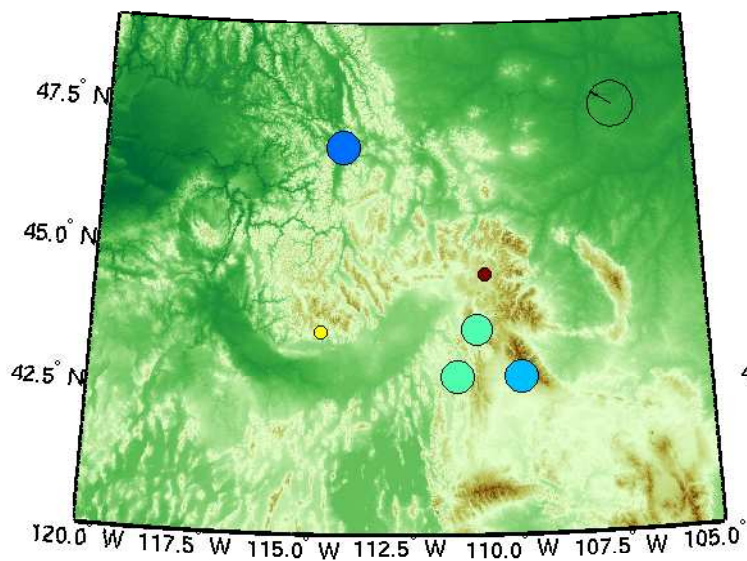
Stack



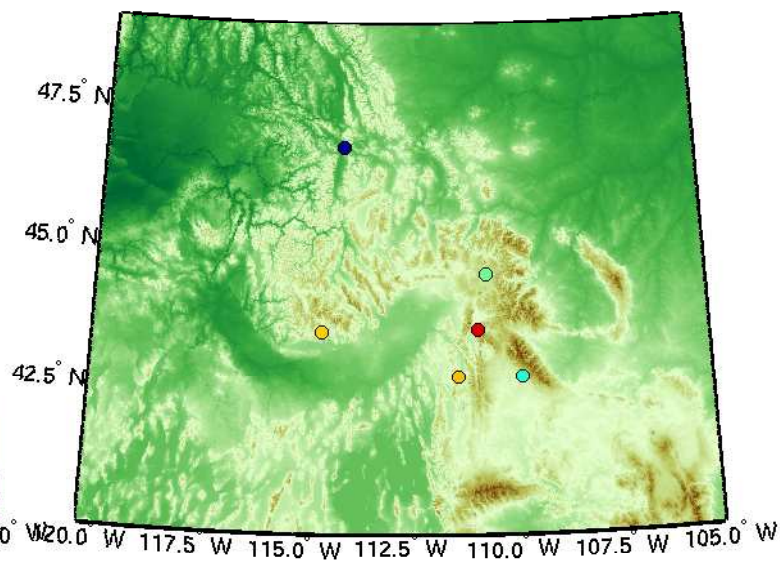
Baz = 125.0275  
Mean xcor value = 0.76833  
Range of  $t^*$  values is 1.4433  
Median  $t^*$  err is 0.62645  
Slope = 0.36443 +/- 0.43087



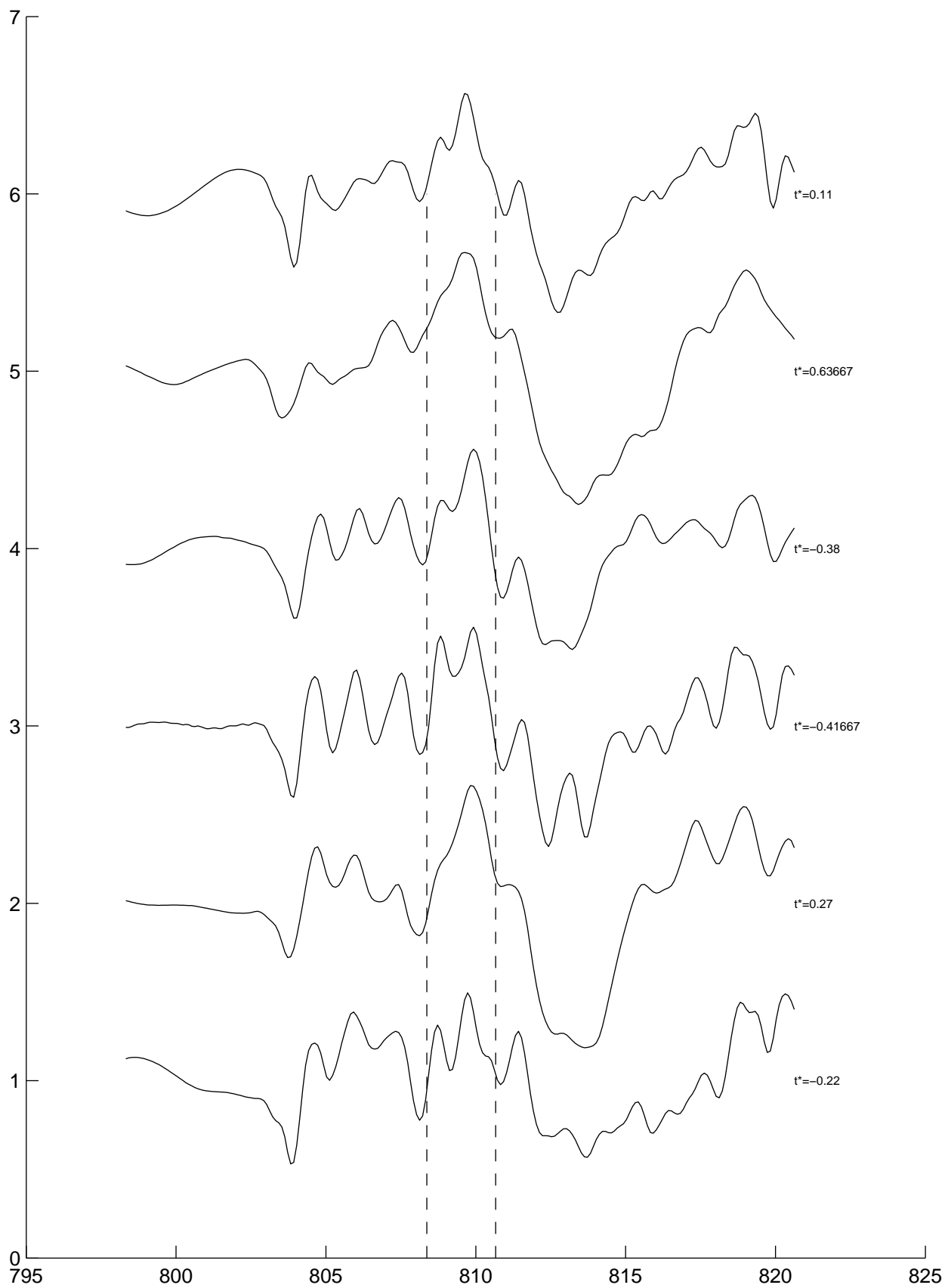
travel time residuals



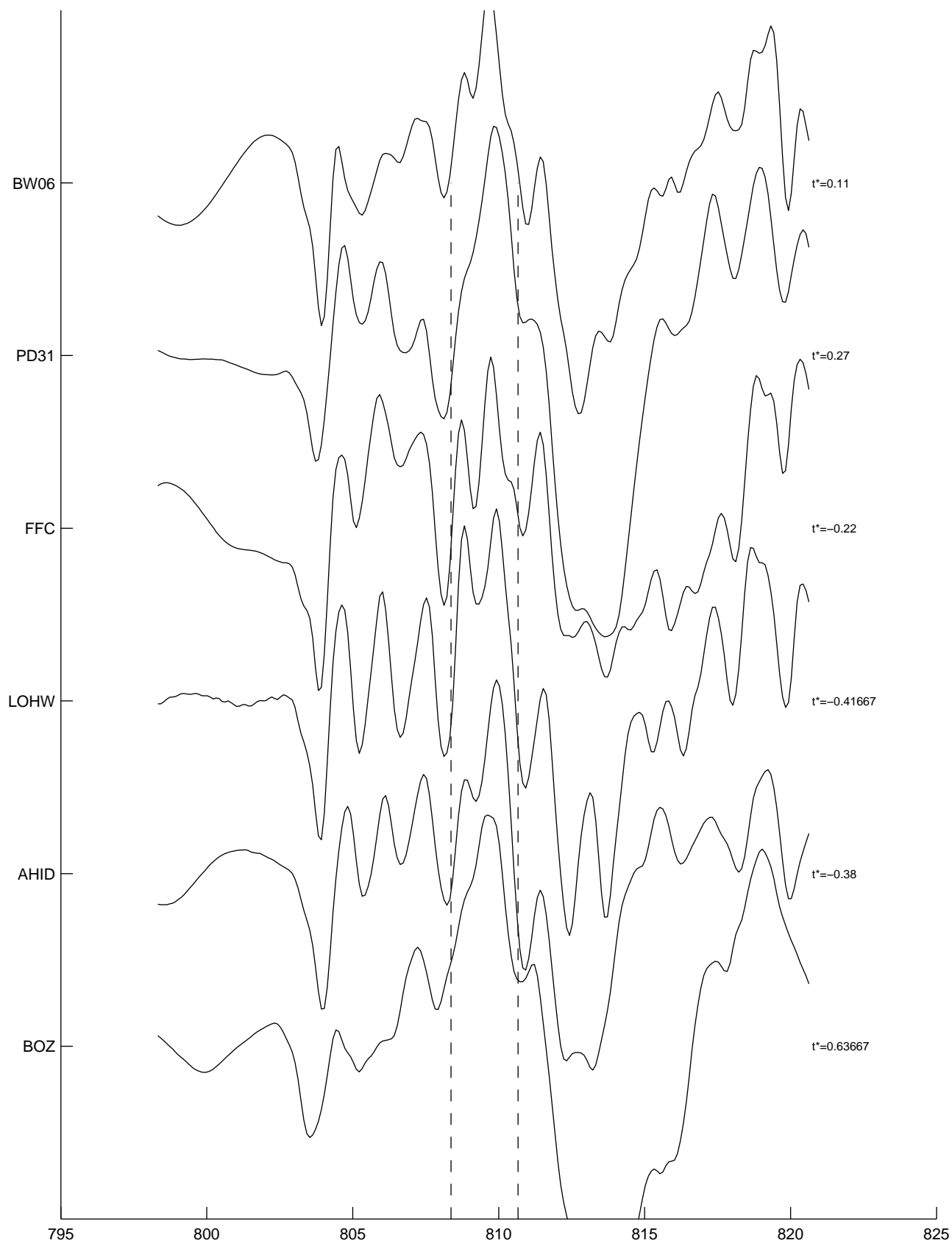
$t^*$  values



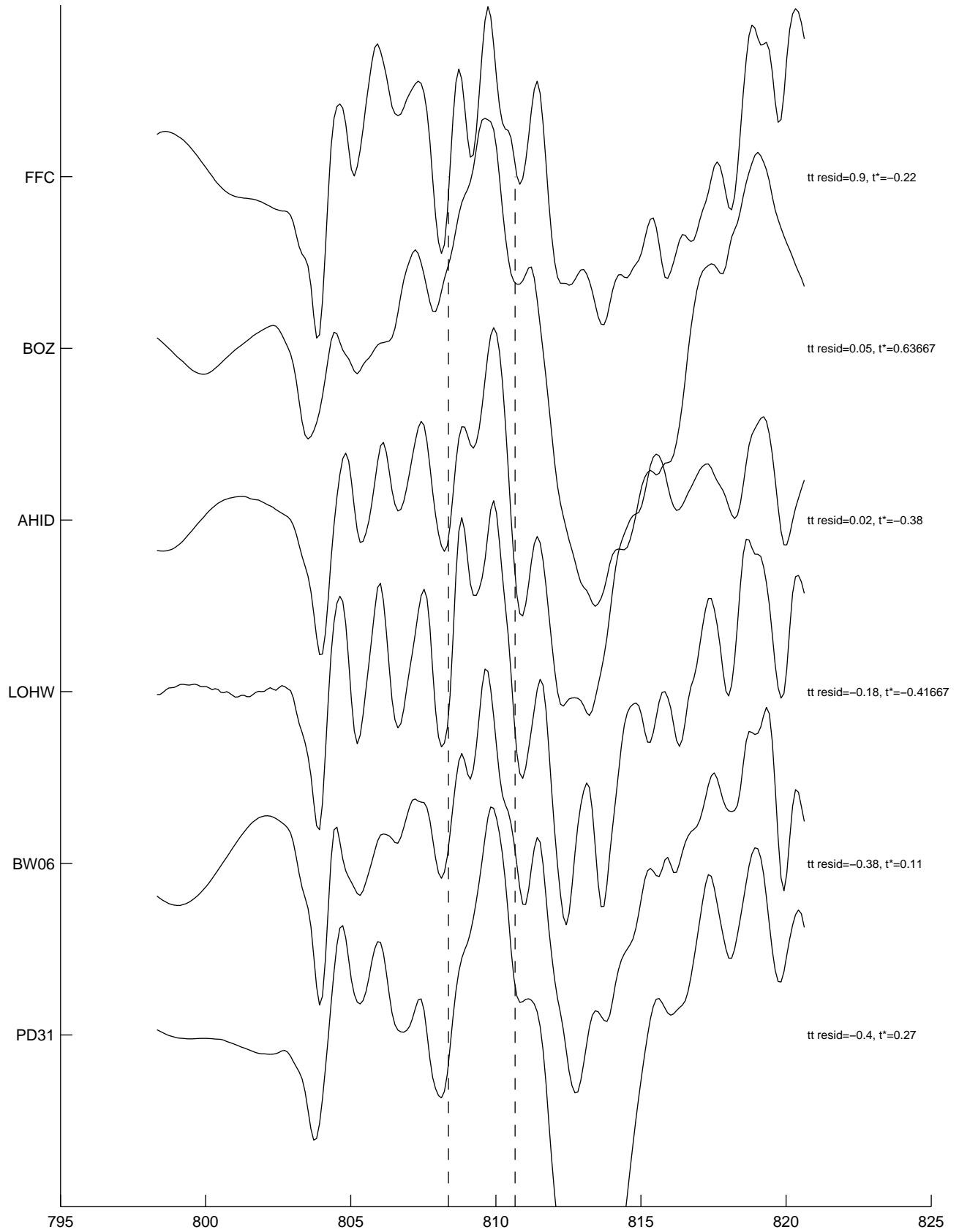
# Event\_2005\_016\_20\_17\_52



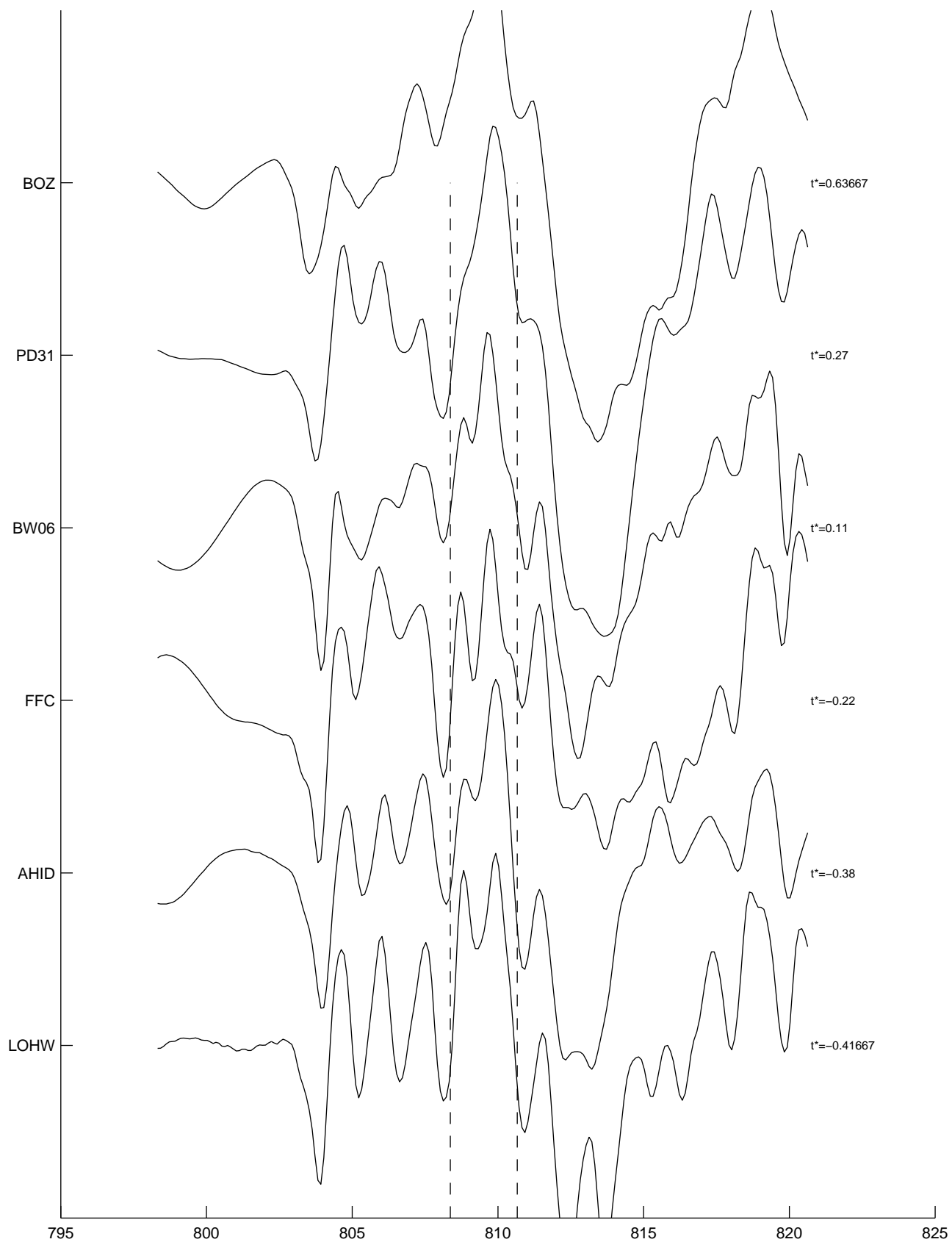
# Sorted by Delta:Event\_2005\_016\_20\_17\_52

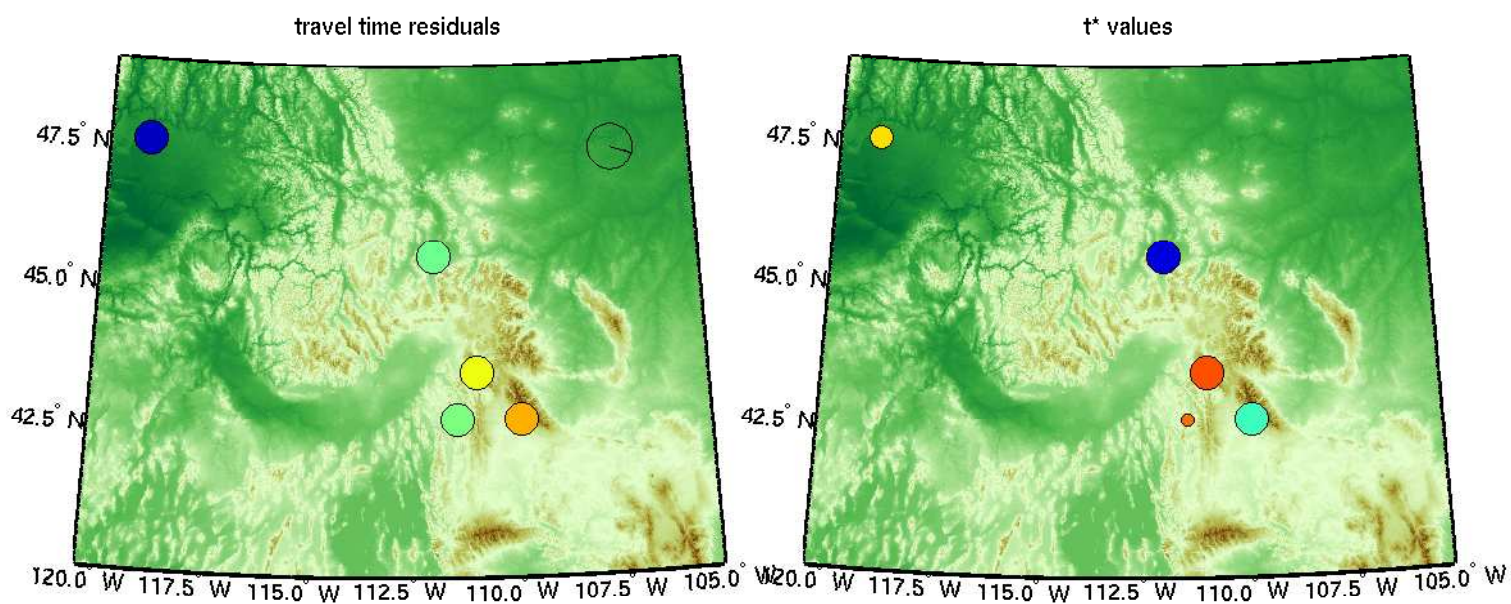
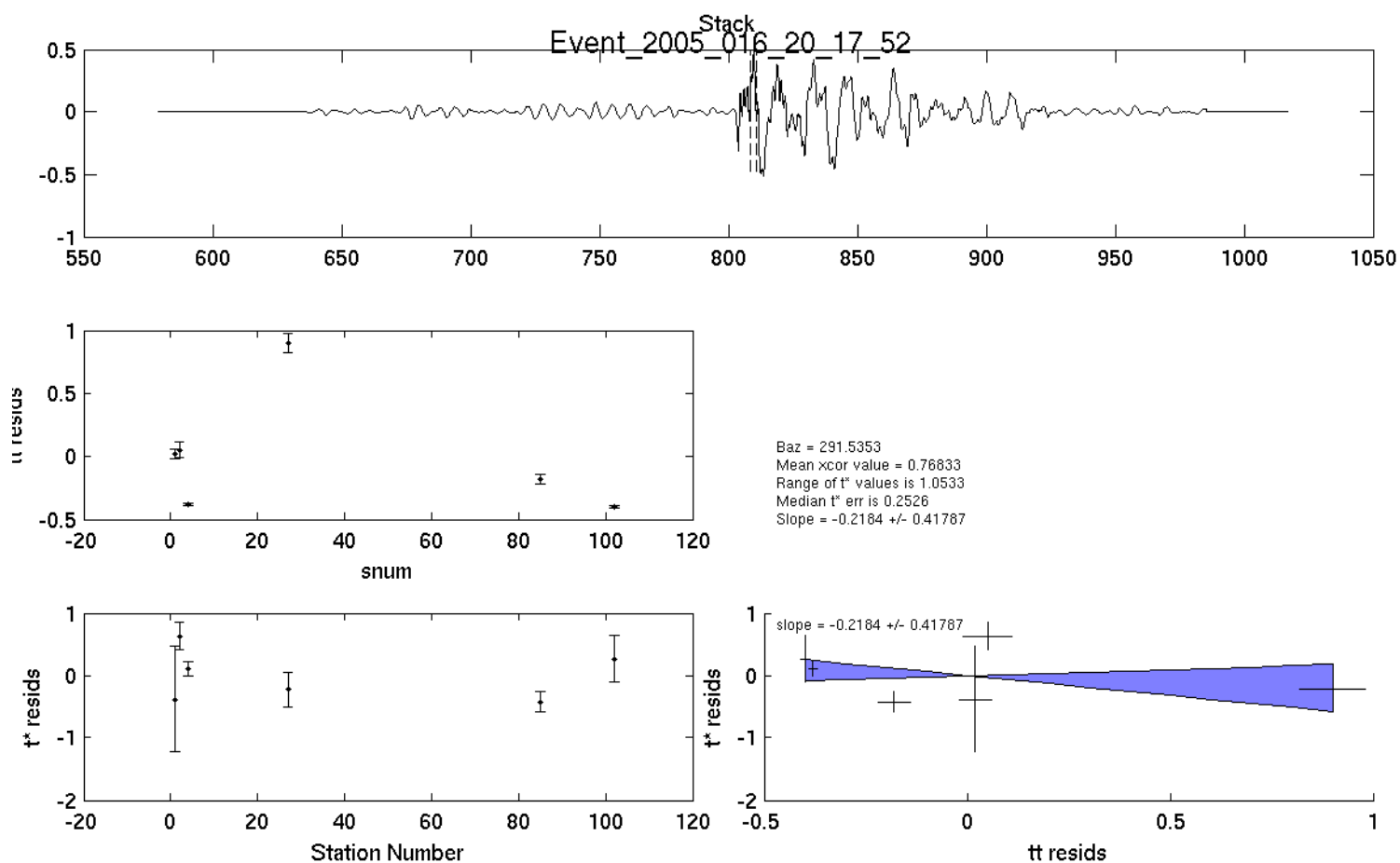


# Sorted by travel time:Event\_2005\_016\_20\_17\_52

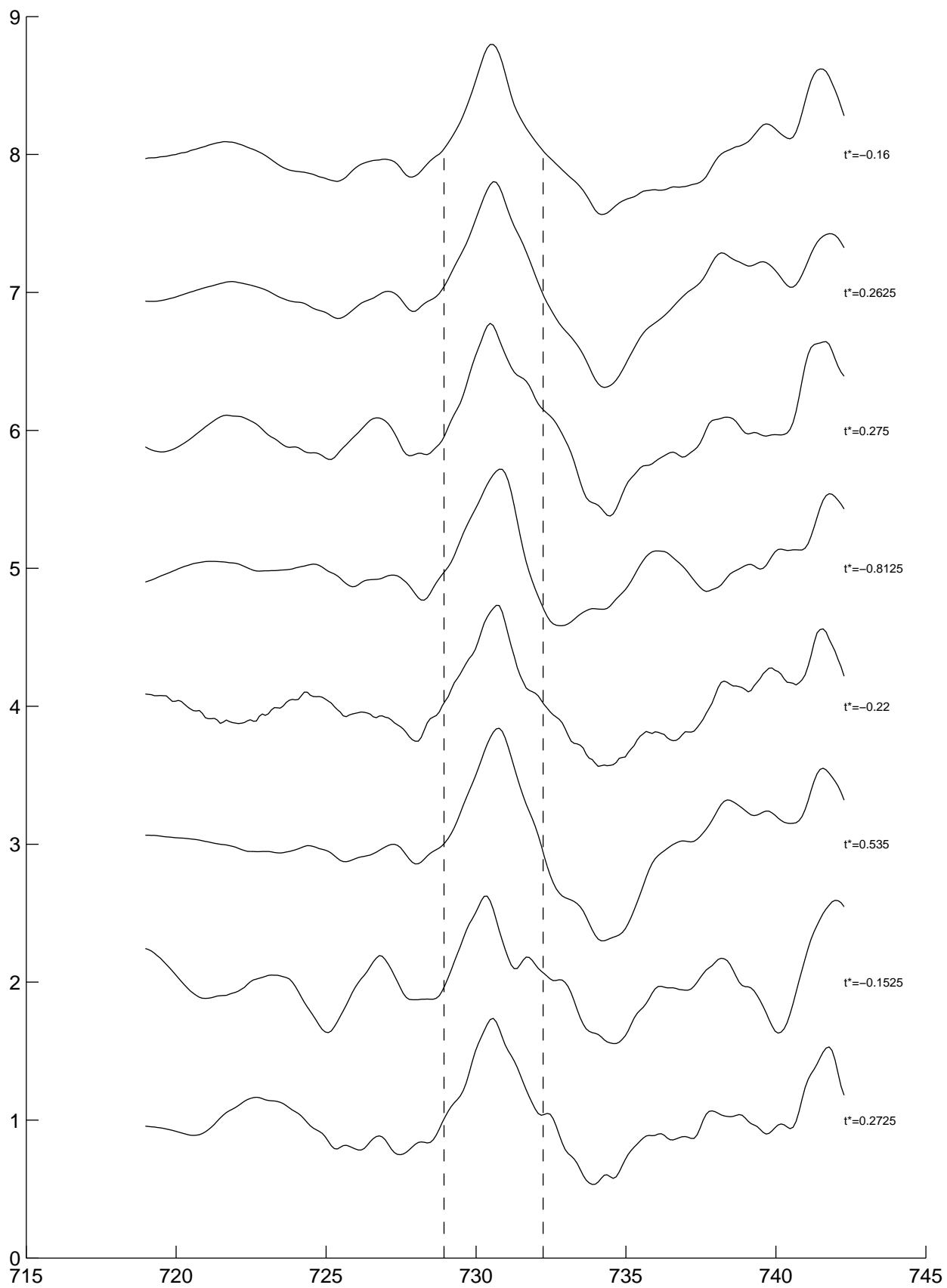


Sorted by t\*:Event\_2005\_016\_20\_17\_52



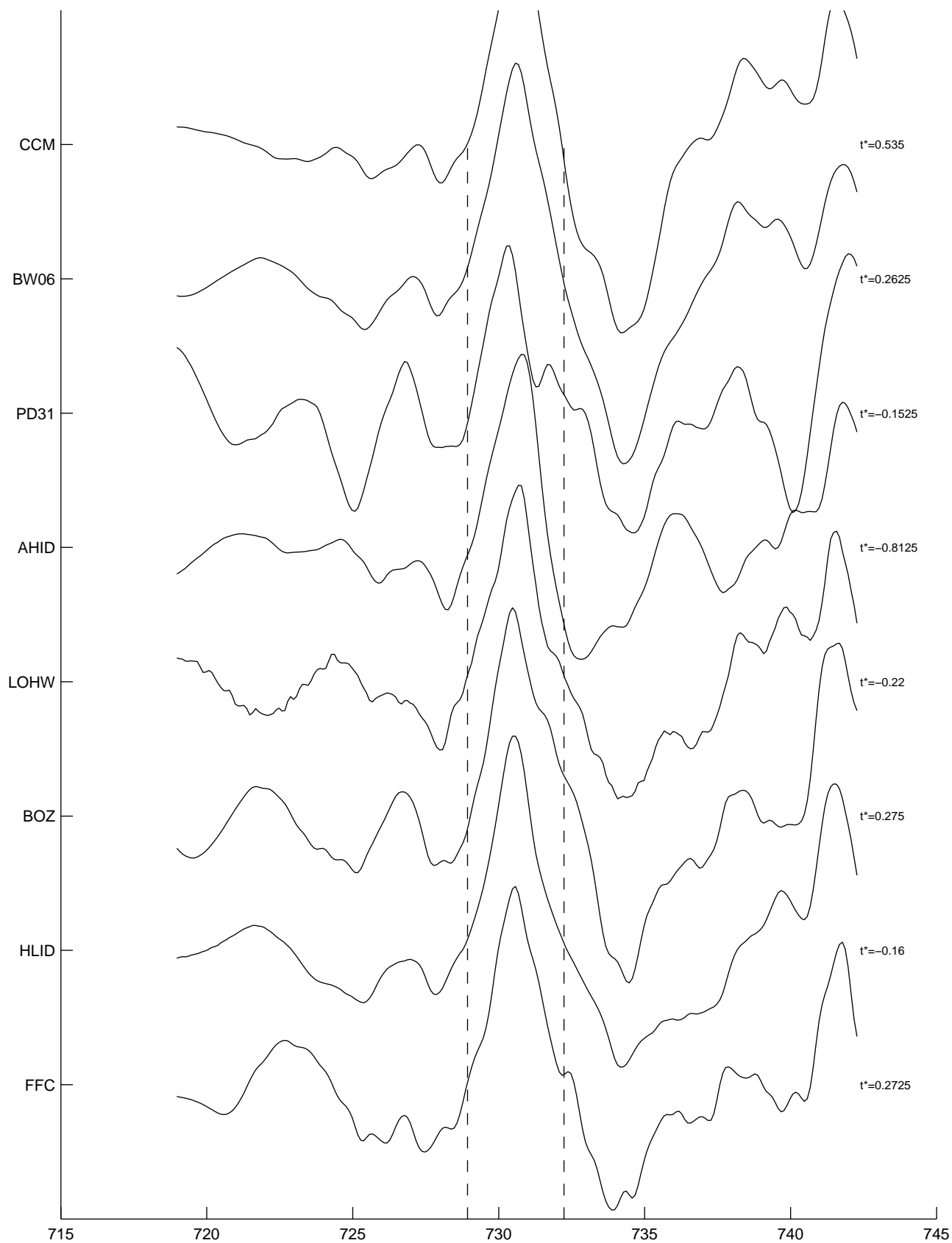


# Event\_2005\_019\_06\_11\_36

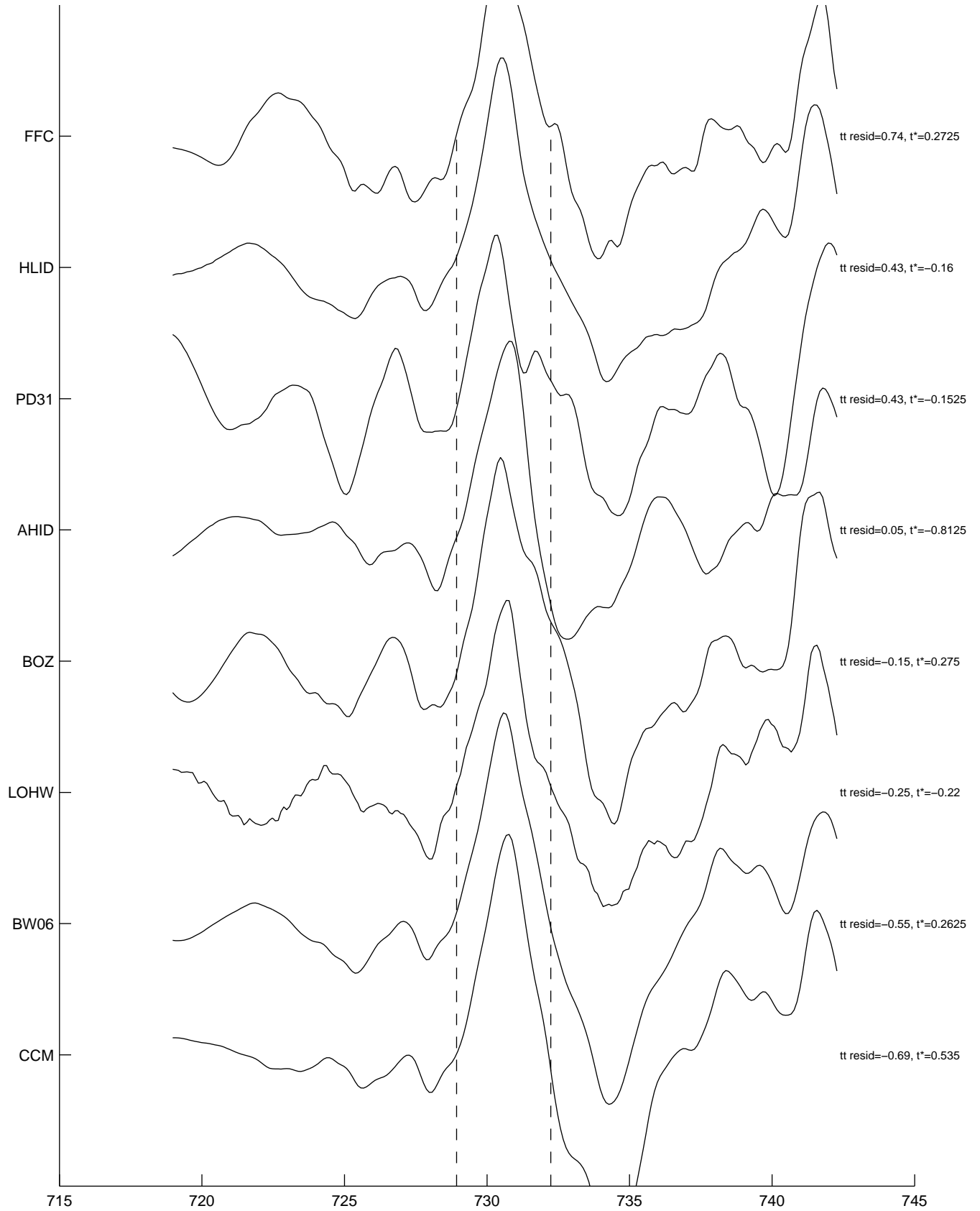




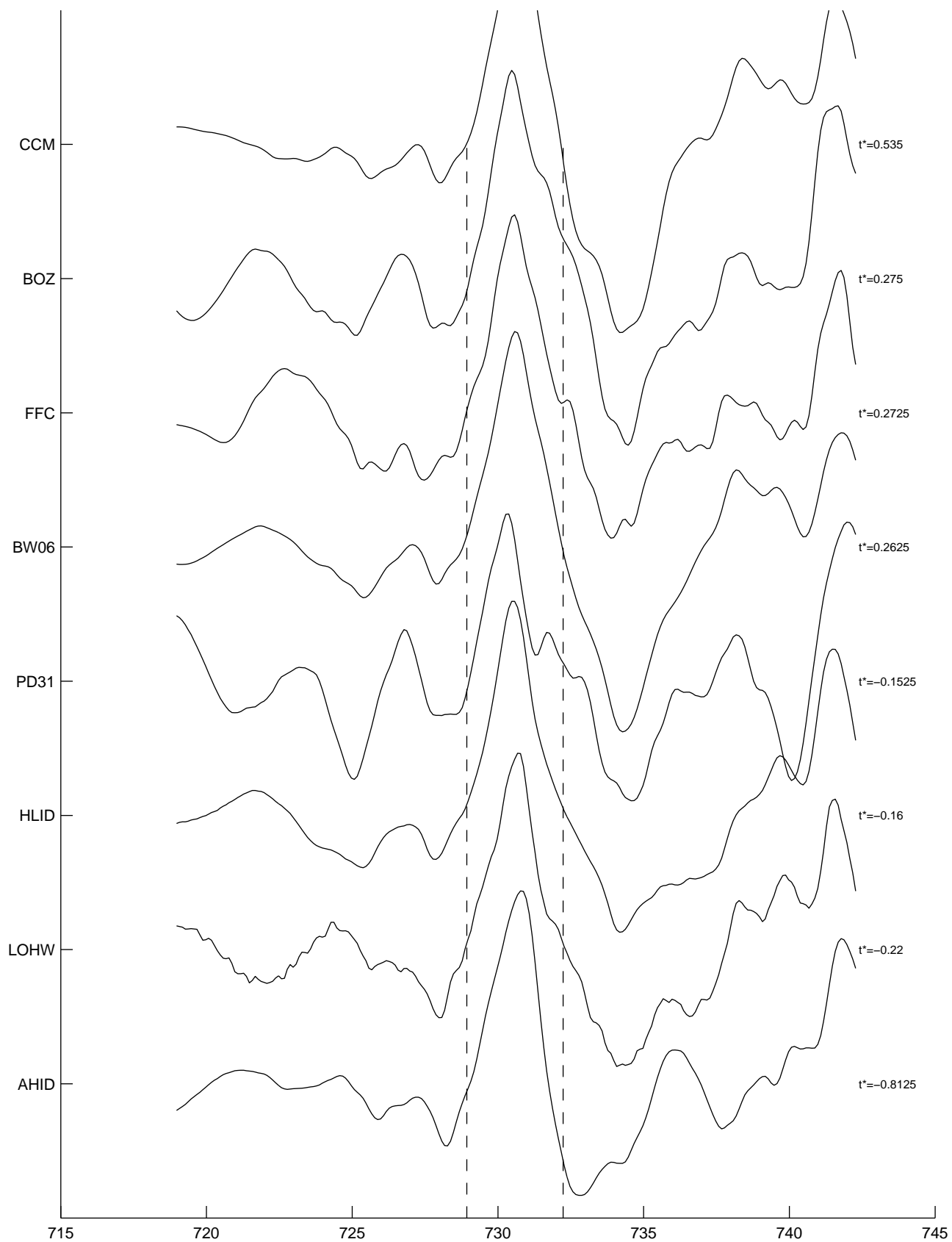
# Sorted by Delta:Event\_2005\_019\_06\_11\_36



# Sorted by travel time: Event\_2005\_019\_06\_11\_36

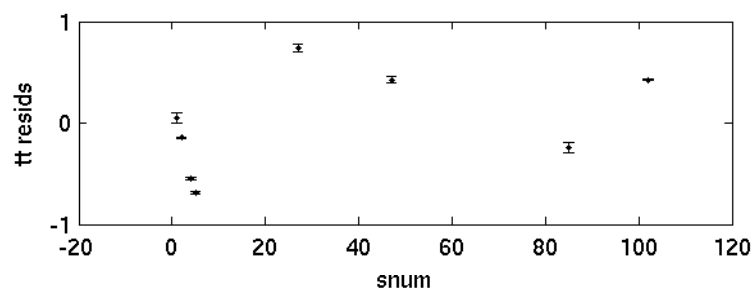
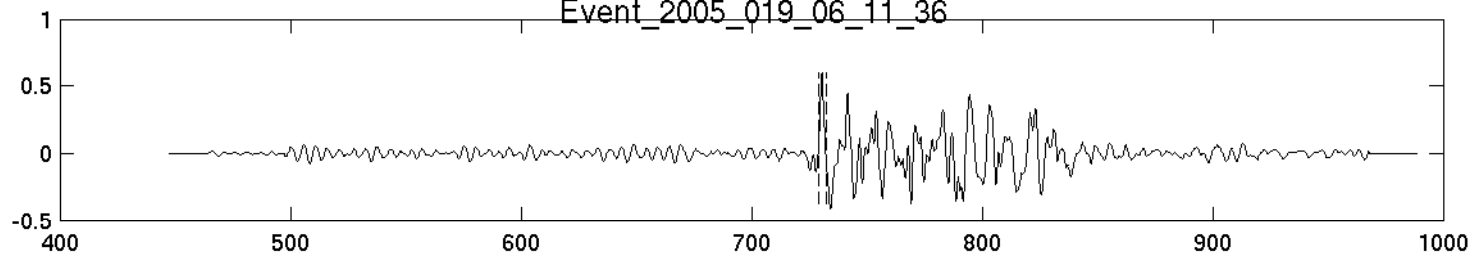


Sorted by  $t^*$ :Event\_2005\_019\_06\_11\_36

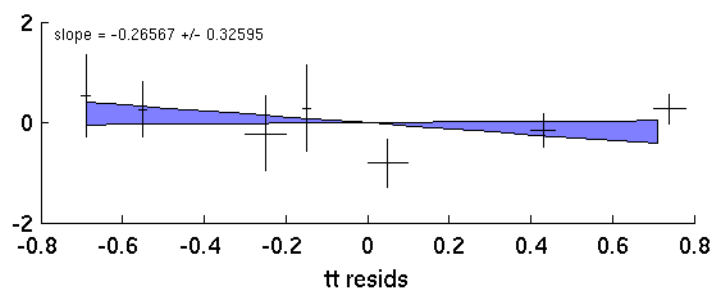
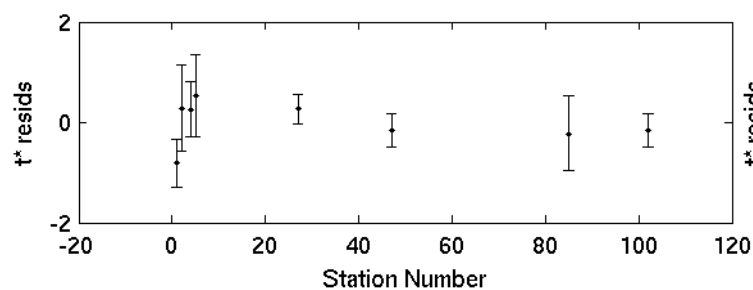


# Event\_2005\_019\_06\_11\_36

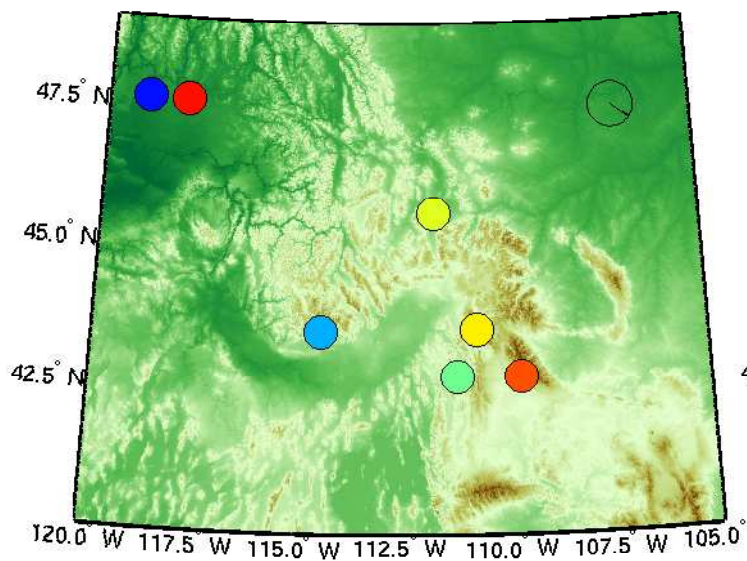
Stack



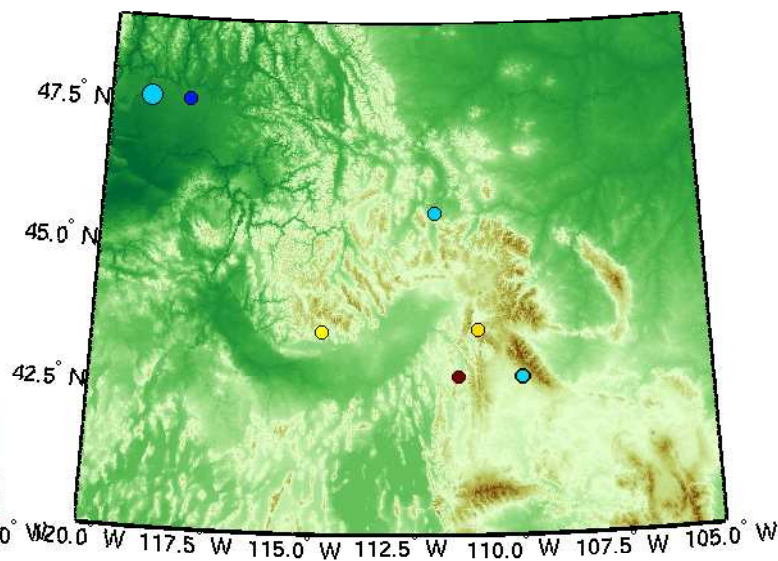
Baz = 307.6781  
Mean xcor value = 0.78125  
Range of t\* values is 1.3475  
Median t\* err is 0.51645  
Slope = -0.26567 +/- 0.32595



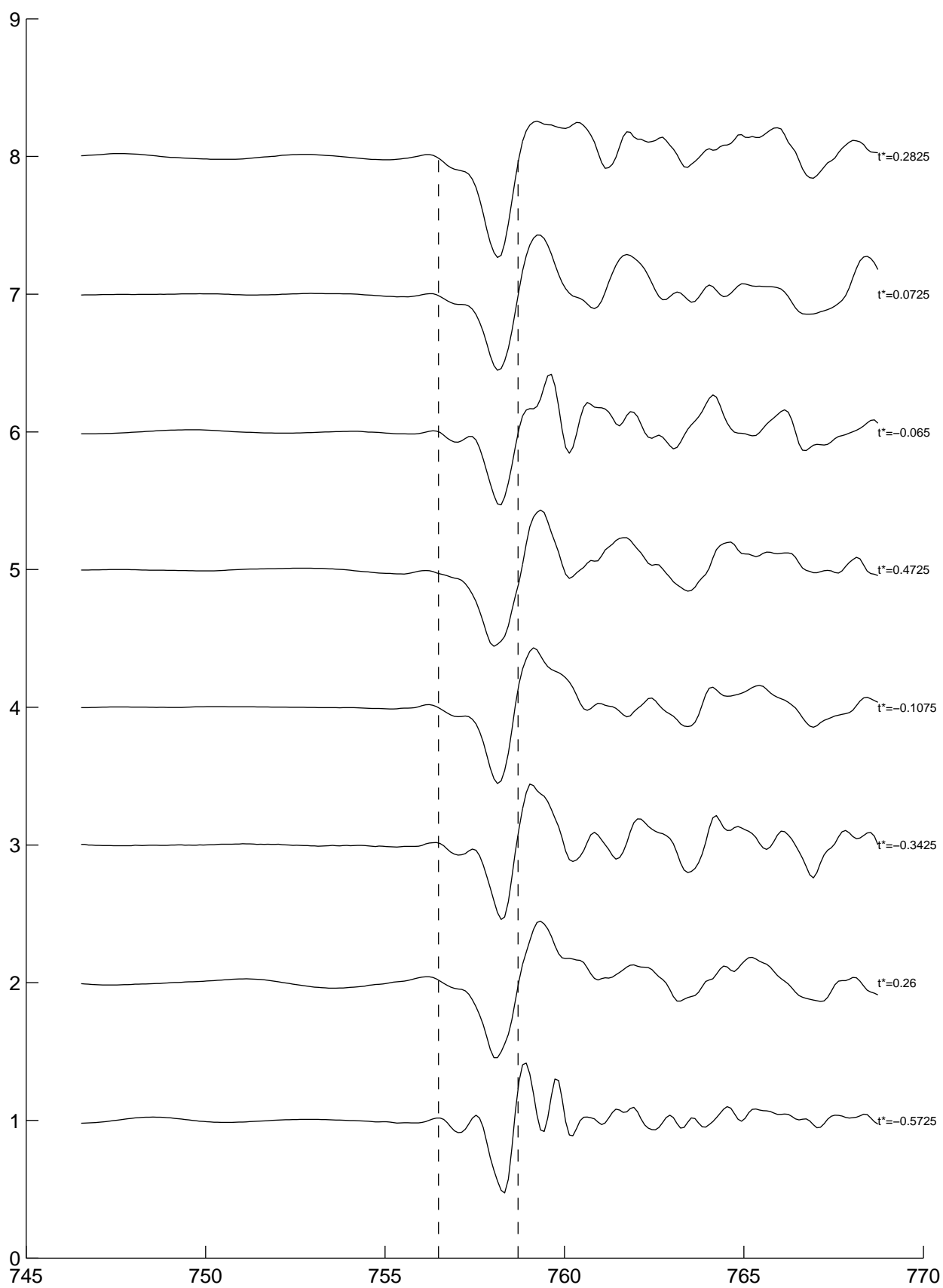
travel time residuals



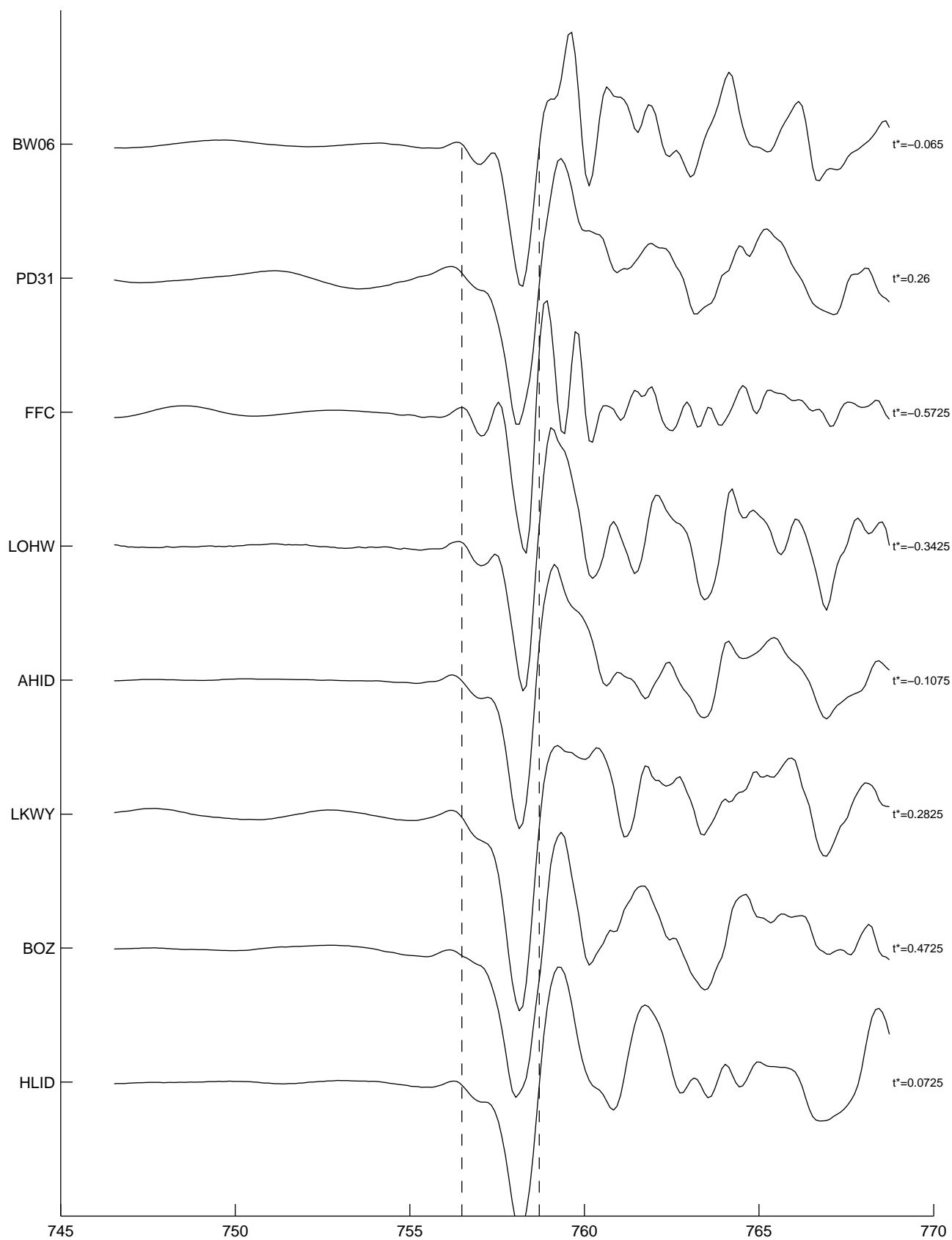
t\* values



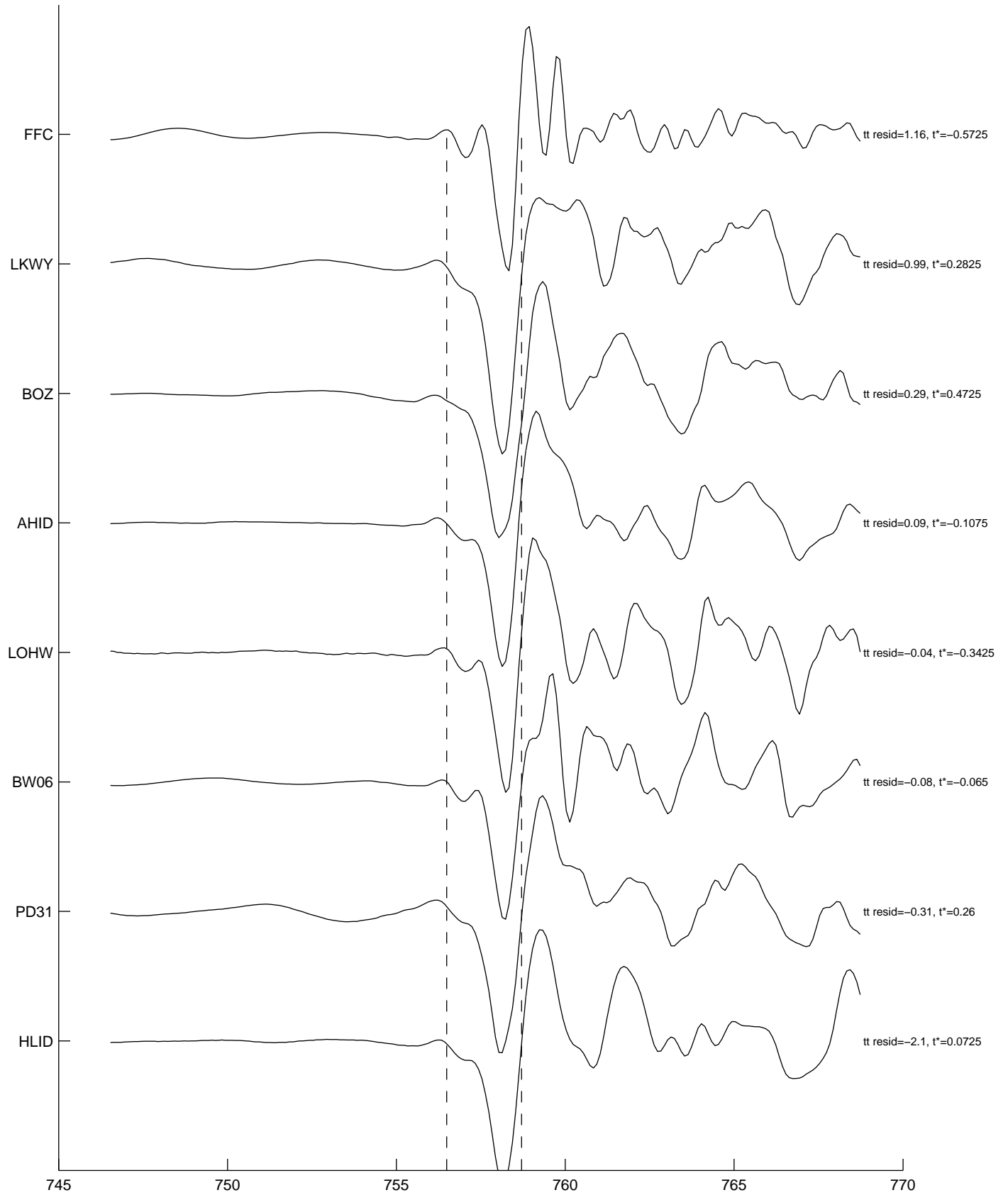
# Event\_2005\_036\_03\_34\_25



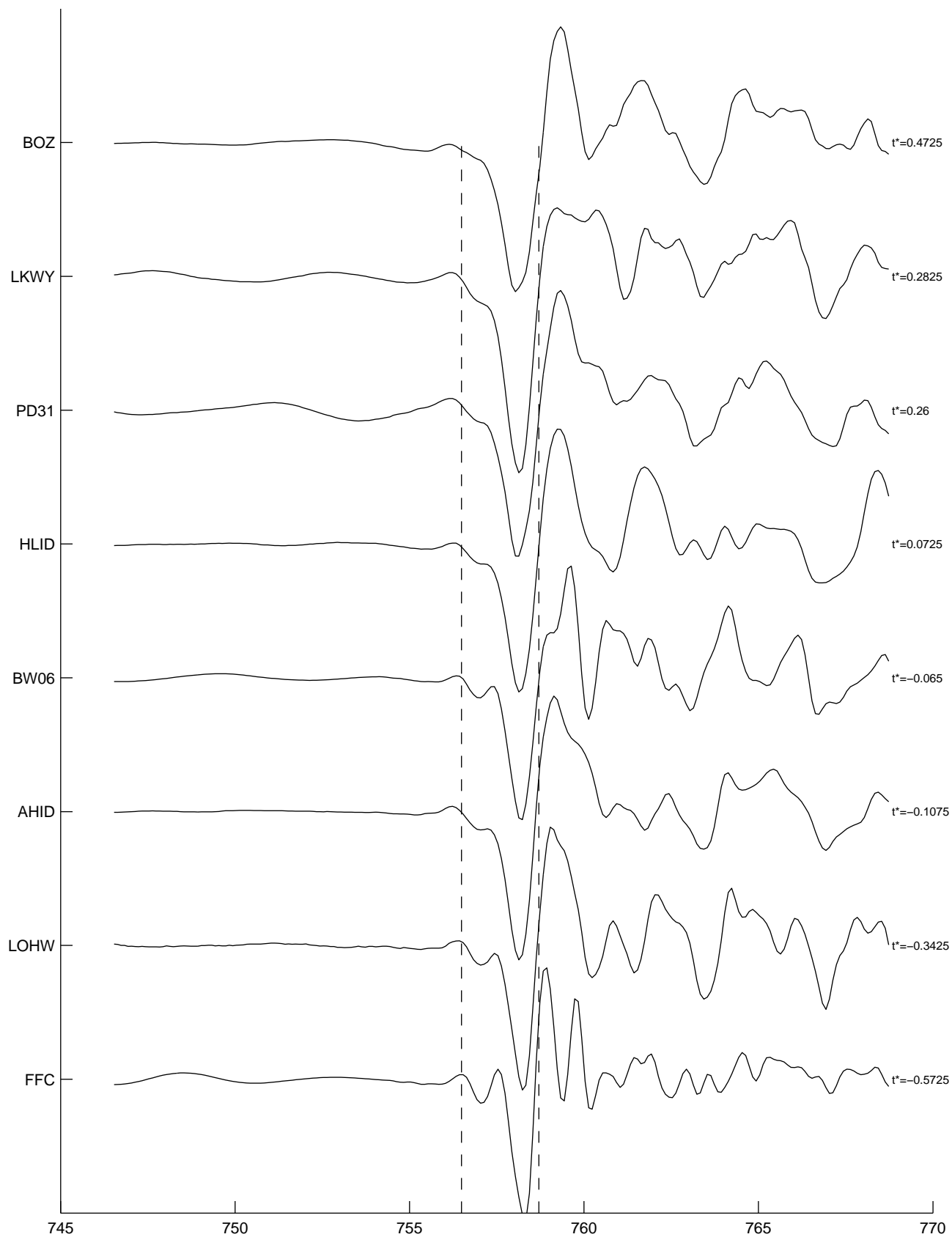
# Sorted by Delta:Event\_2005\_036\_03\_34\_25



# Sorted by travel time:Event\_2005\_036\_03\_34\_25



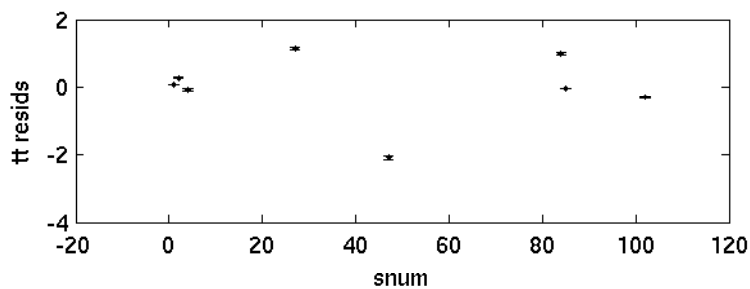
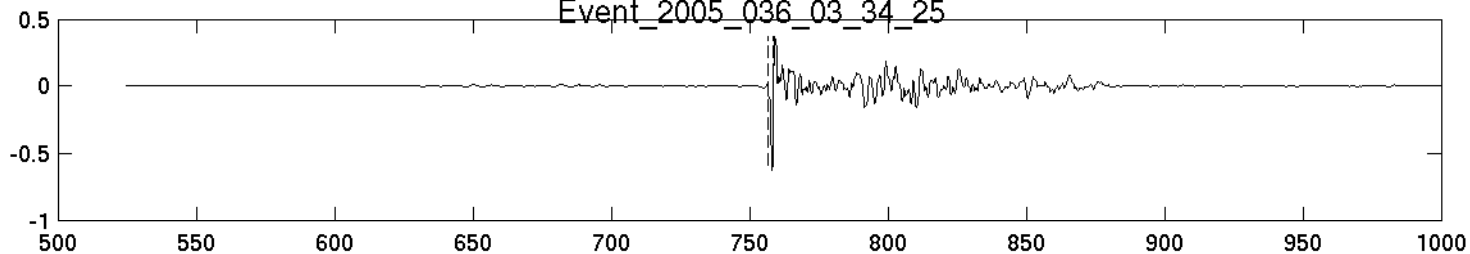
Sorted by  $t^*$ :Event\_2005\_036\_03\_34\_25



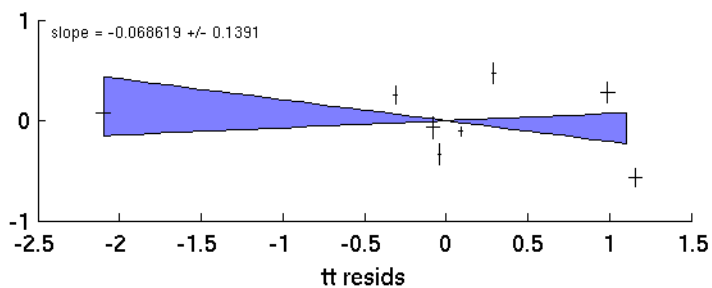
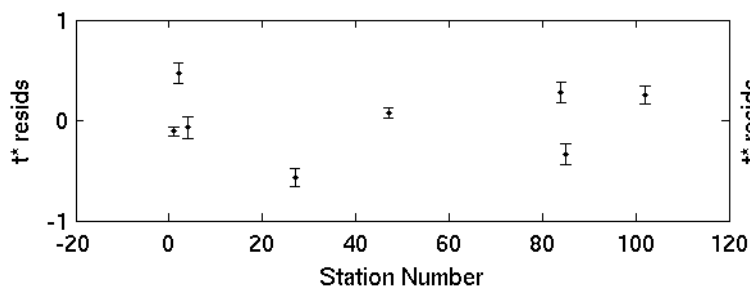


# Event\_2005\_036\_03\_34\_25

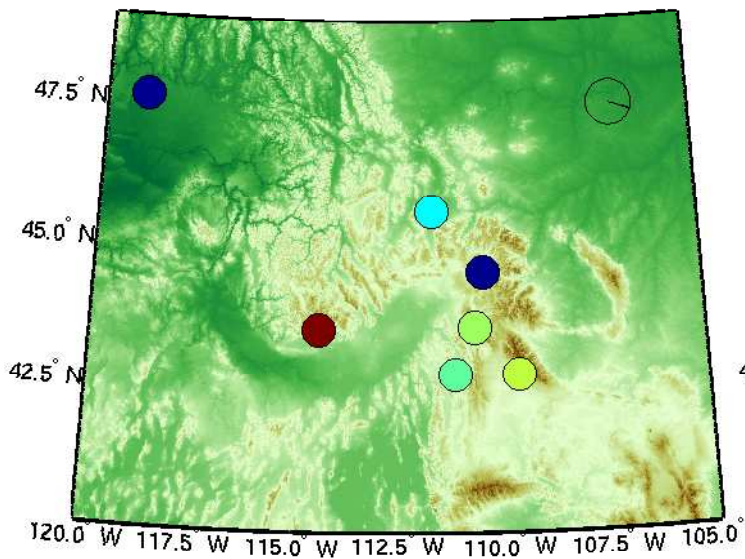
Stack



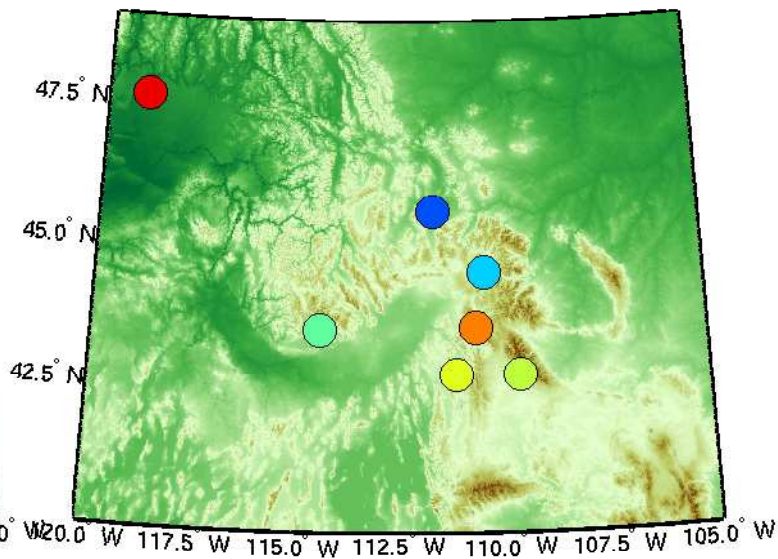
Baz = 290.9767  
Mean xcor value = 0.73375  
Range of  $t^*$  values is 1.045  
Median  $t^*$  err is 0.094307  
Slope = -0.068619 +/- 0.1391



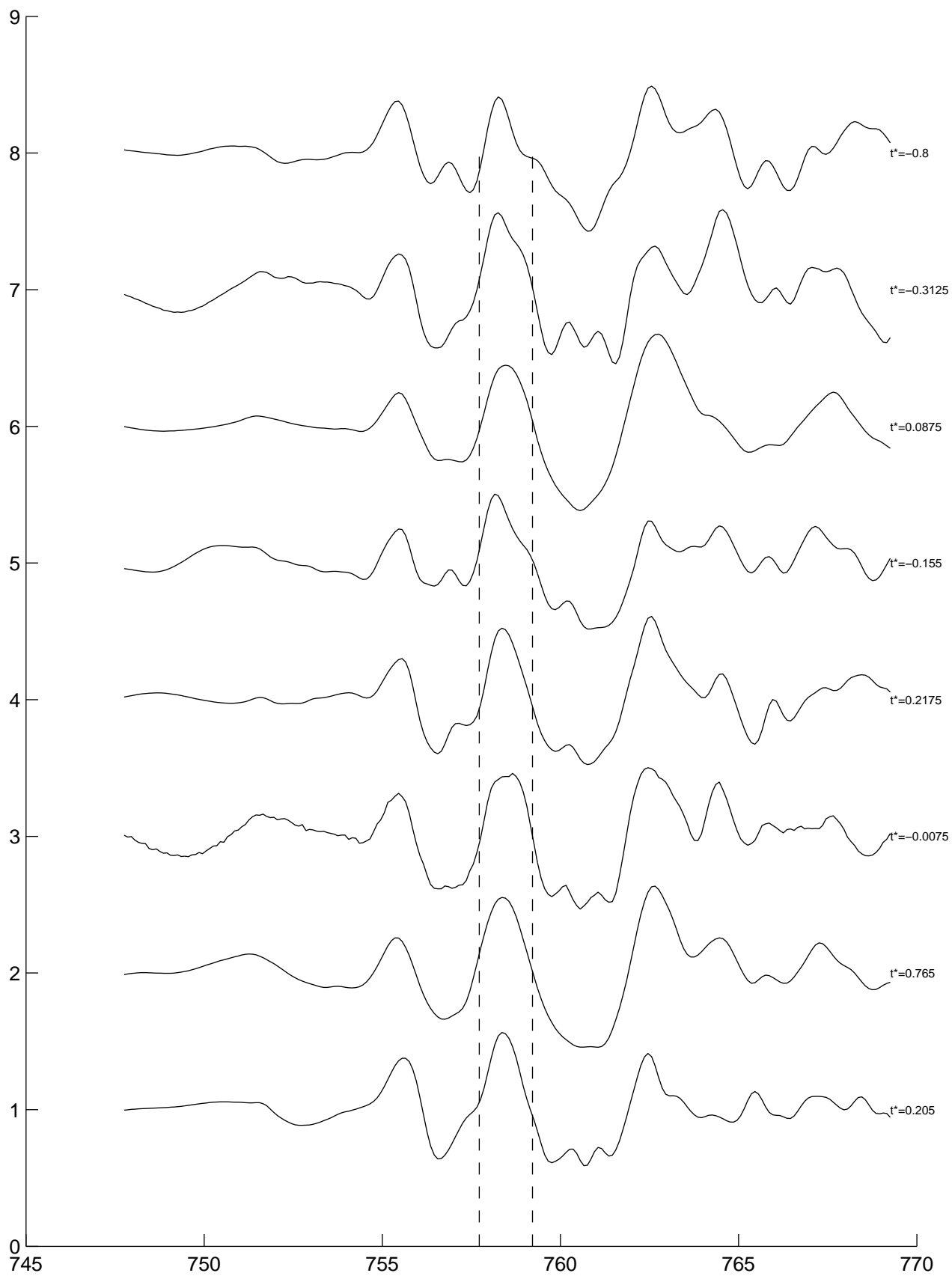
travel time residuals



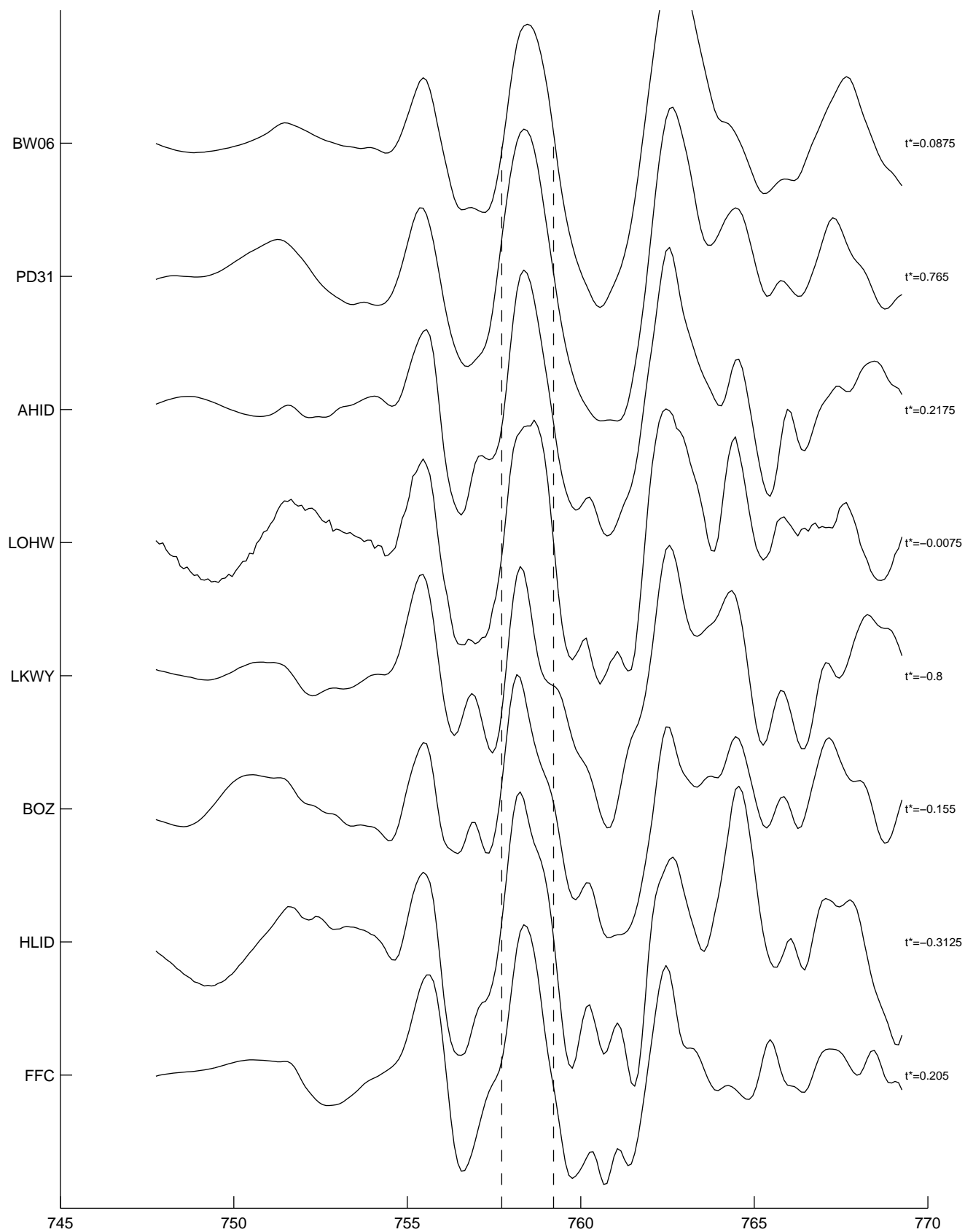
$t^*$  values



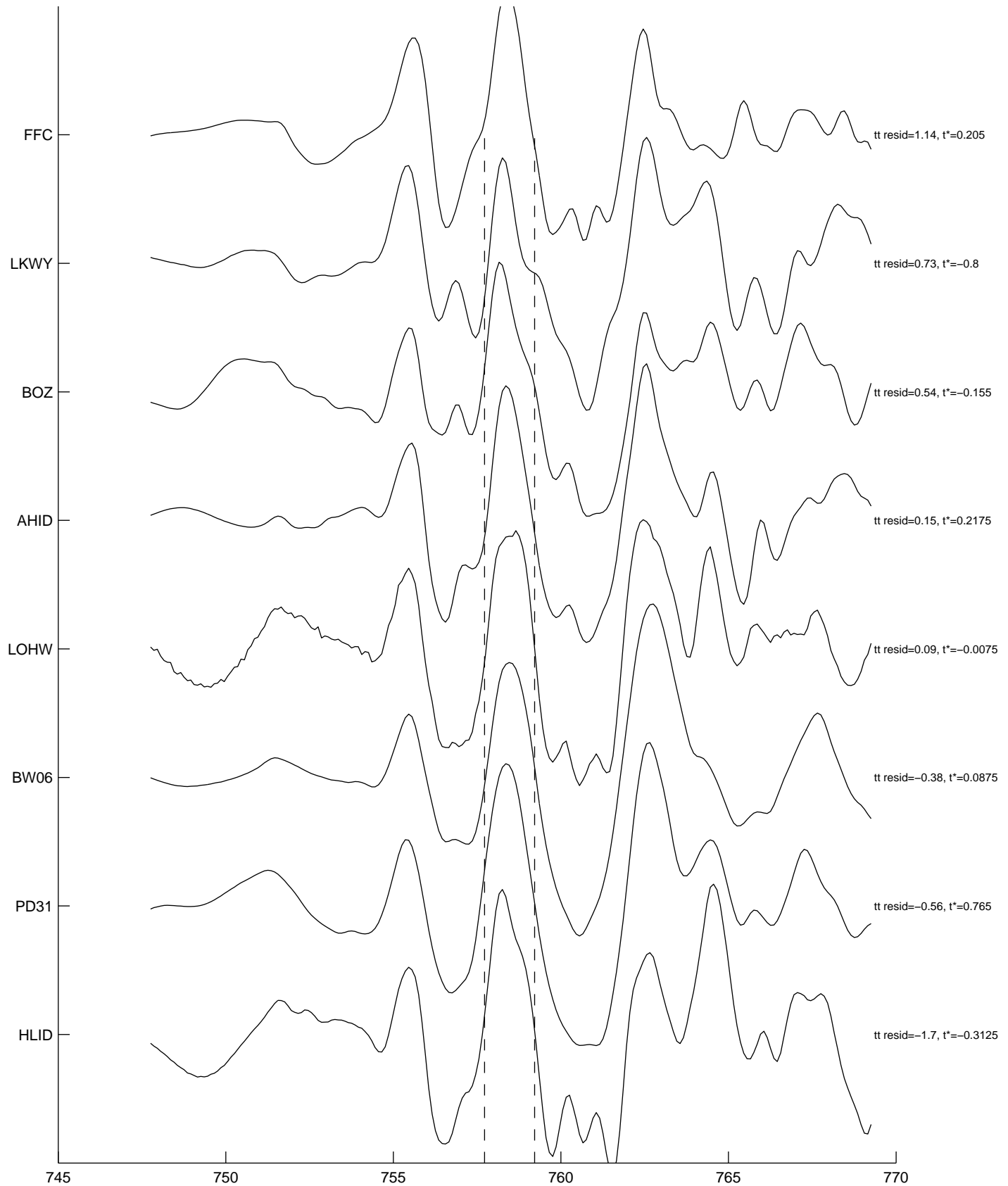
# Event\_2005\_079\_01\_53\_41



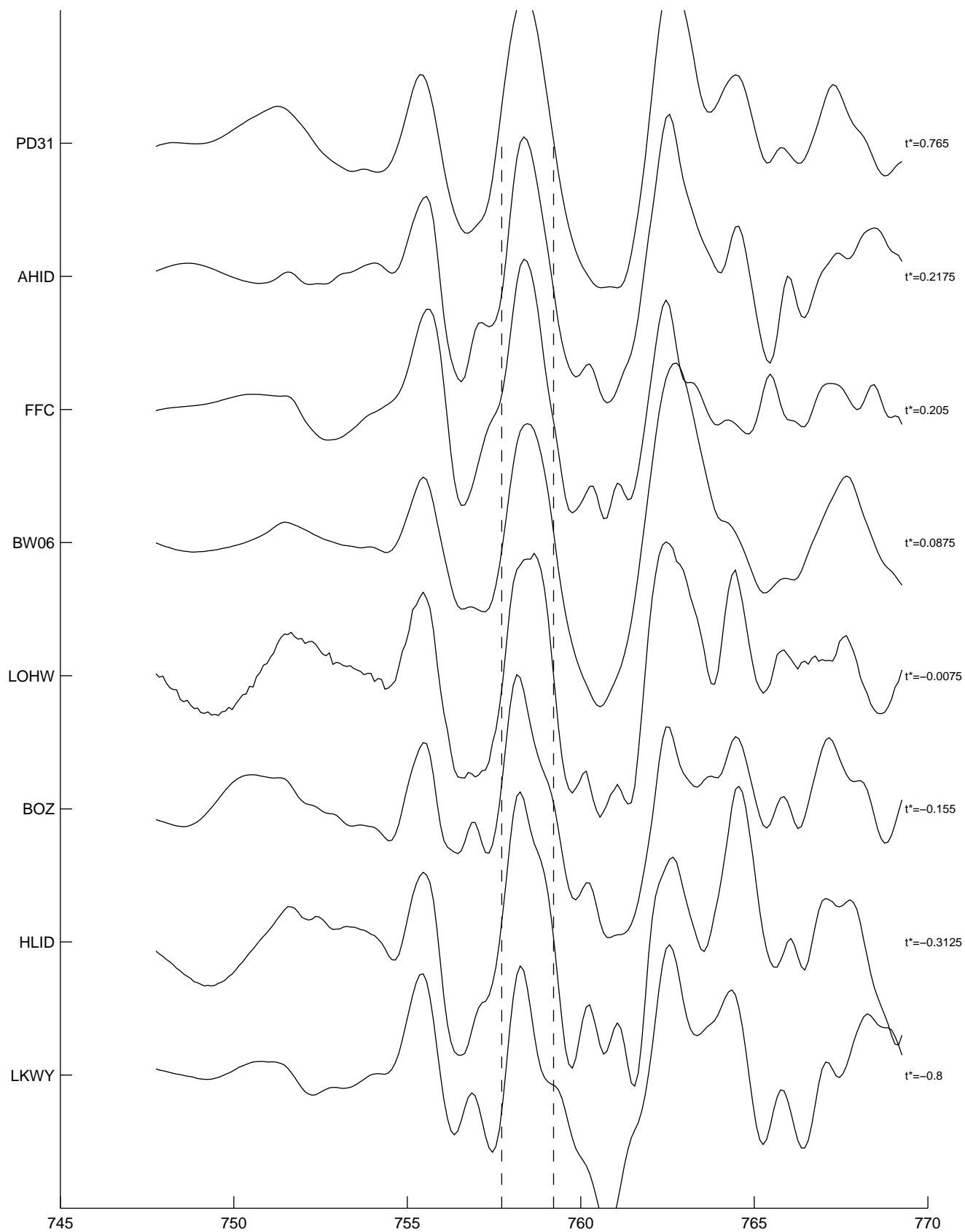
# Sorted by Delta:Event\_2005\_079\_01\_53\_41



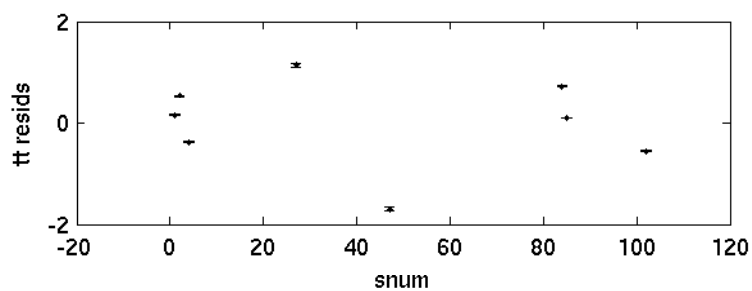
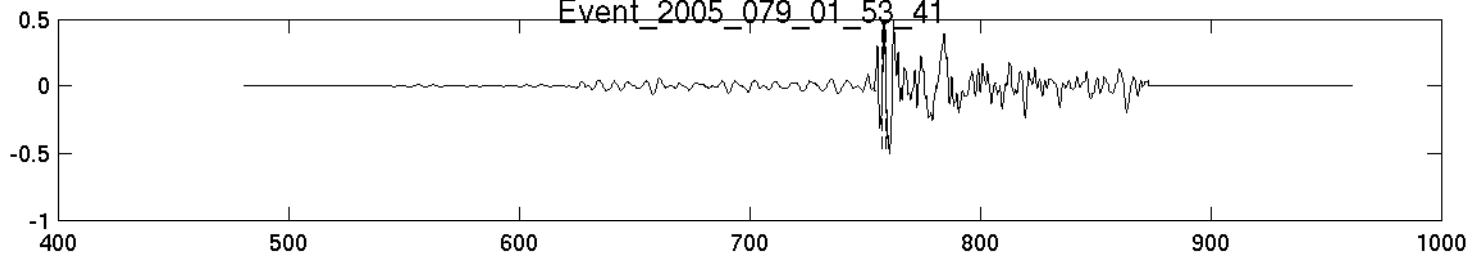
# Sorted by travel time:Event\_2005\_079\_01\_53\_41



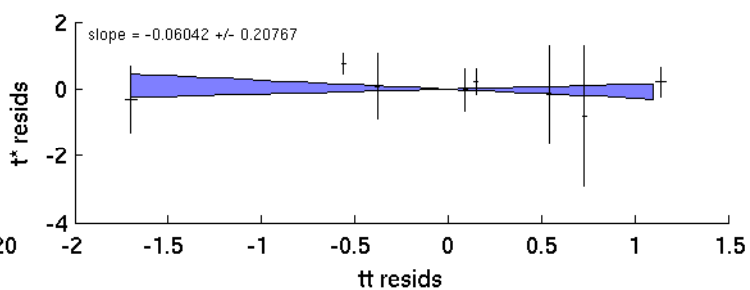
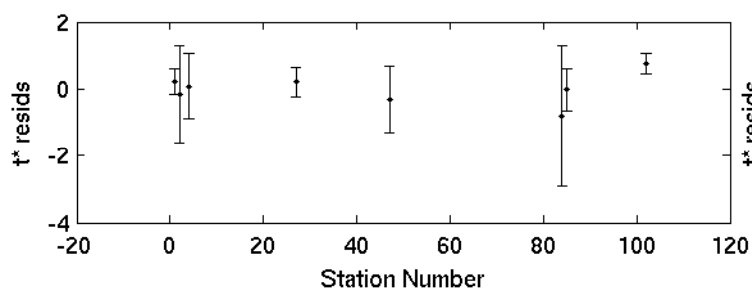
Sorted by t\*:Event\_2005\_079\_01\_53\_41



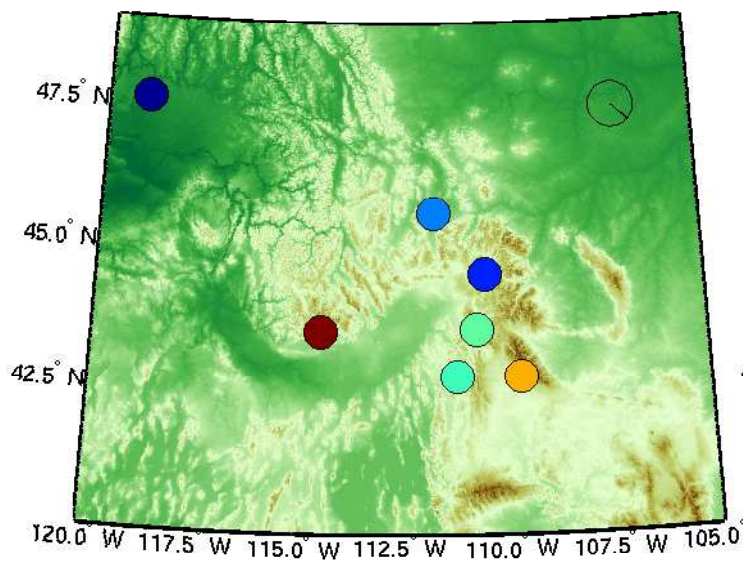
Stack  
Event\_2005\_079\_01\_53\_41



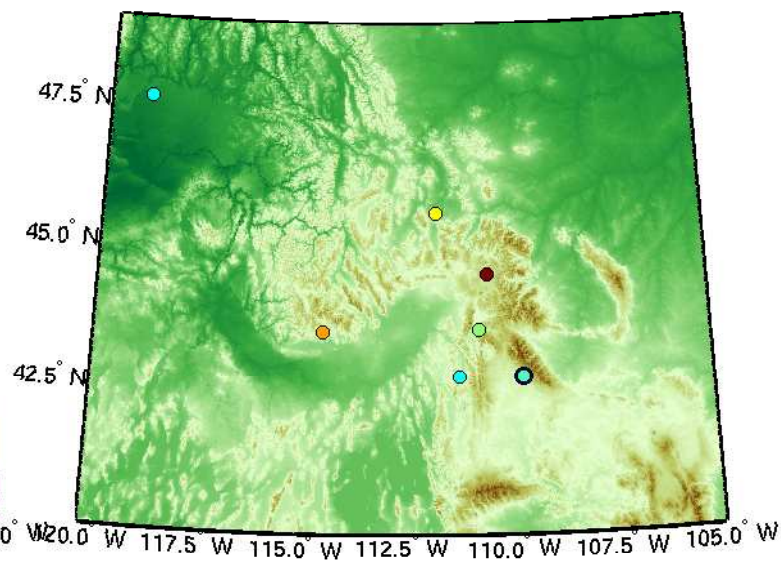
Baz = 313.3649  
Mean xcor value = 0.78375  
Range of  $t^*$  values is 1.565  
Median  $t^*$  err is 0.79868  
Slope = -0.06042 +/- 0.20767



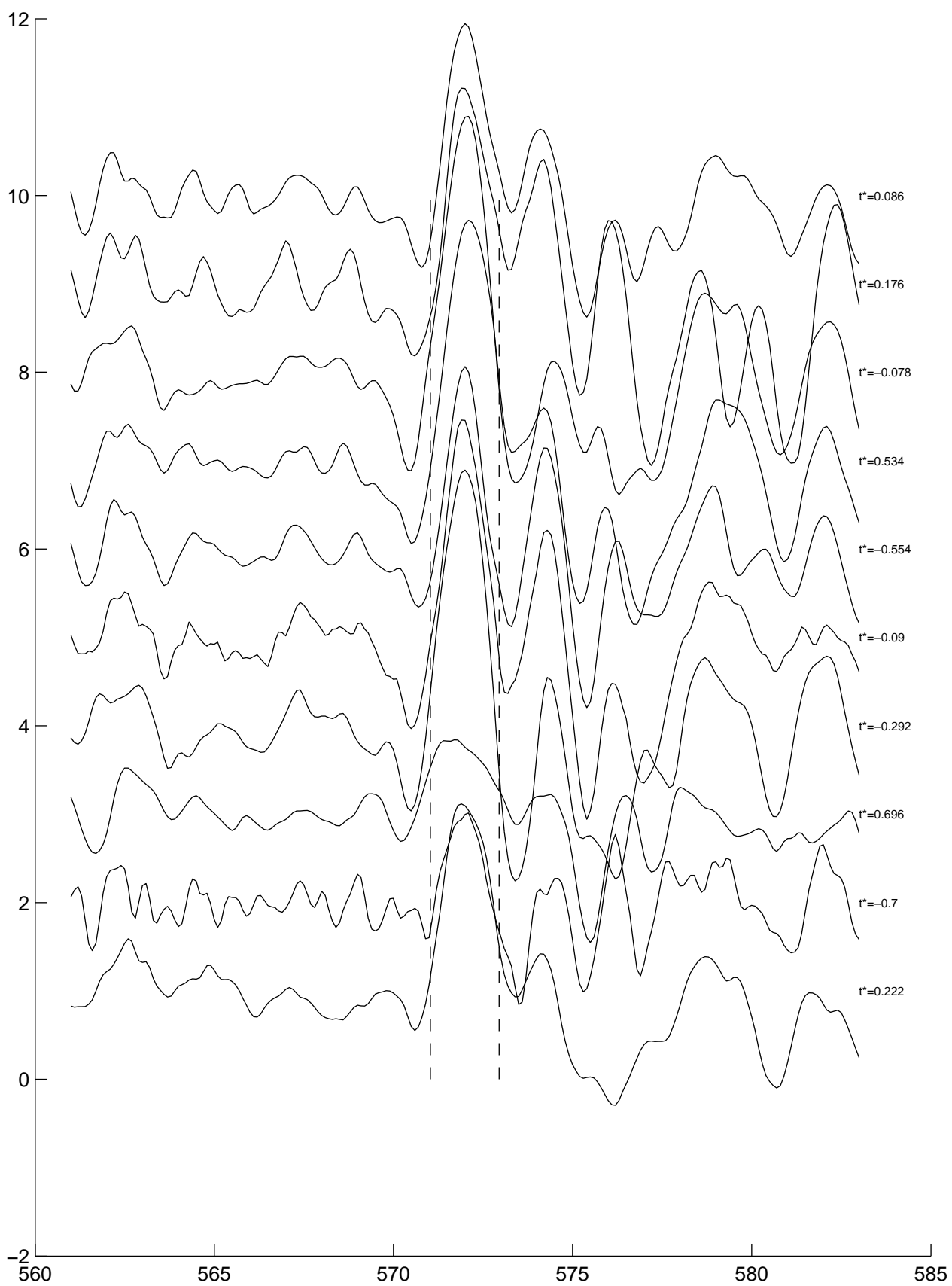
travel time residuals



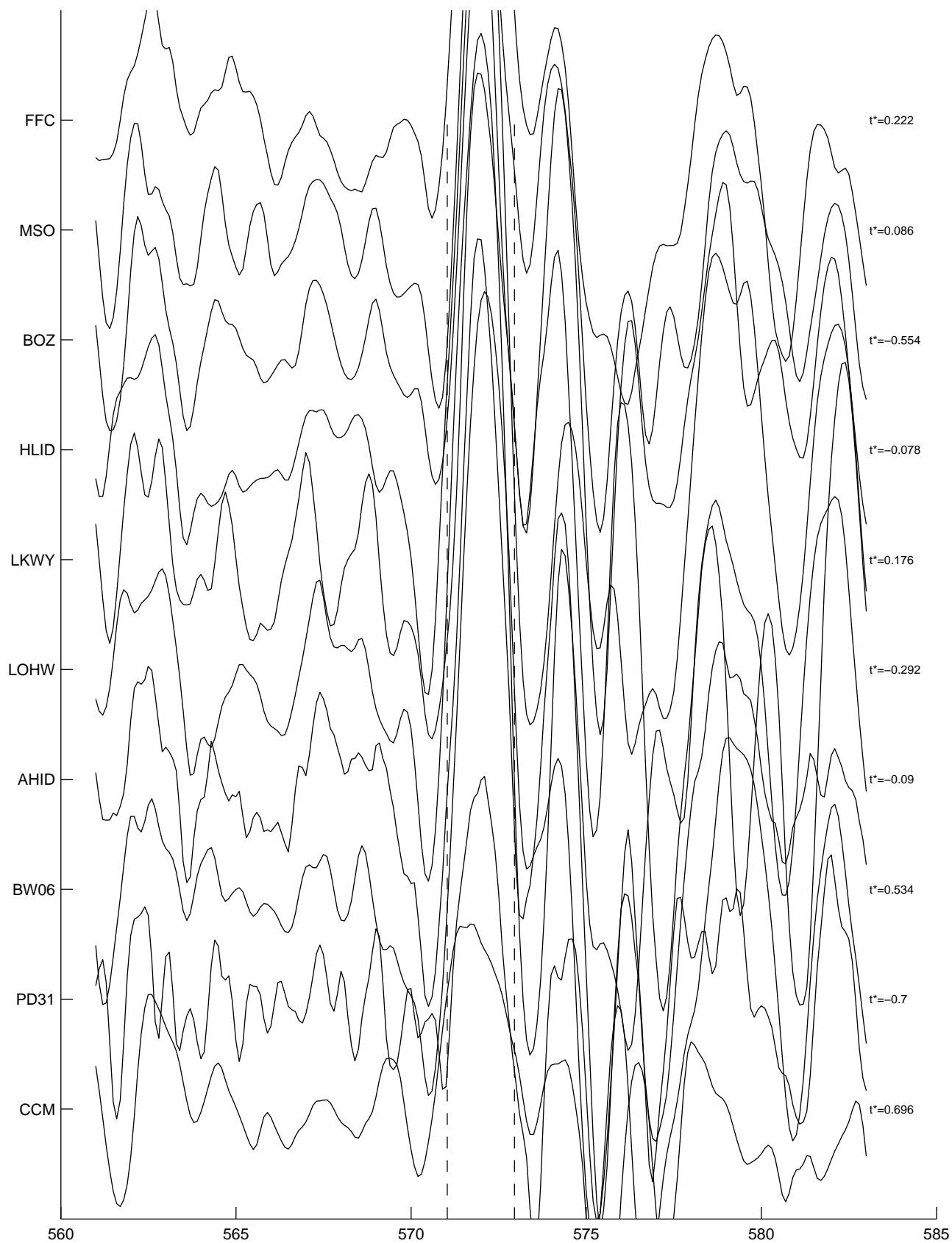
$t^*$  values



# Event\_2005\_141\_05\_11\_35

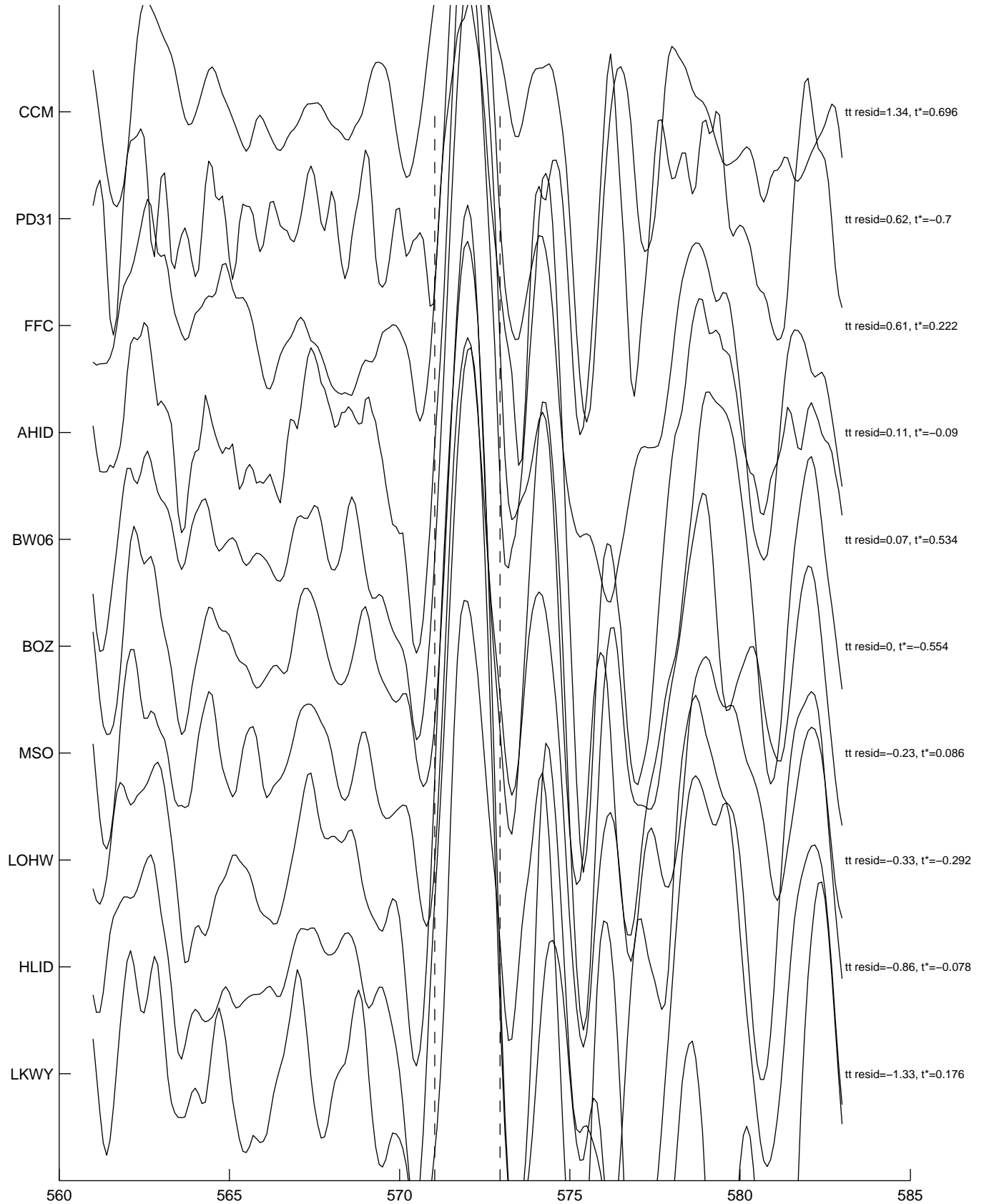


# Sorted by Delta:Event\_2005\_141\_05\_11\_35

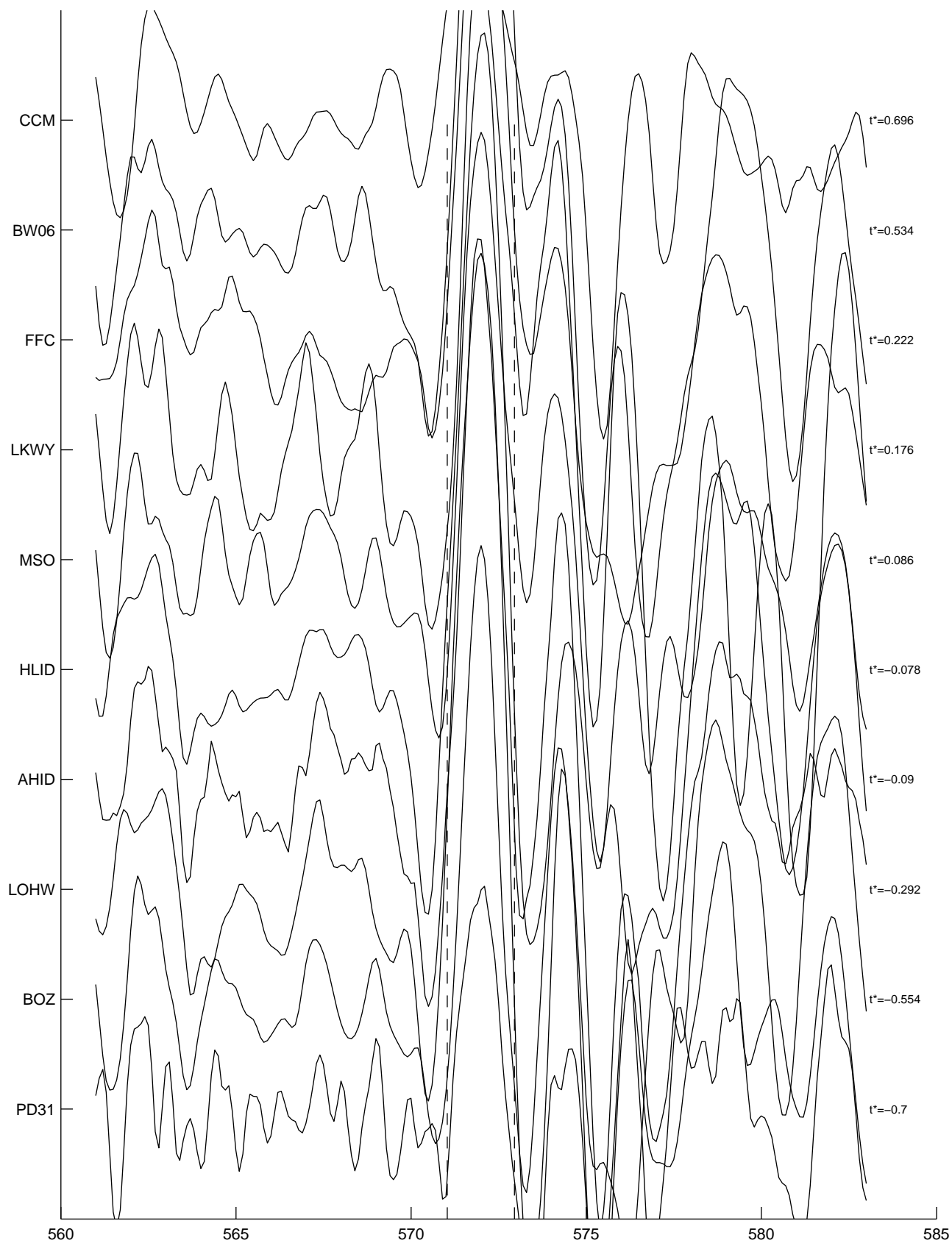




# Sorted by travel time:Event\_2005\_141\_05\_11\_35

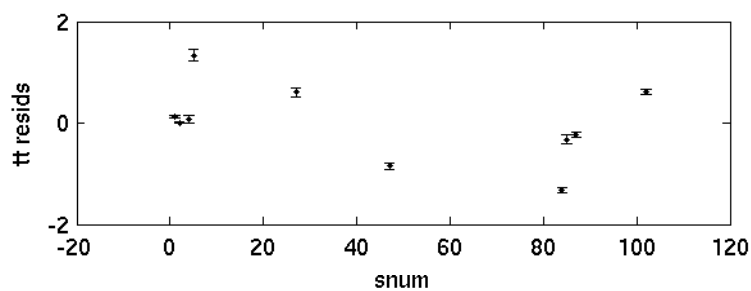
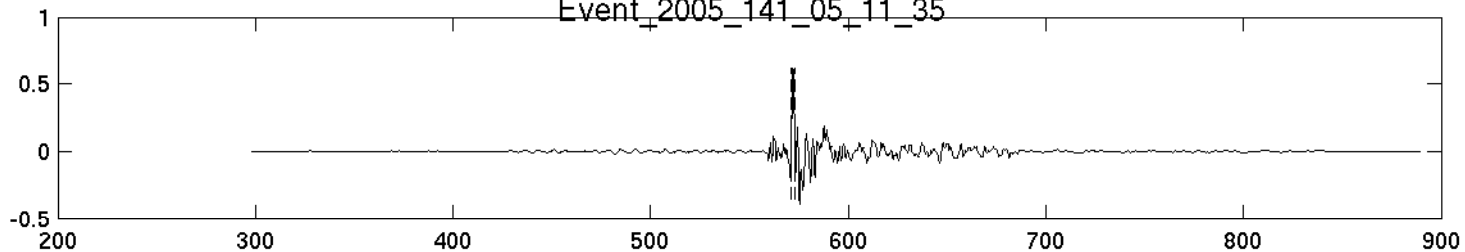


Sorted by t\*:Event\_2005\_141\_05\_11\_35

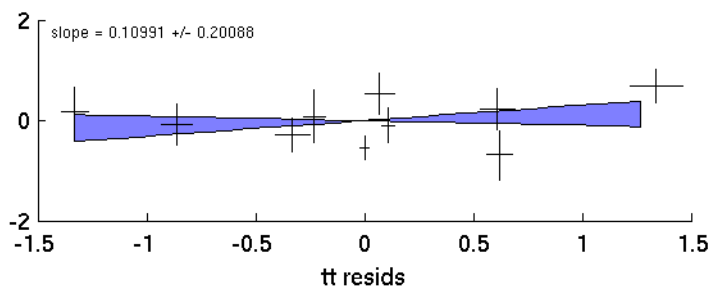
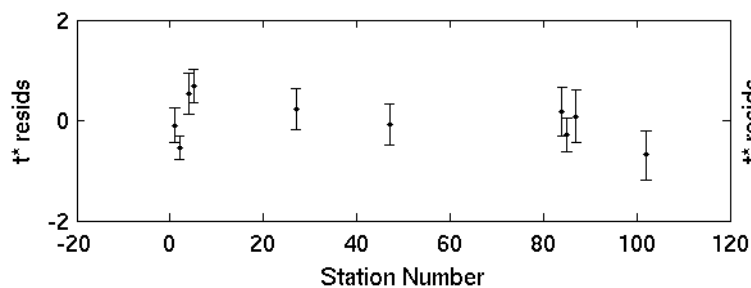


# Event\_2005\_141\_05\_11\_35

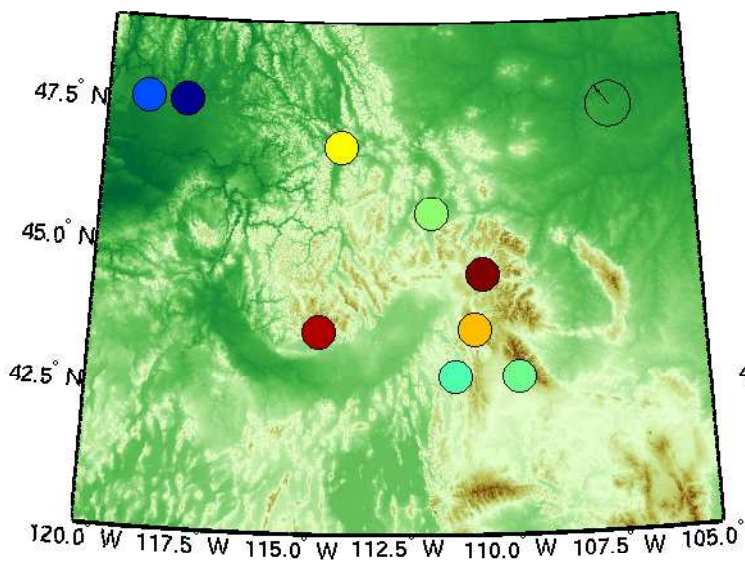
Stack



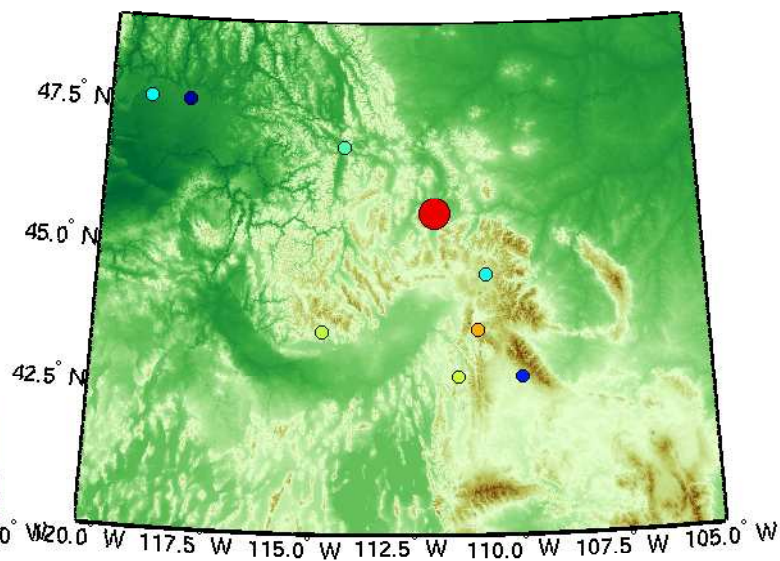
Baz = 145.4132  
Mean xcor value = 0.758  
Range of  $t^*$  values is 1.396  
Median  $t^*$  err is 0.40659  
Slope = 0.10991 +/- 0.20088



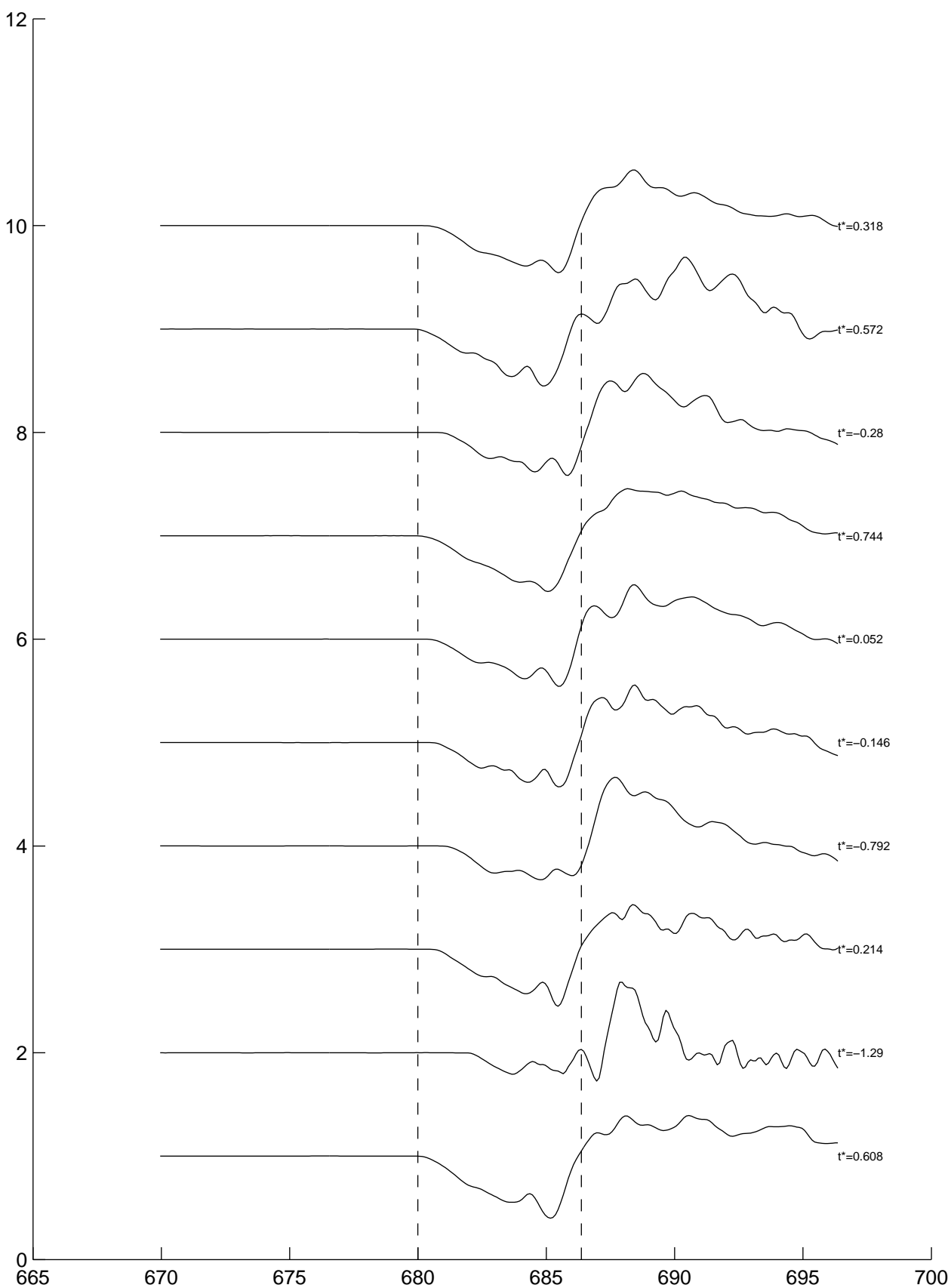
travel time residuals



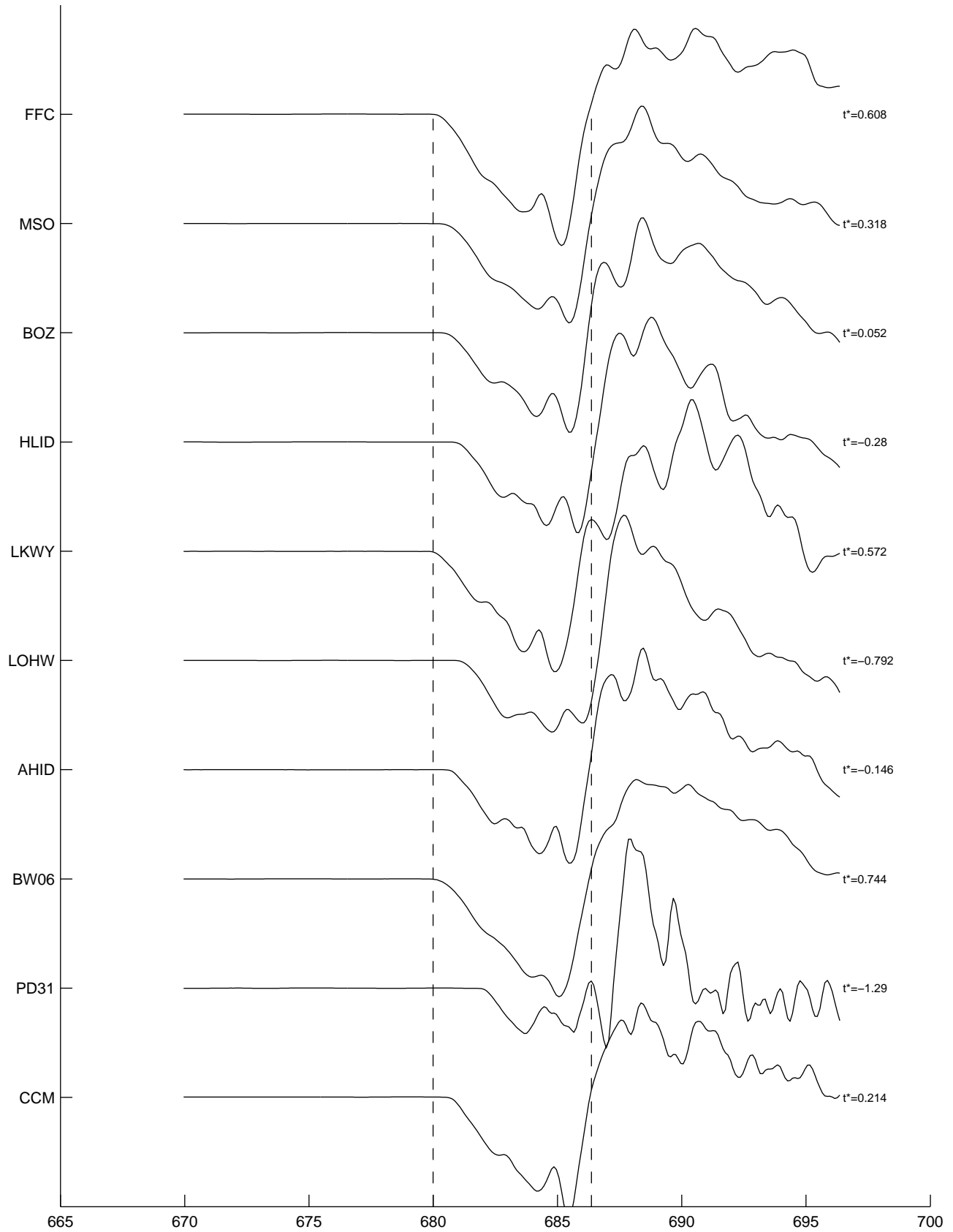
$t^*$  values



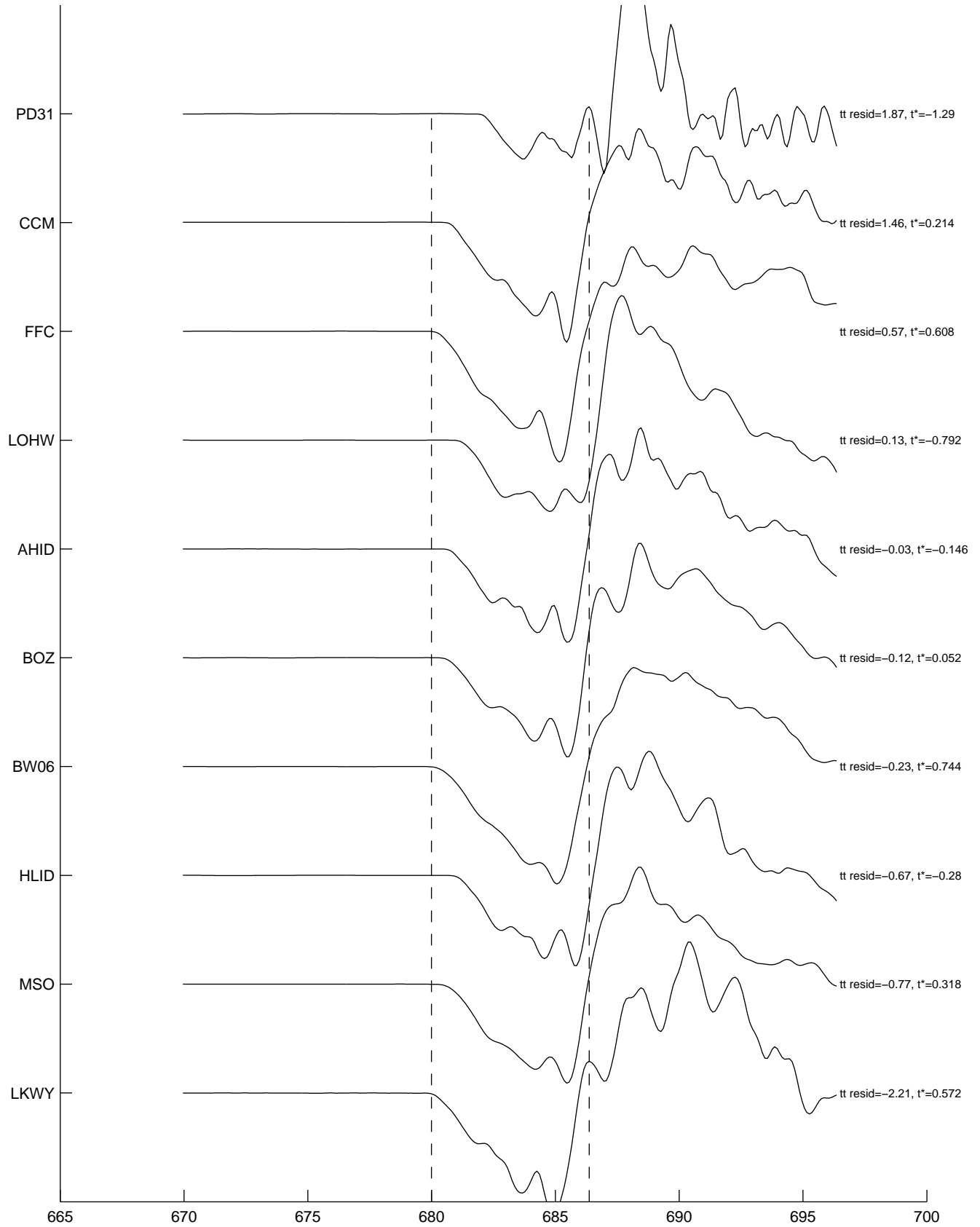
# Event\_2005\_164\_22\_44\_33



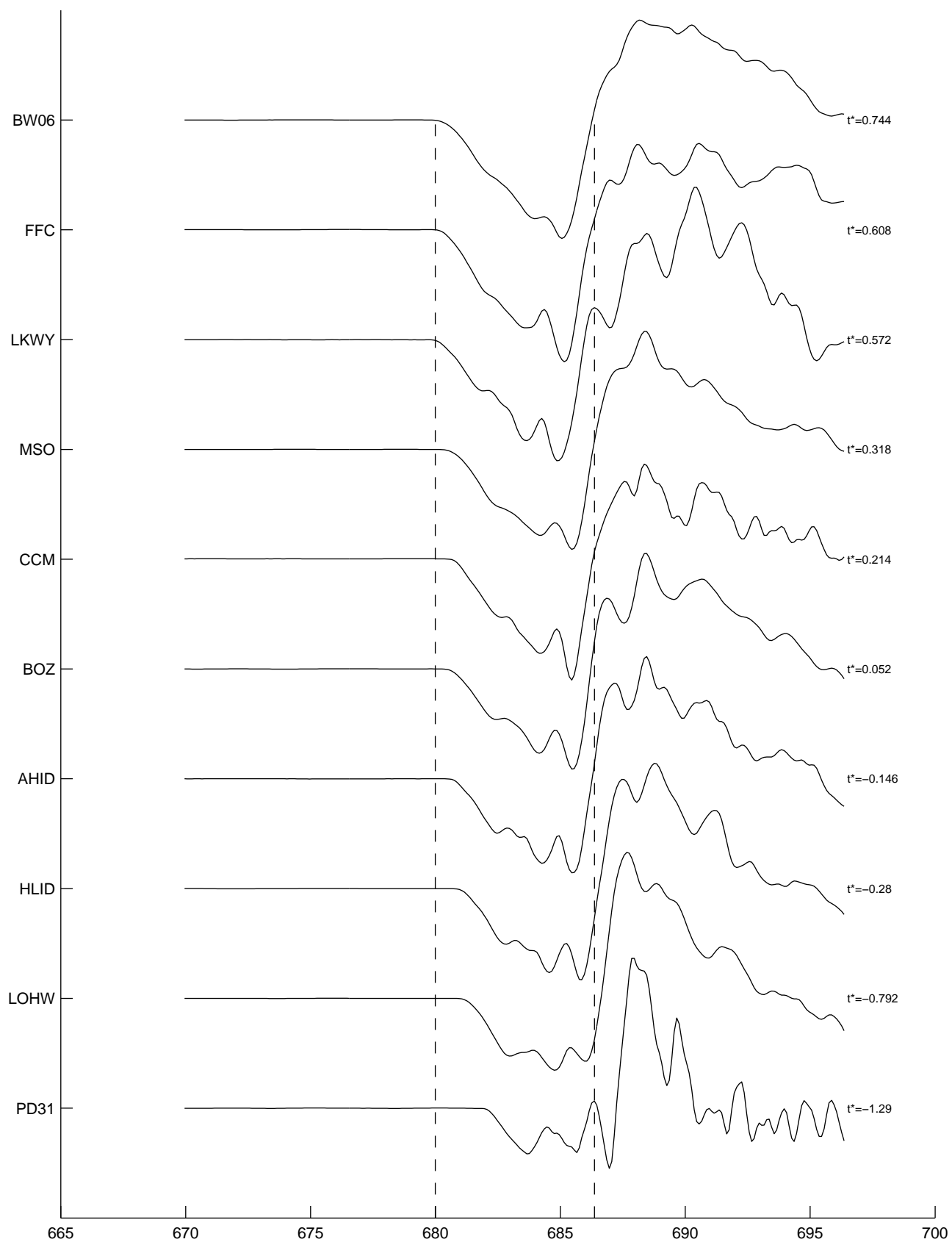
# Sorted by Delta:Event\_2005\_164\_22\_44\_33



# Sorted by travel time:Event\_2005\_164\_22\_44\_33

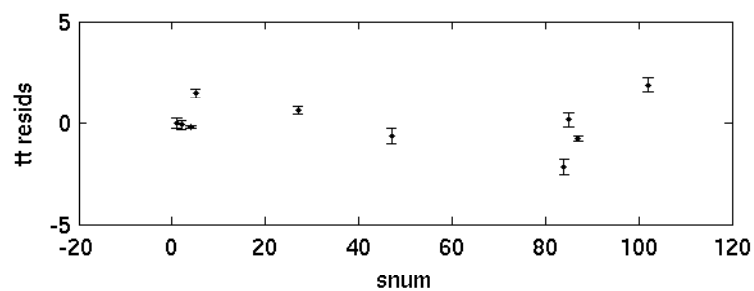
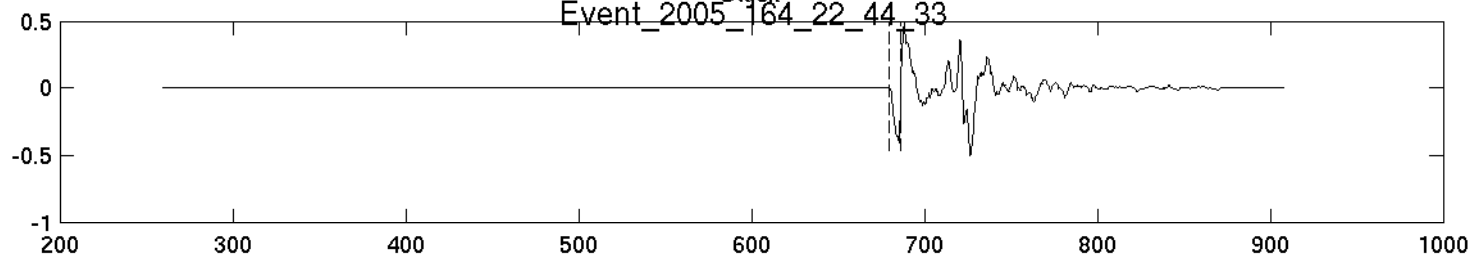


Sorted by  $t^*$ :Event\_2005\_164\_22\_44\_33

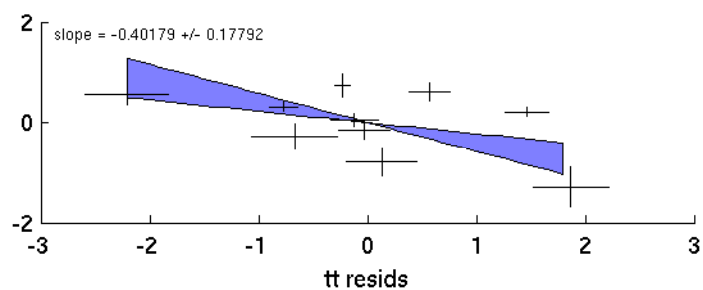
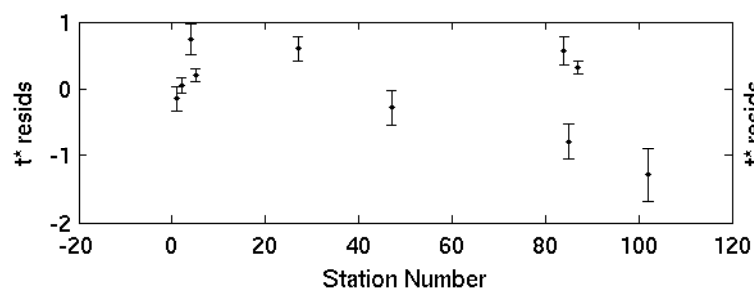


Event\_2005\_164\_22\_44\_33

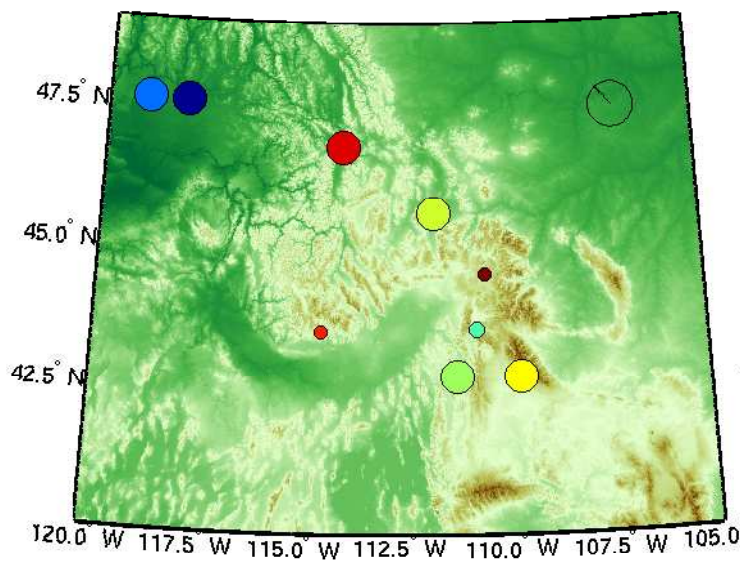
Stack



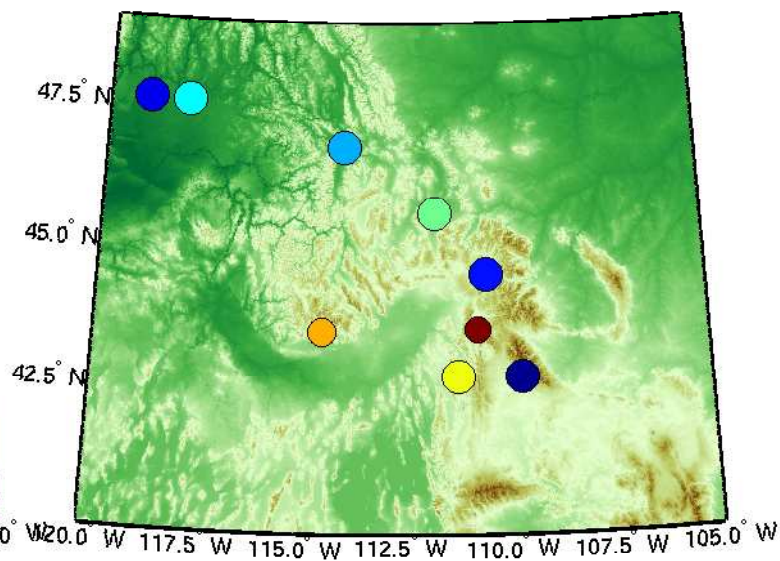
Baz = 141.8301  
Mean xcor value = 0.842  
Range of  $t^*$  values is 2.034  
Median  $t^*$  err is 0.19666  
Slope =  $-0.40179 \pm 0.17792$



travel time residuals

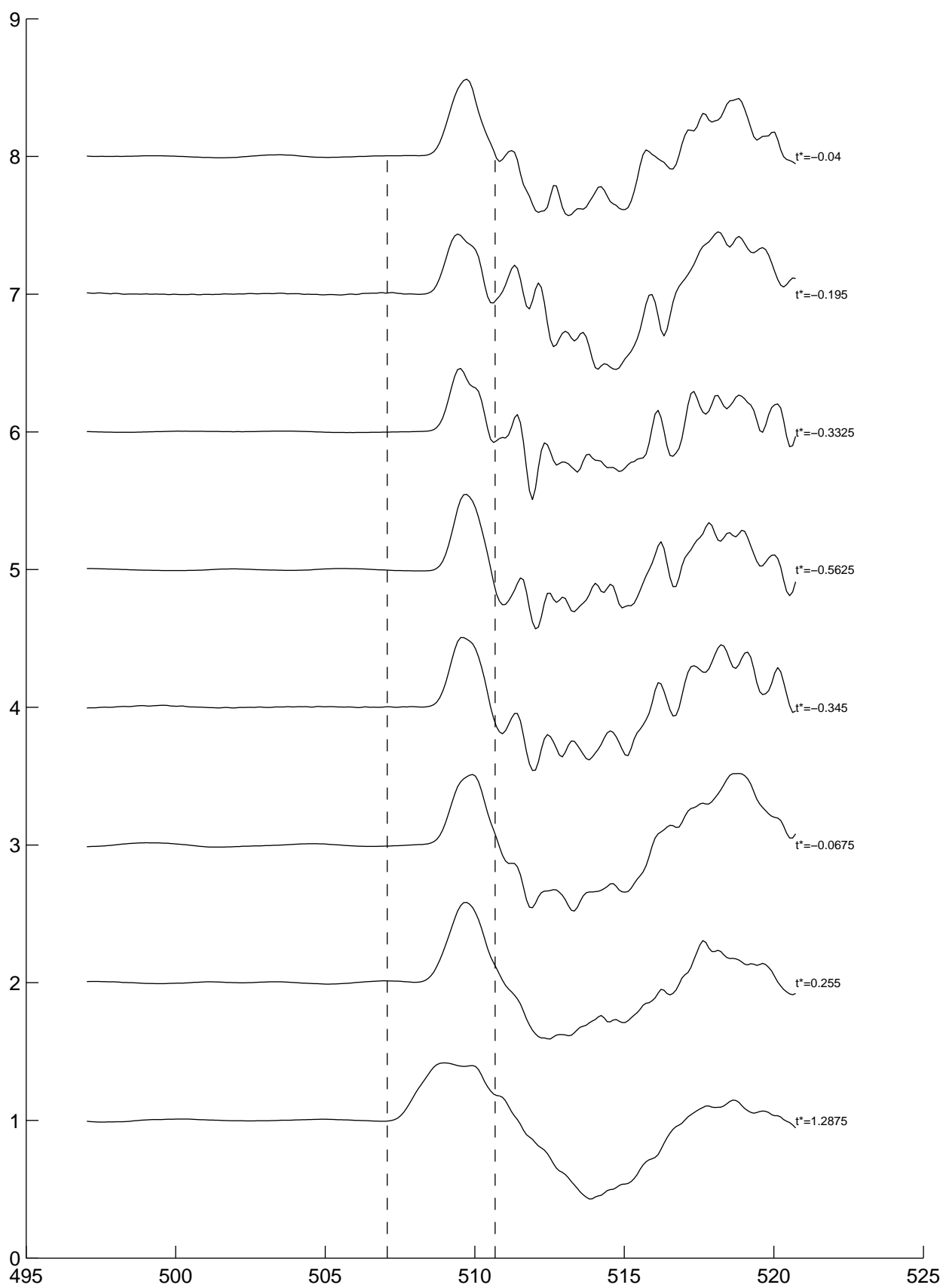


$t^*$  values

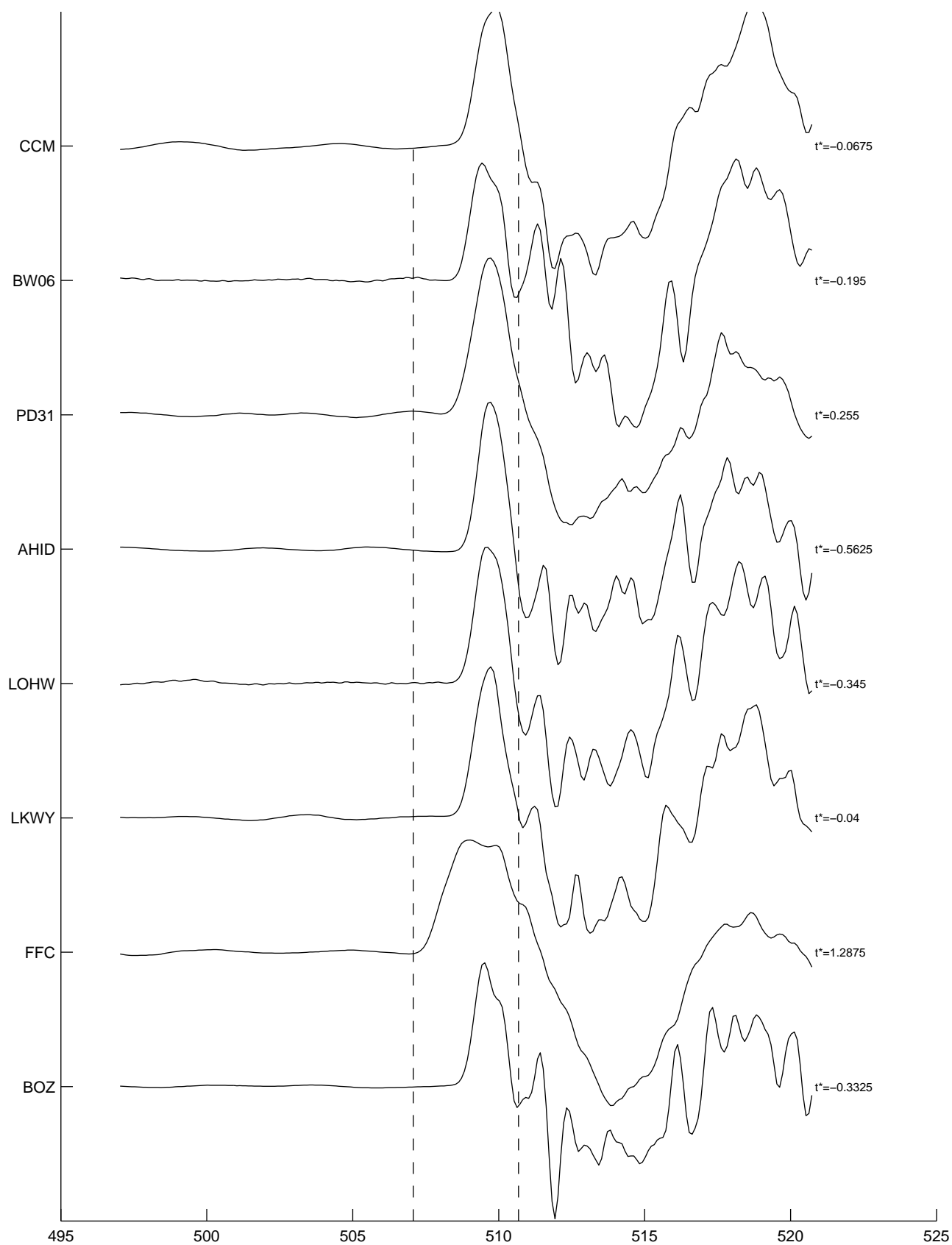




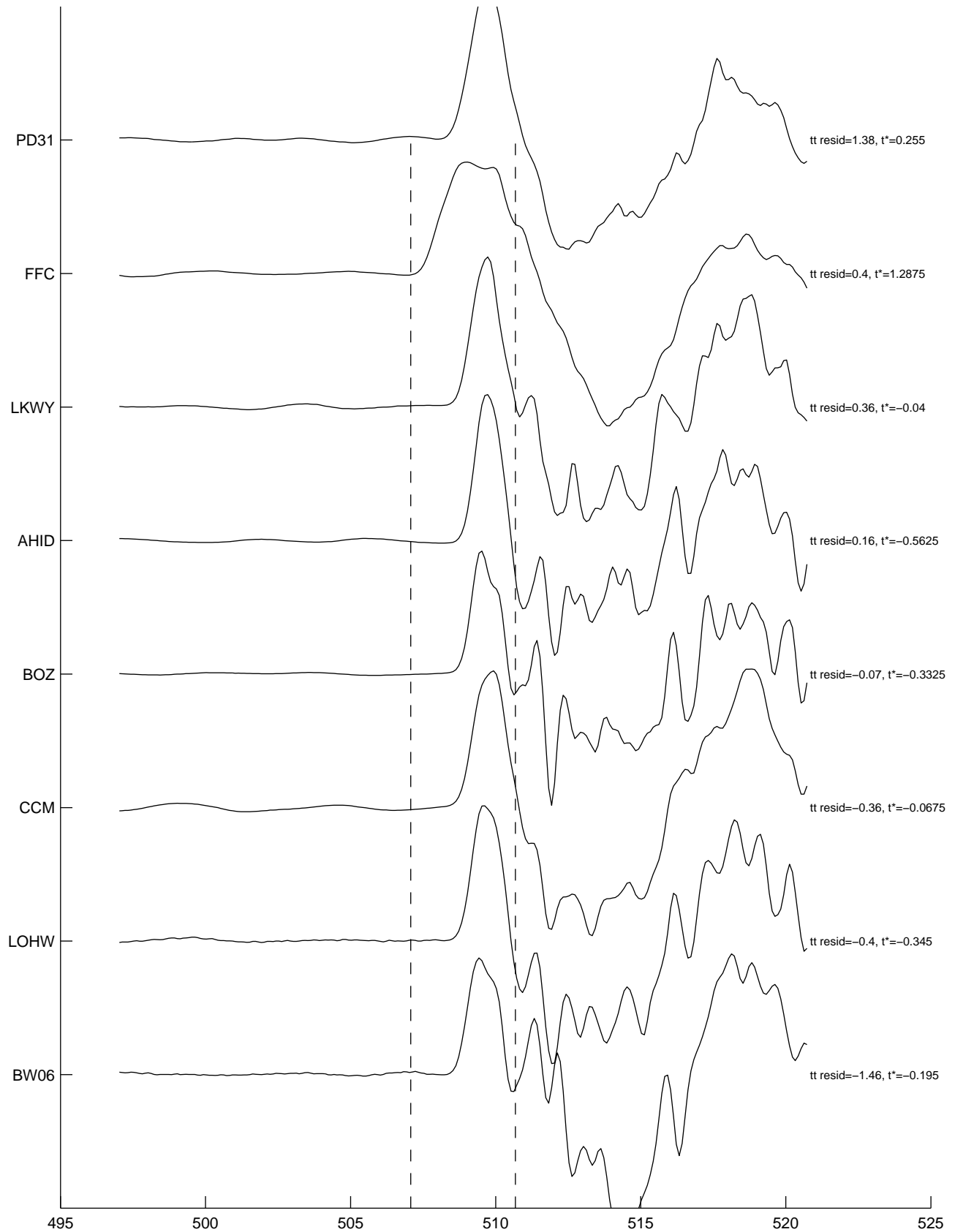
# Event\_2005\_165\_17\_10\_16



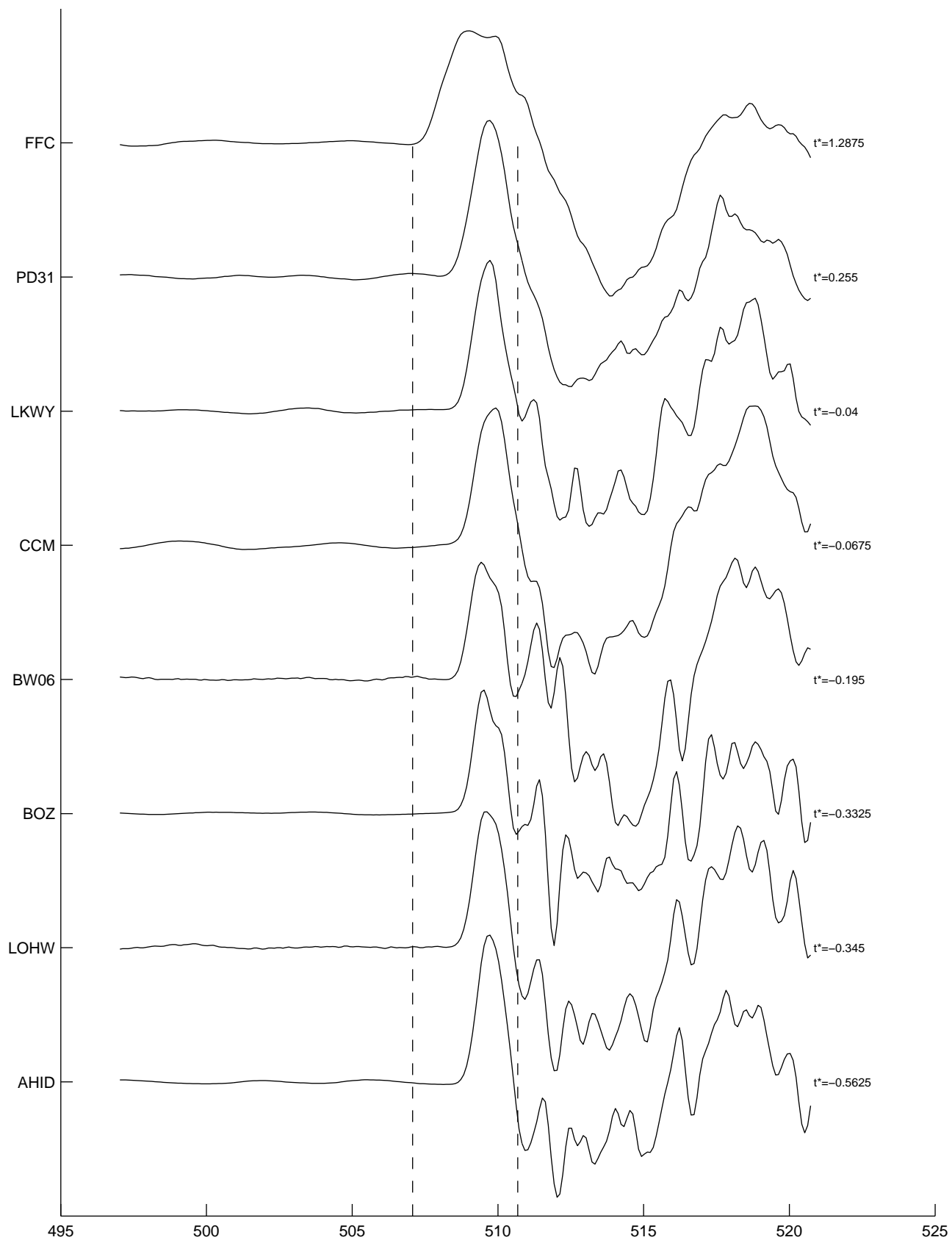
# Sorted by Delta:Event\_2005\_165\_17\_10\_16



# Sorted by travel time:Event\_2005\_165\_17\_10\_16

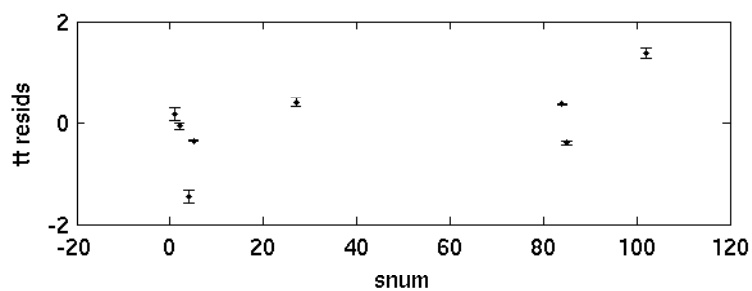
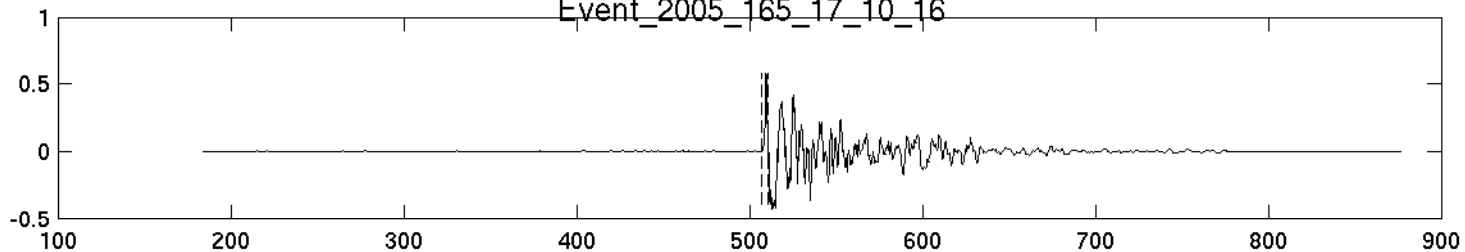


# Sorted by t\*:Event\_2005\_165\_17\_10\_16

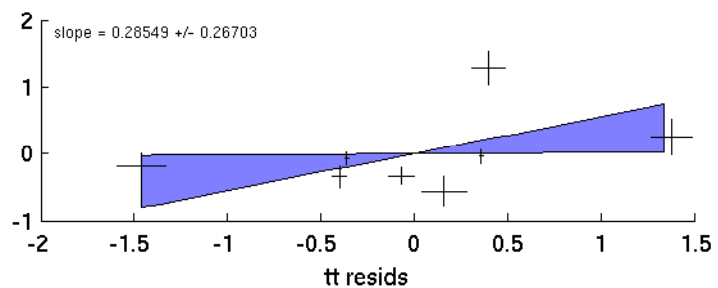
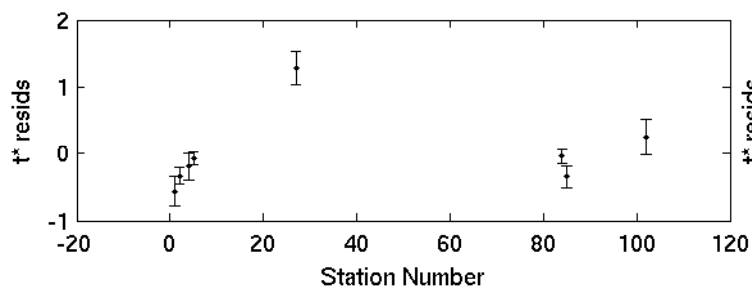


# Event\_2005\_165\_17\_10\_16

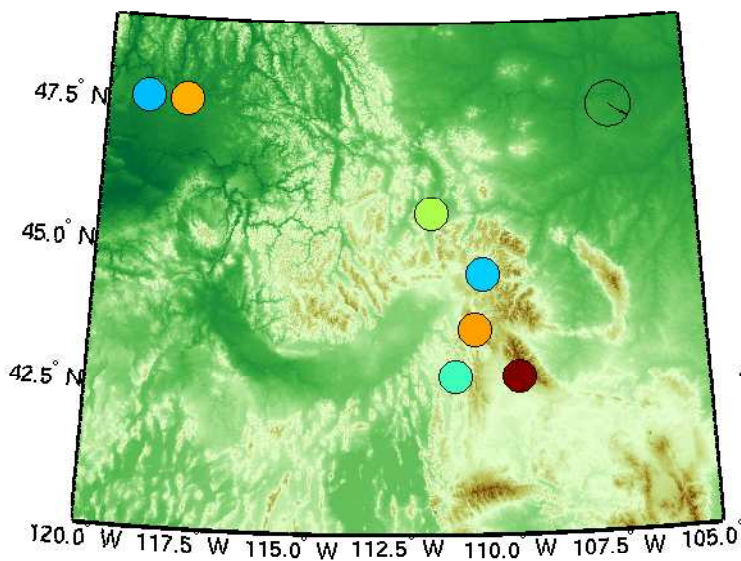
Stack



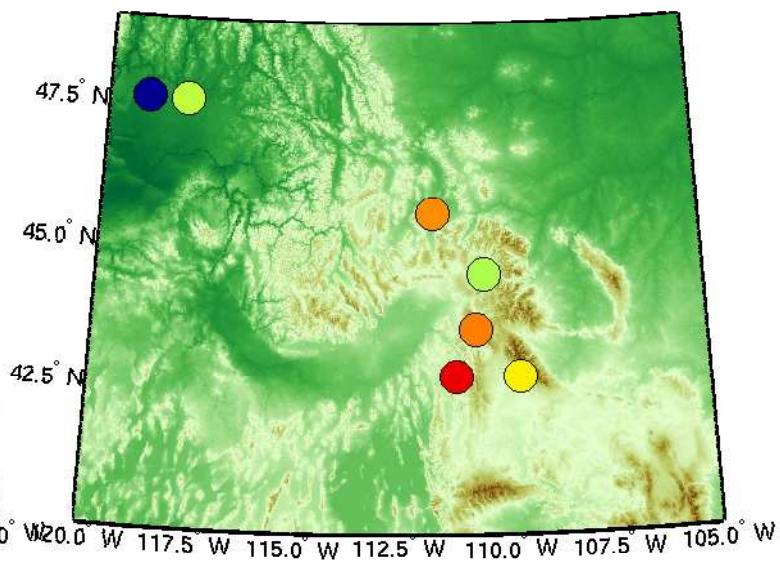
Baz = 305.2191  
Mean xcor value = 0.75125  
Range of  $t^*$  values is 1.85  
Median  $t^*$  err is 0.18524  
Slope = 0.28549 +/- 0.26703



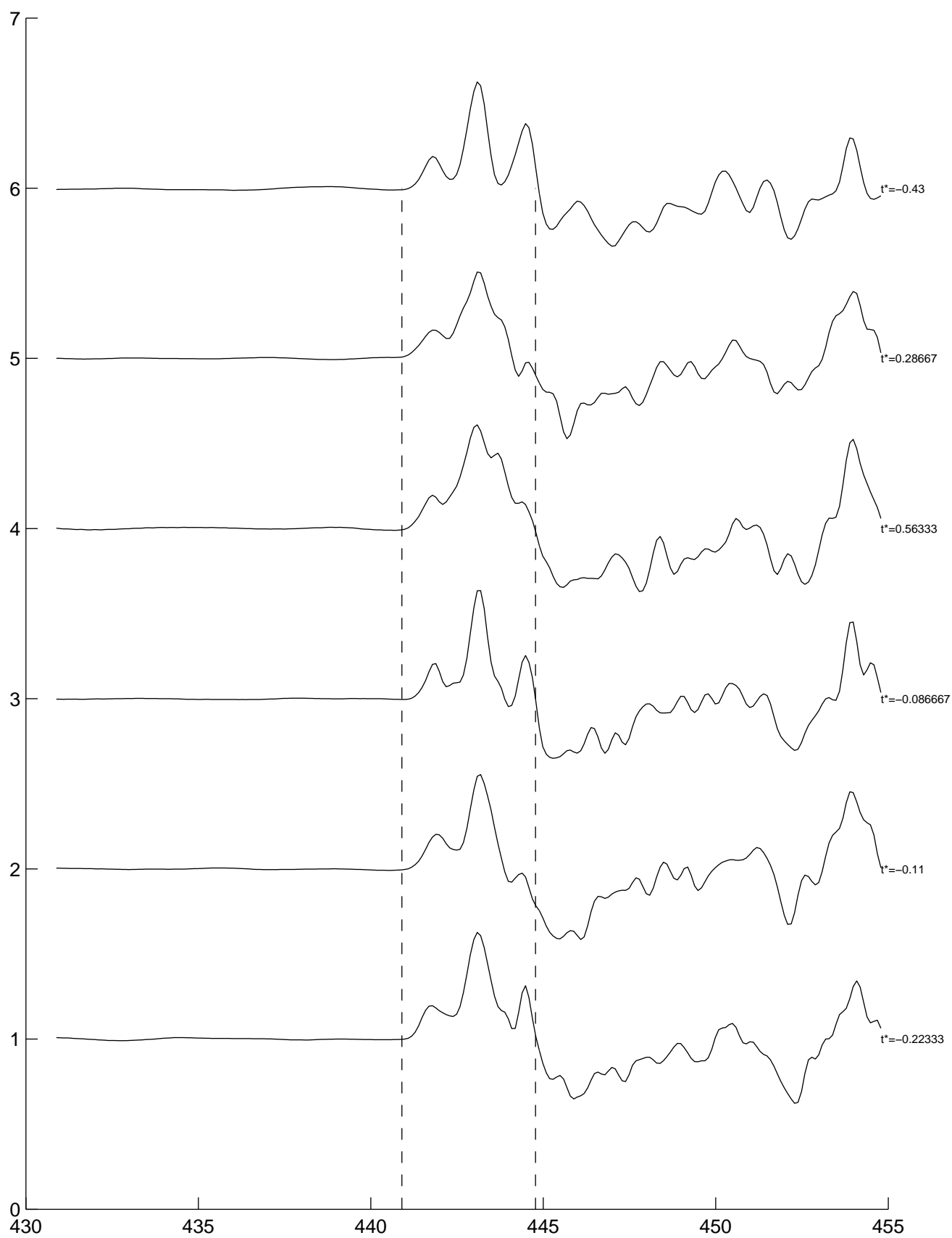
travel time residuals



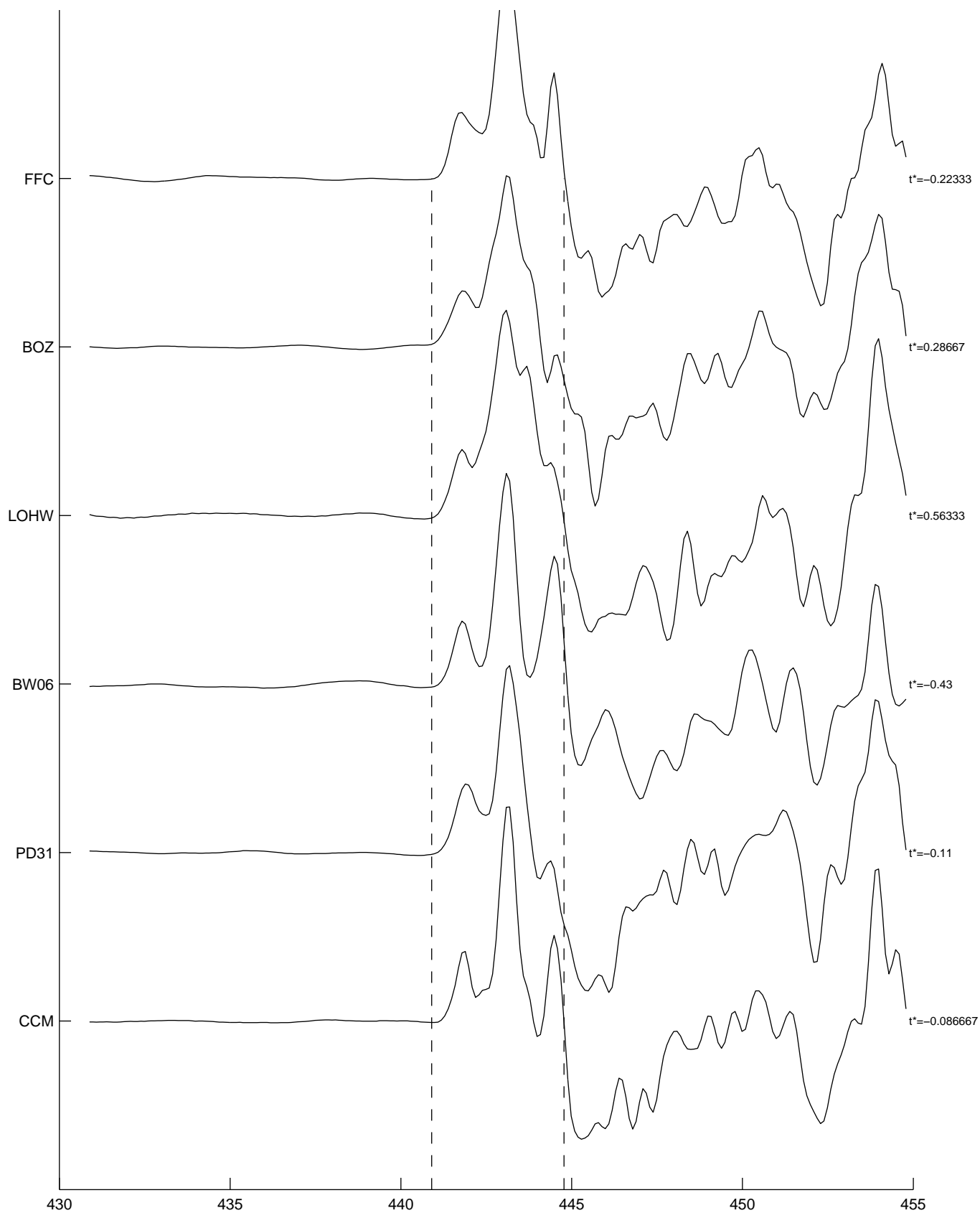
$t^*$  values



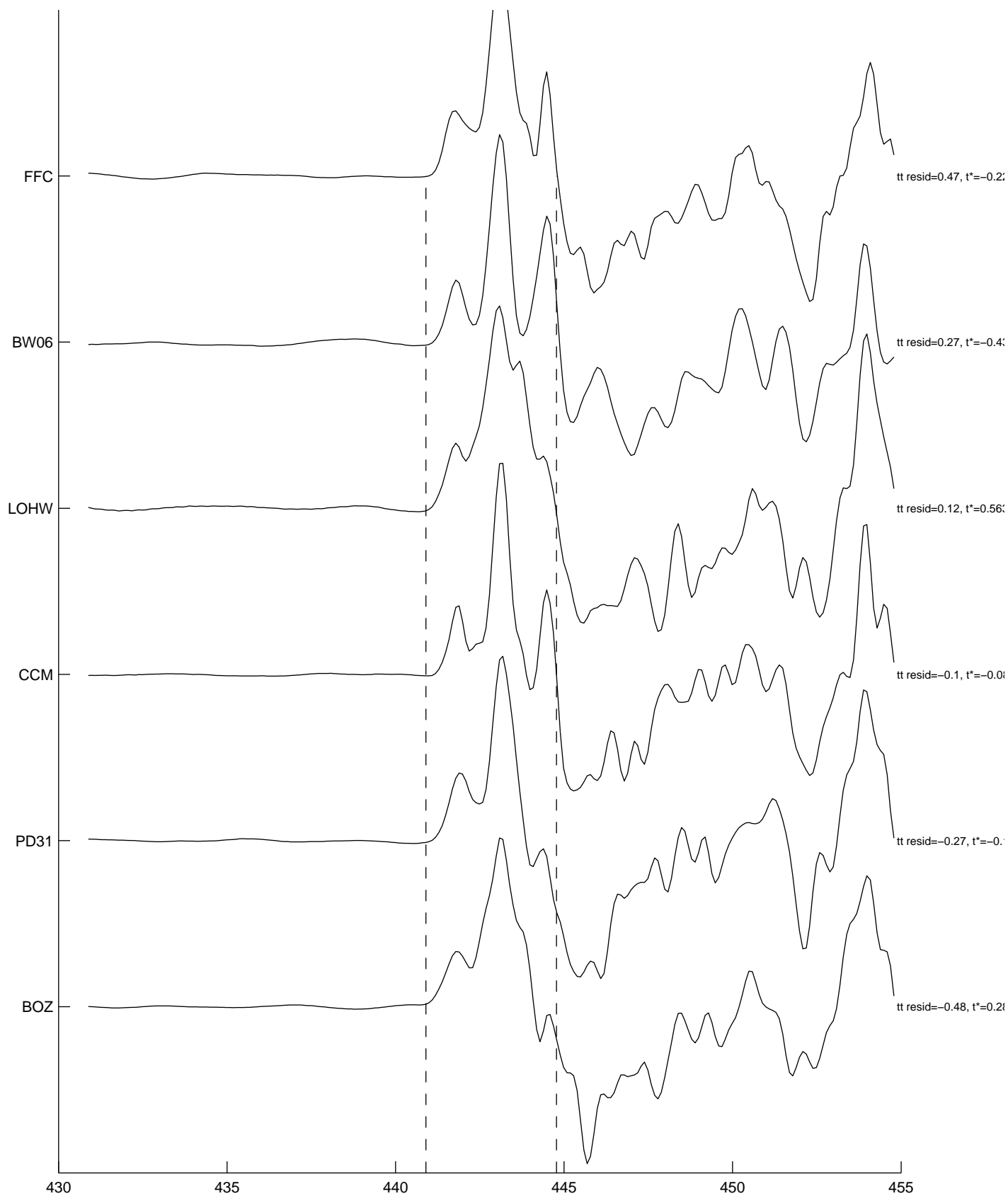
# Event\_2005\_183\_02\_16\_43



# Sorted by Delta:Event\_2005\_183\_02\_16\_43

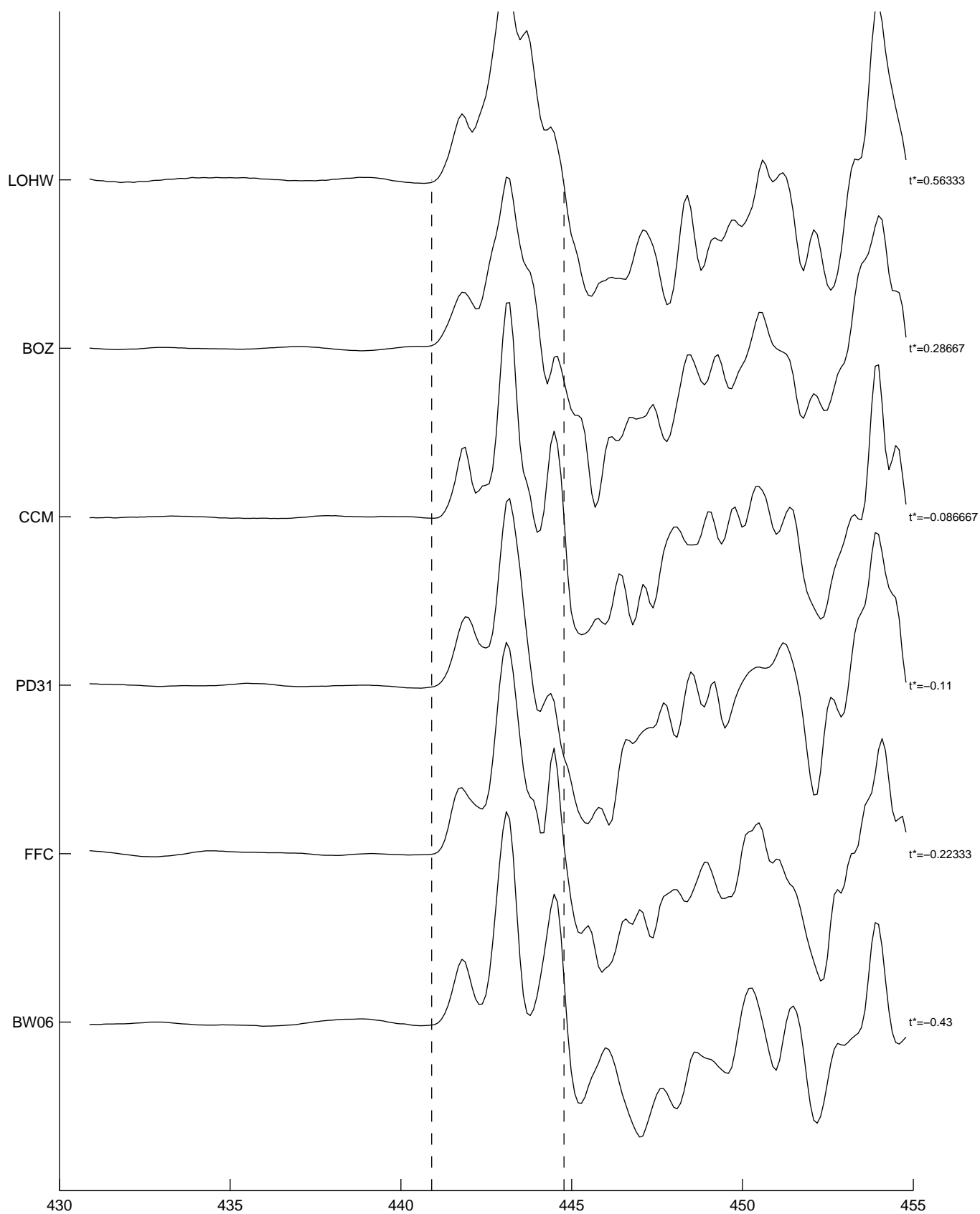


# Sorted by travel time: Event\_2005\_183\_02\_16\_43

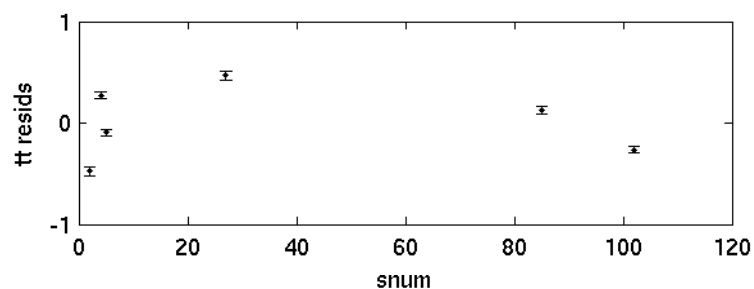
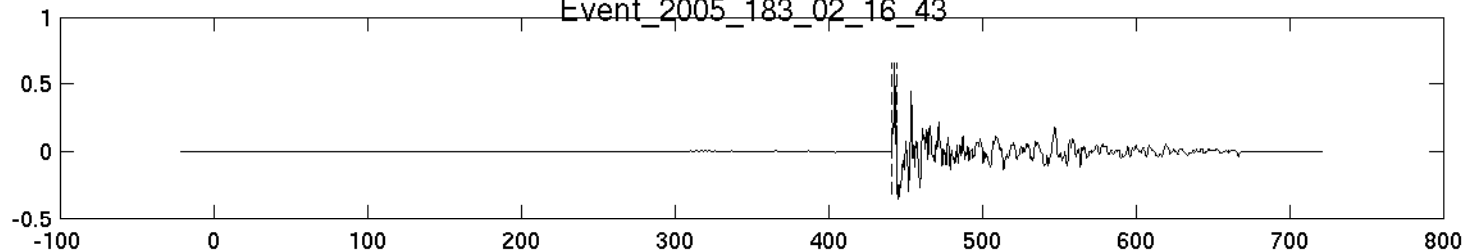




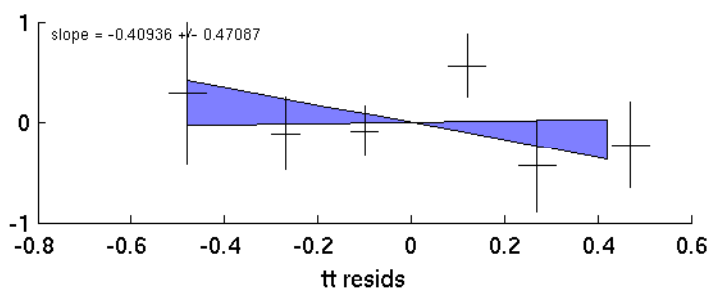
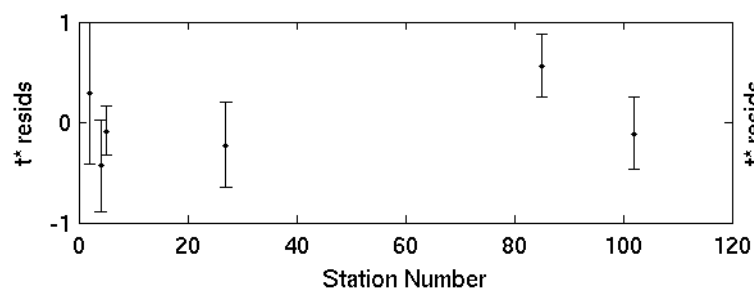
Sorted by  $t^*$ :Event\_2005\_183\_02\_16\_43



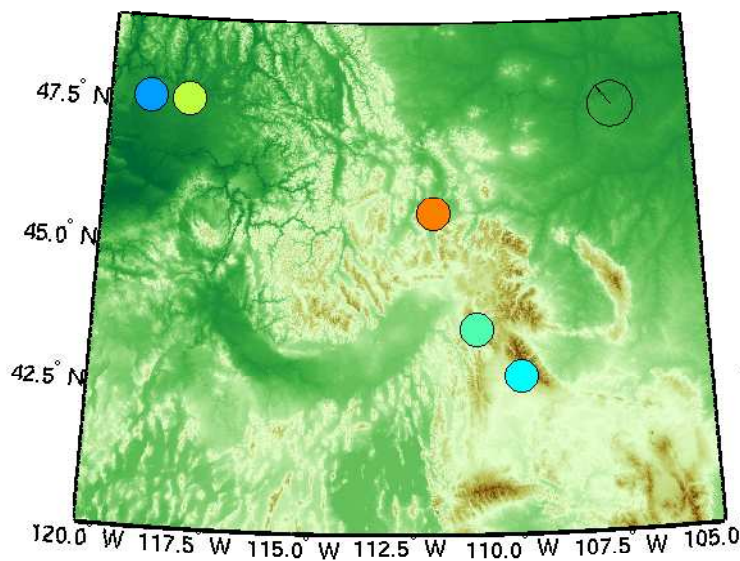
# Stack Event\_2005\_183\_02\_16\_43



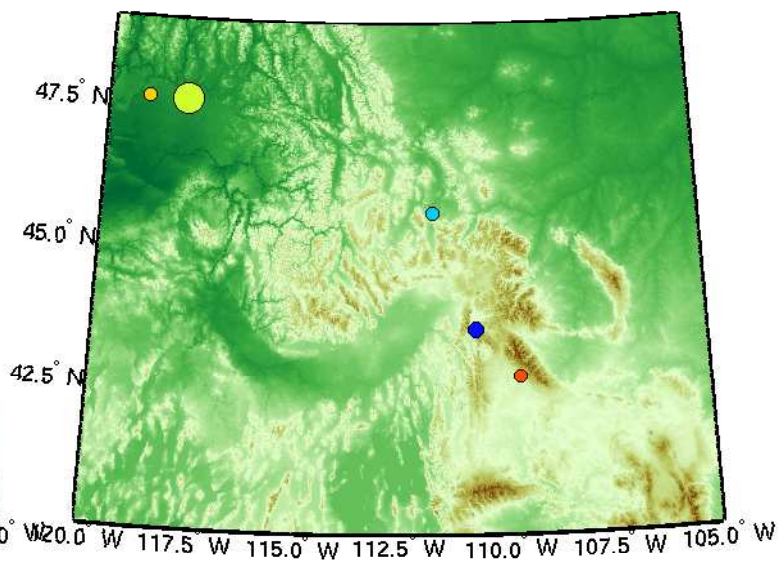
Baz = 144.343  
Mean xcor value = 0.65667  
Range of  $t^*$  values is 0.99333  
Median  $t^*$  err is 0.39839  
Slope = -0.40936 +/- 0.47087



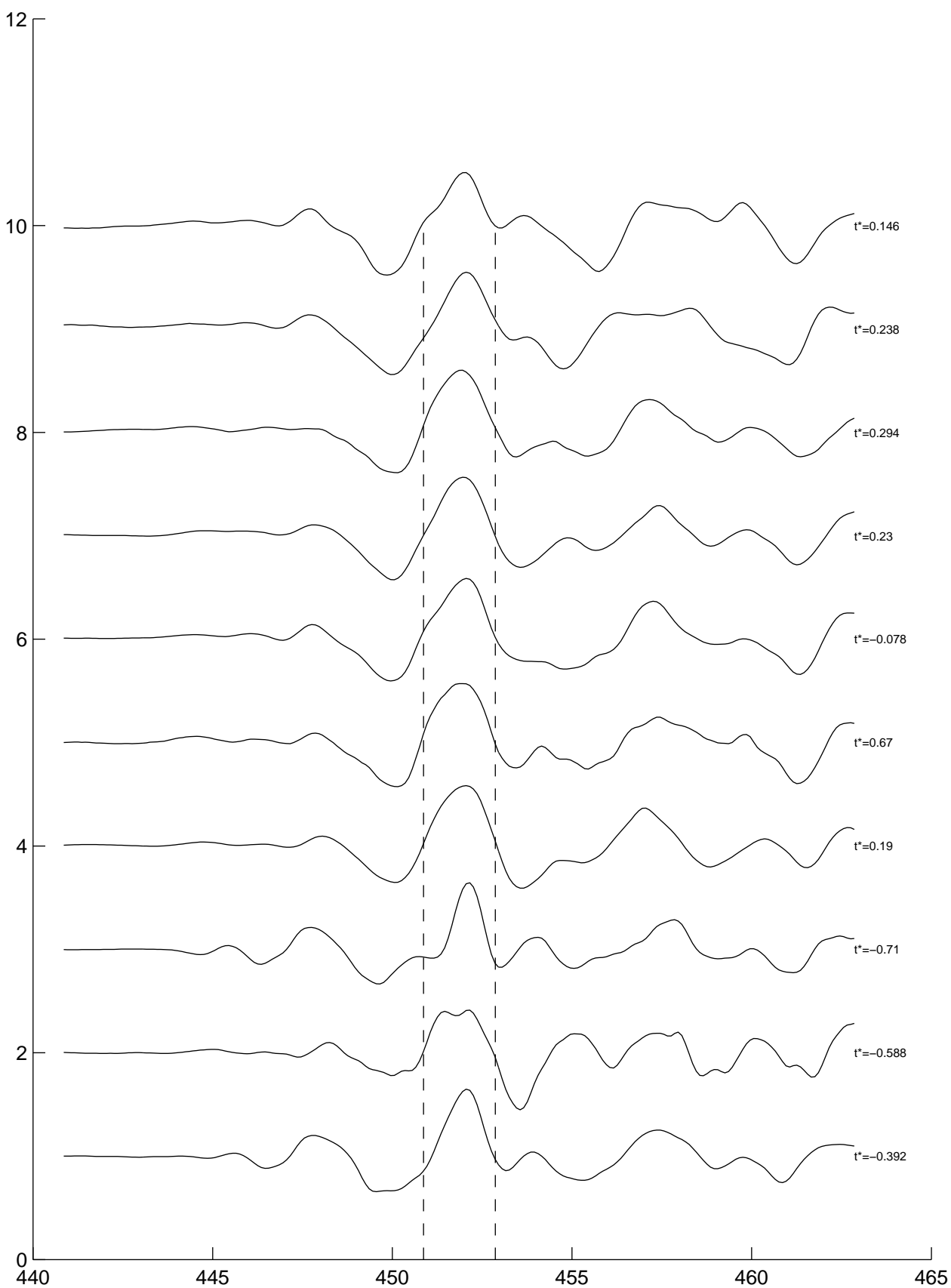
travel time residuals



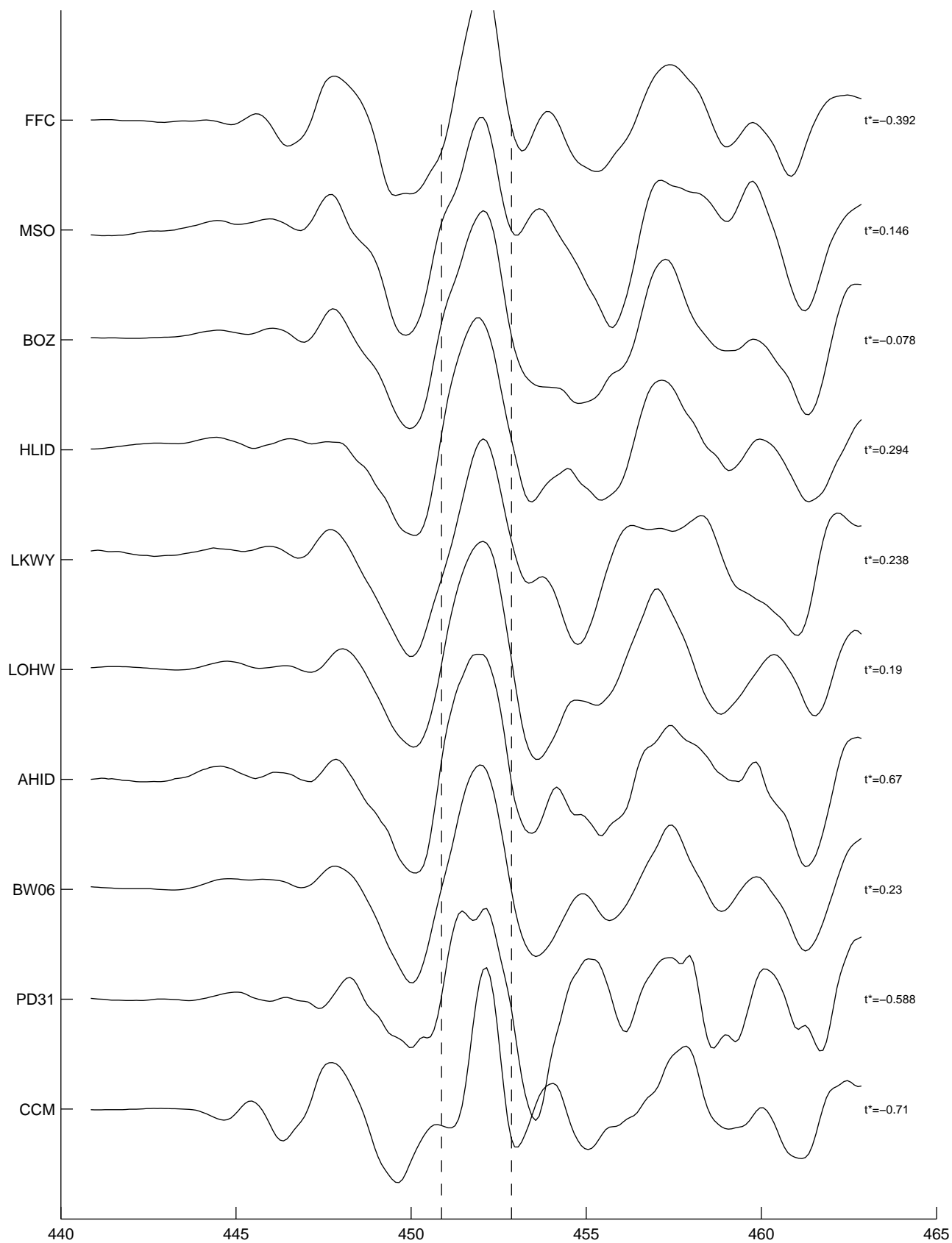
$t^*$  values



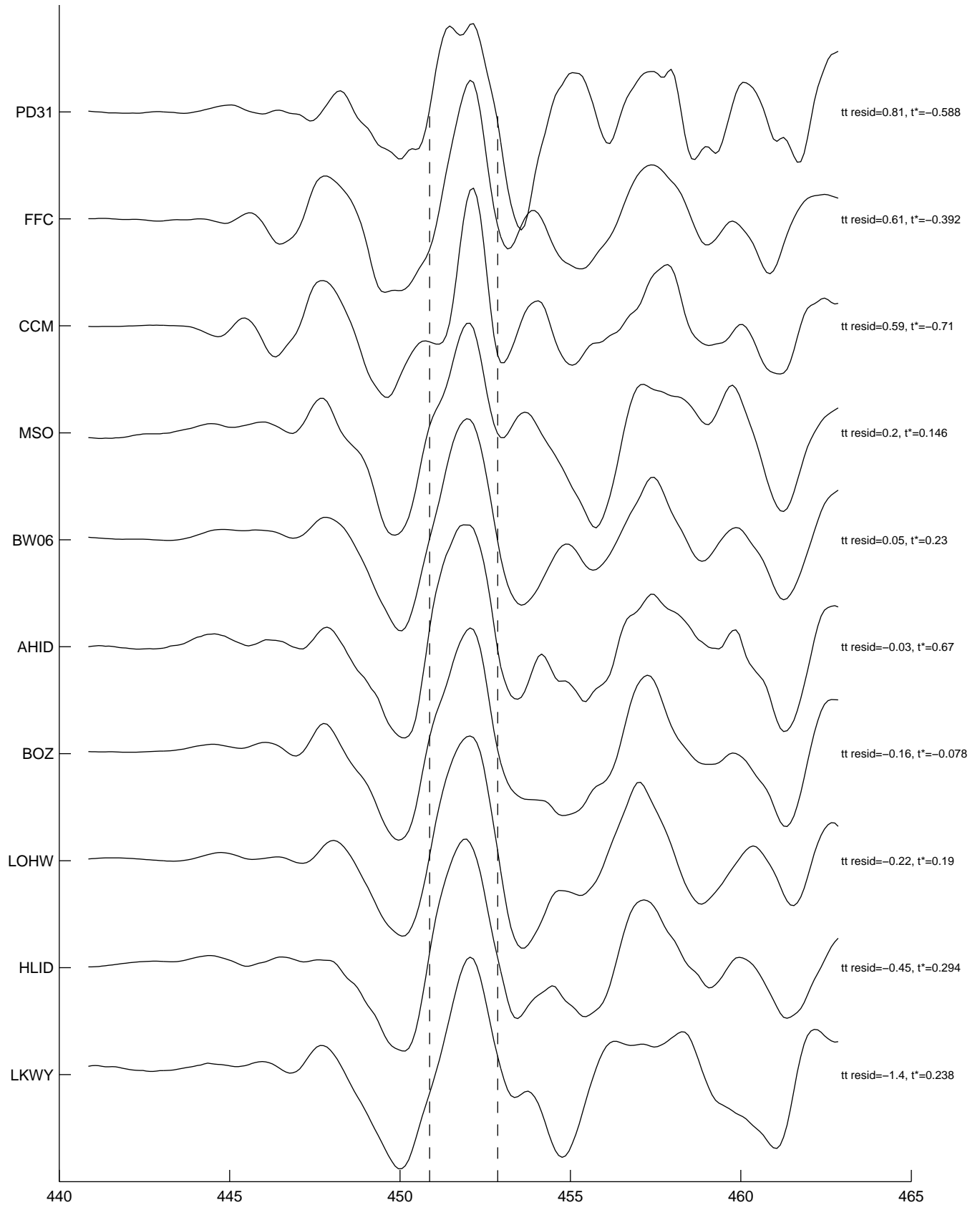
# Event\_2005\_215\_11\_03\_15



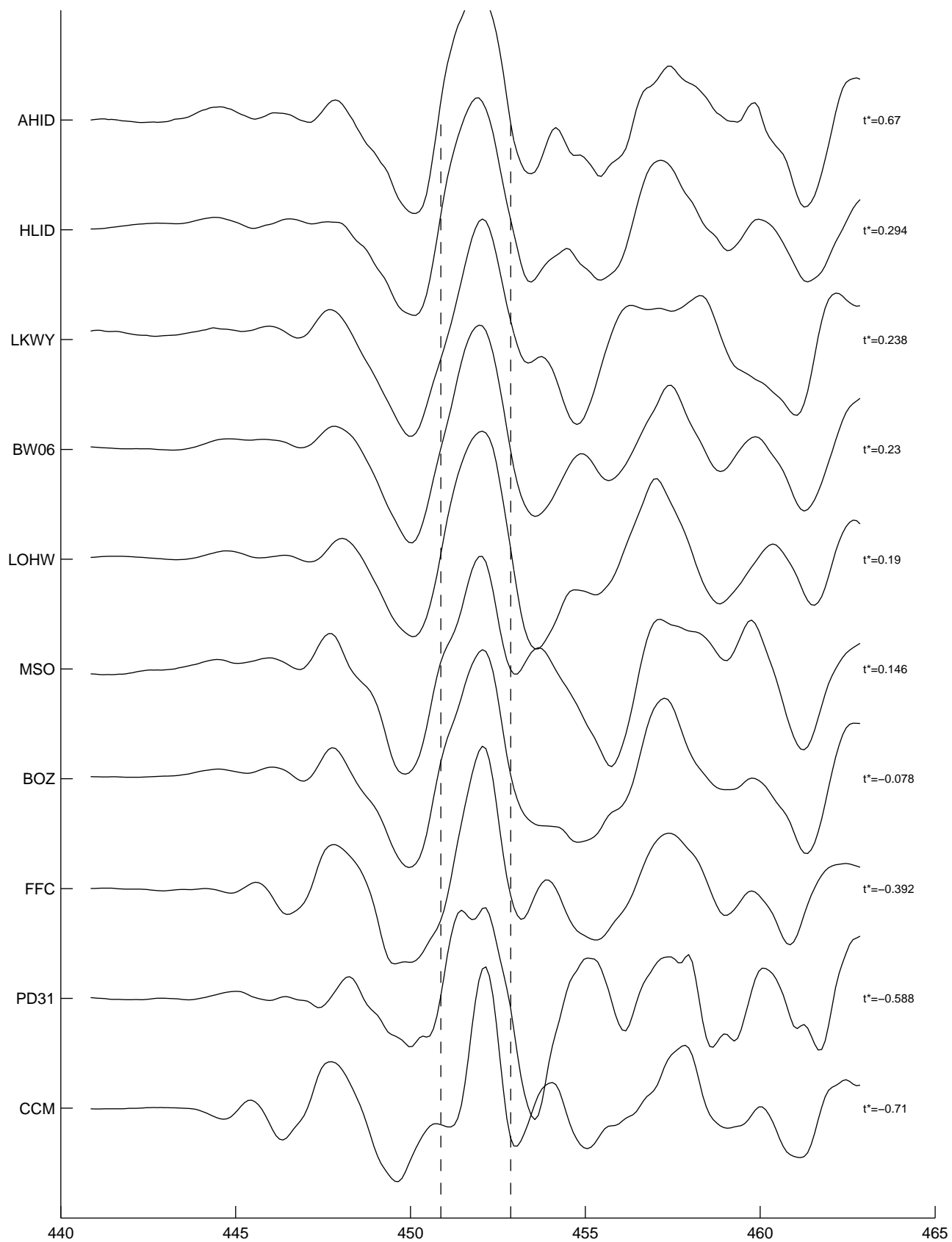
# Sorted by Delta:Event\_2005\_215\_11\_03\_15



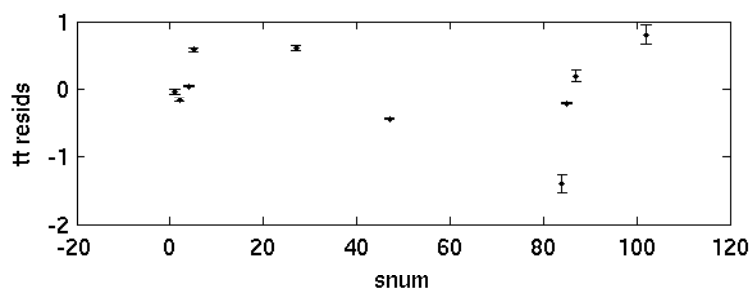
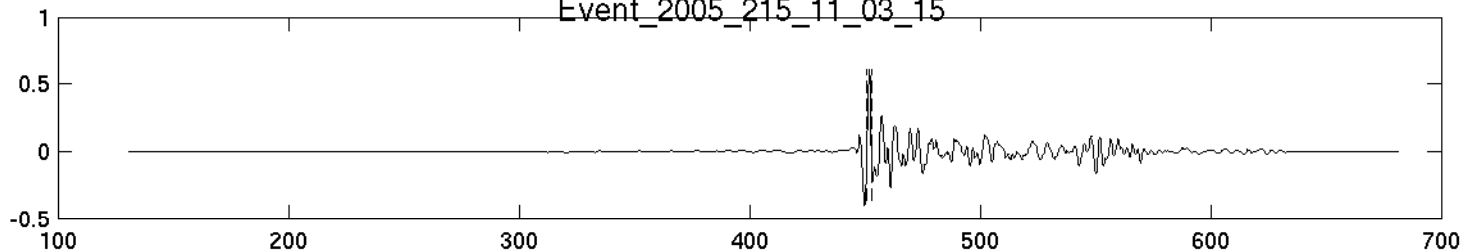
# Sorted by travel time:Event\_2005\_215\_11\_03\_15



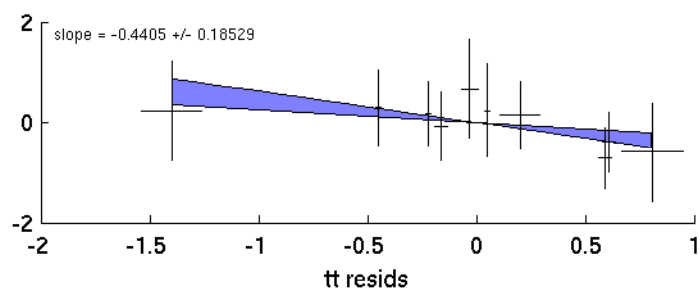
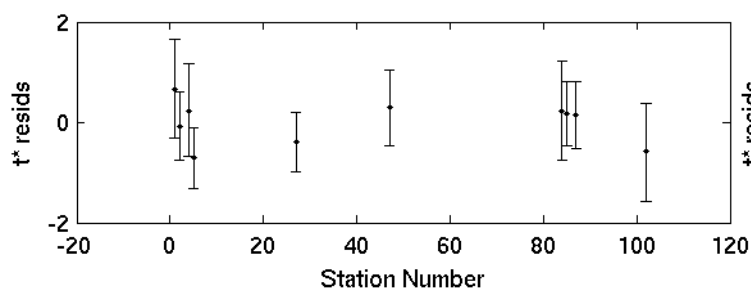
Sorted by  $t^*$ :Event\_2005\_215\_11\_03\_15



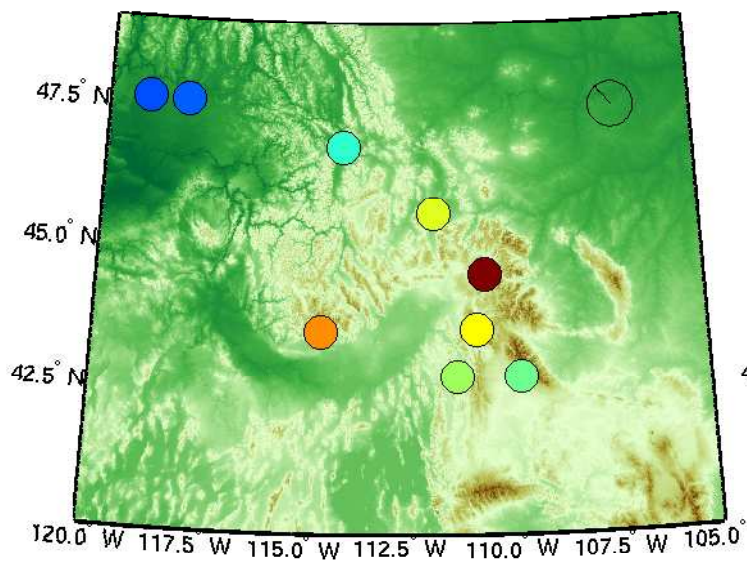
Stack  
Event\_2005\_215\_11\_03\_15



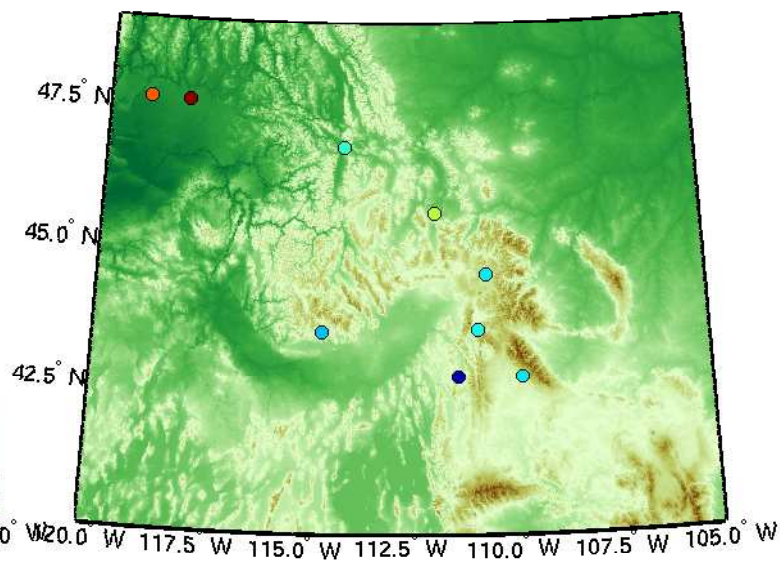
Baz = 142.8185  
Mean xcor value = 0.801  
Range of  $t^*$  values is 1.38  
Median  $t^*$  err is 0.71243  
Slope =  $-0.4405 \pm 0.18529$



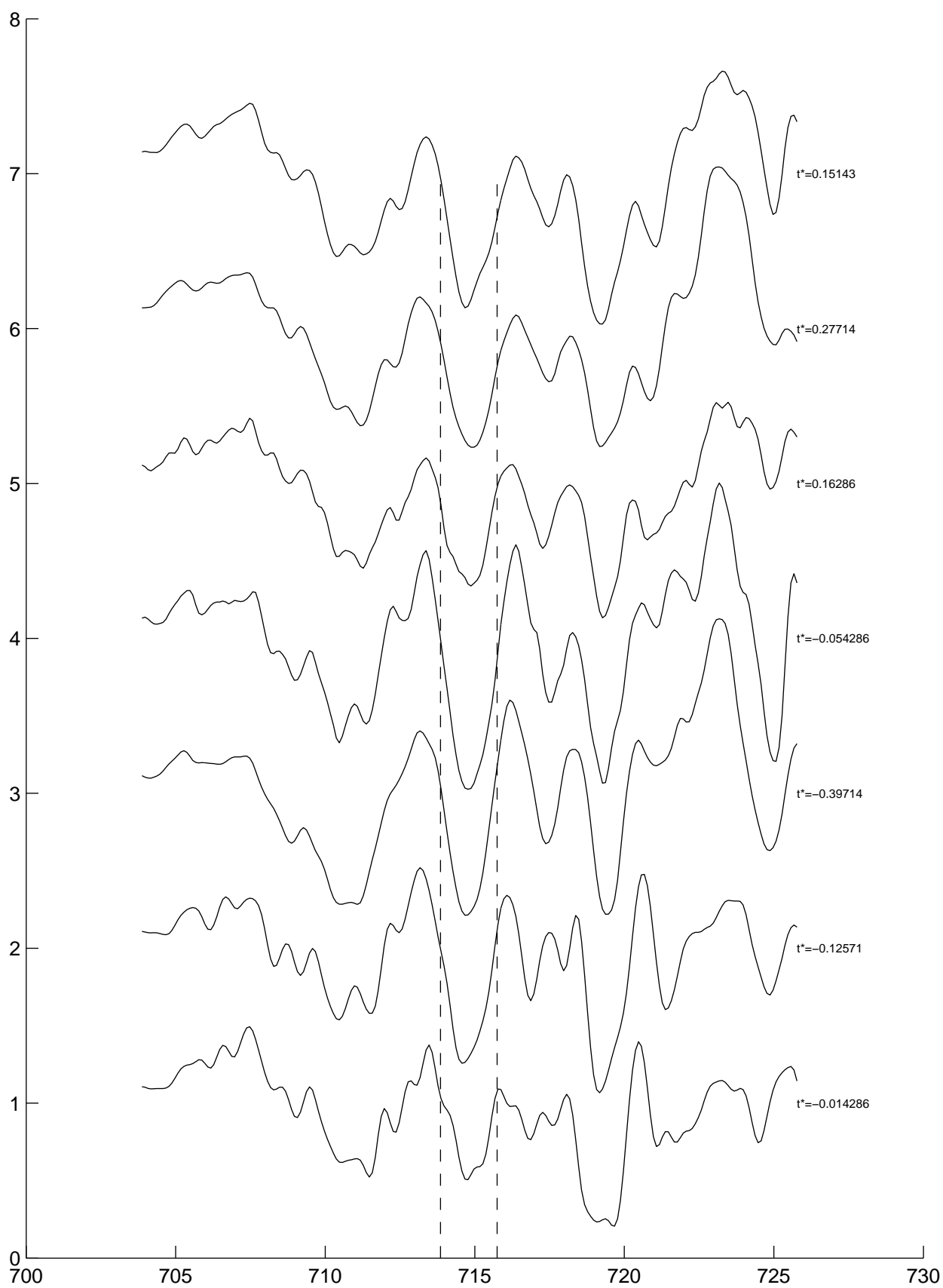
travel time residuals



$t^*$  values

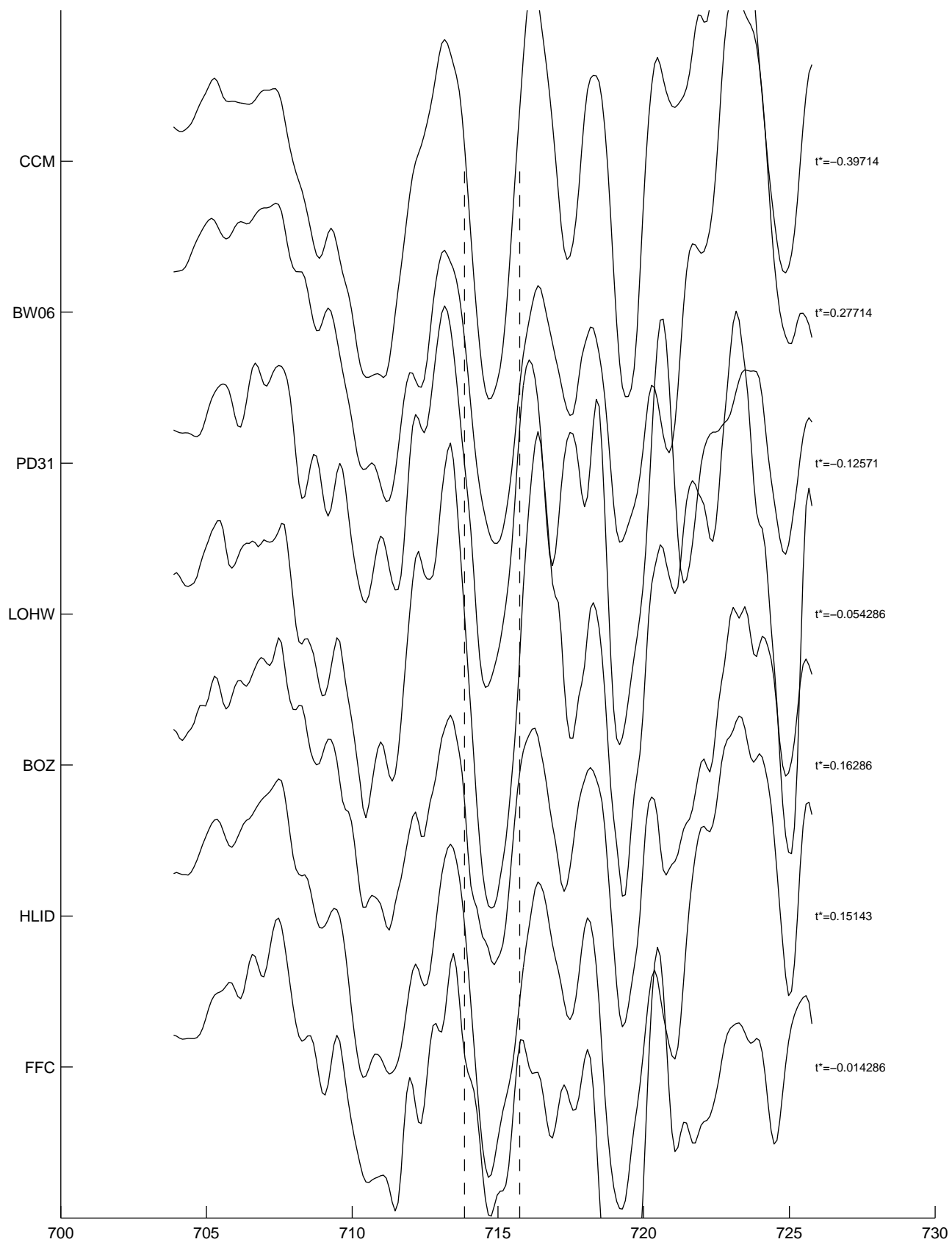


# Event\_2005\_228\_02\_46\_28

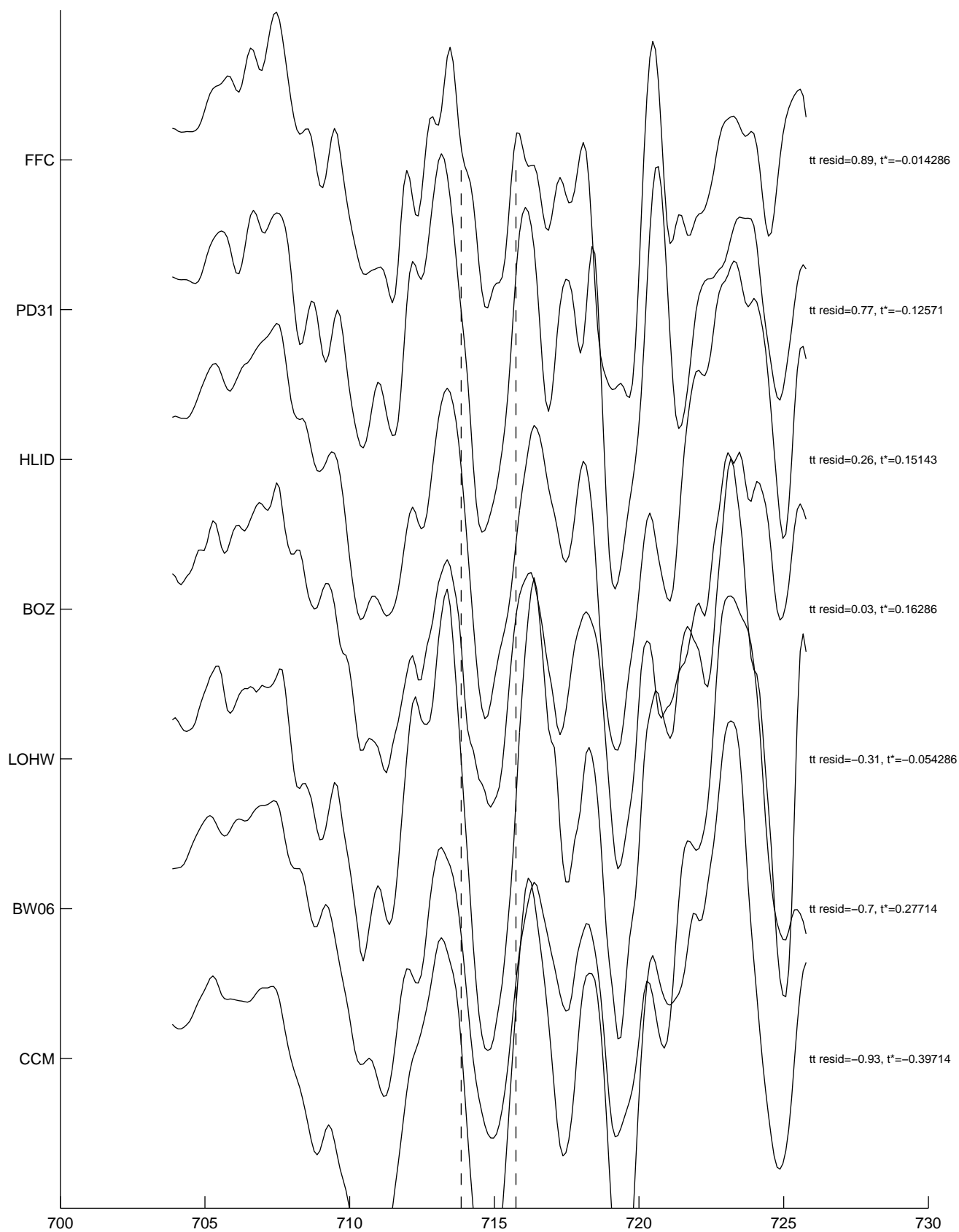




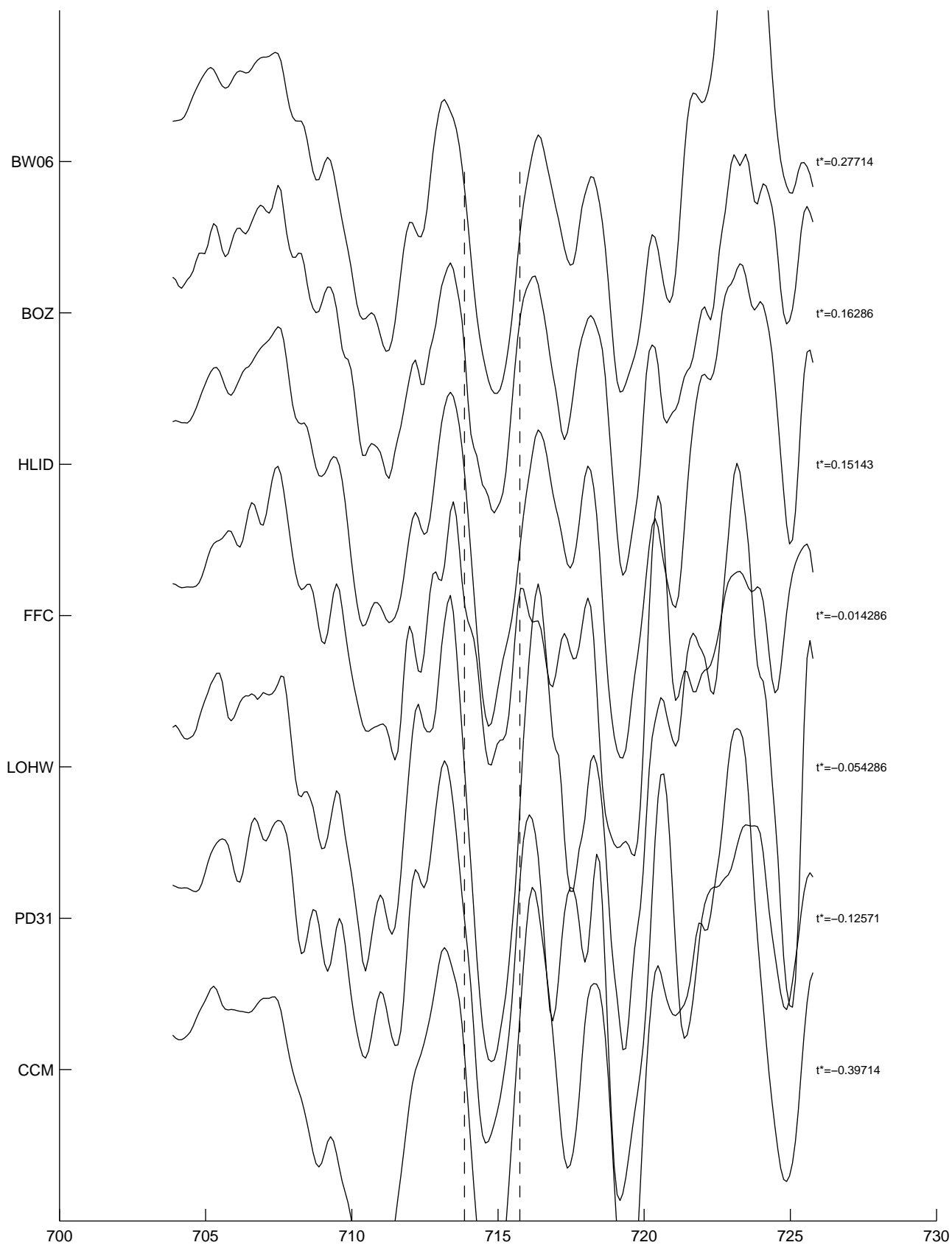
# Sorted by Delta:Event\_2005\_228\_02\_46\_28



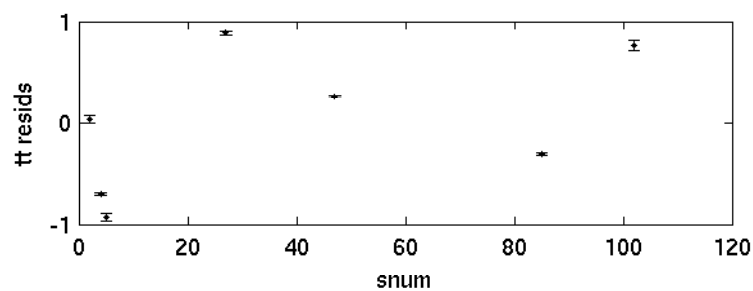
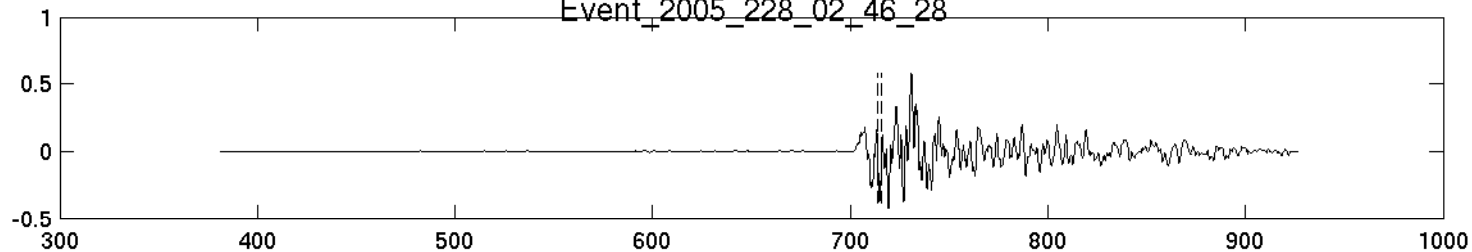
# Sorted by travel time:Event\_2005\_228\_02\_46\_28



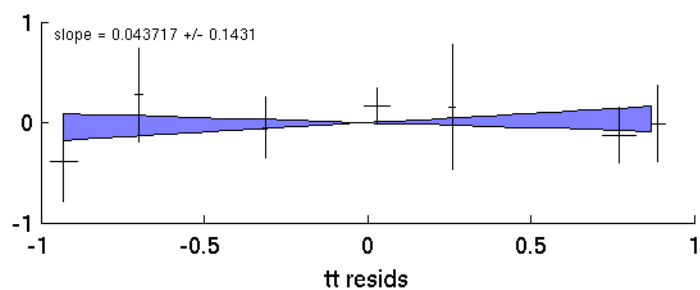
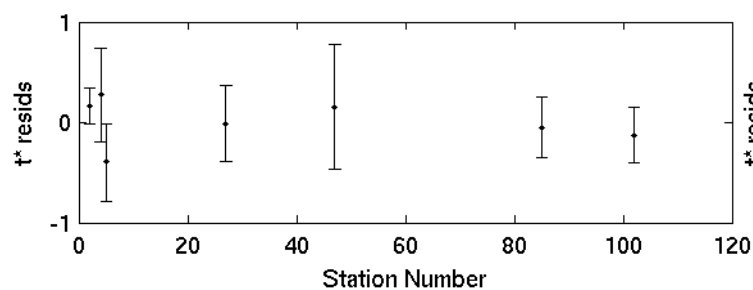
Sorted by  $t^*$ :Event\_2005\_228\_02\_46\_28



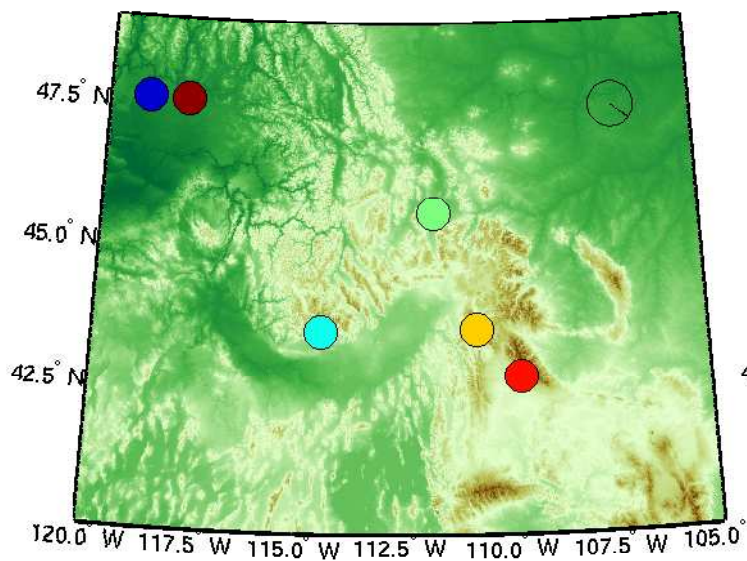
# Stack Event\_2005\_228\_02\_46\_28



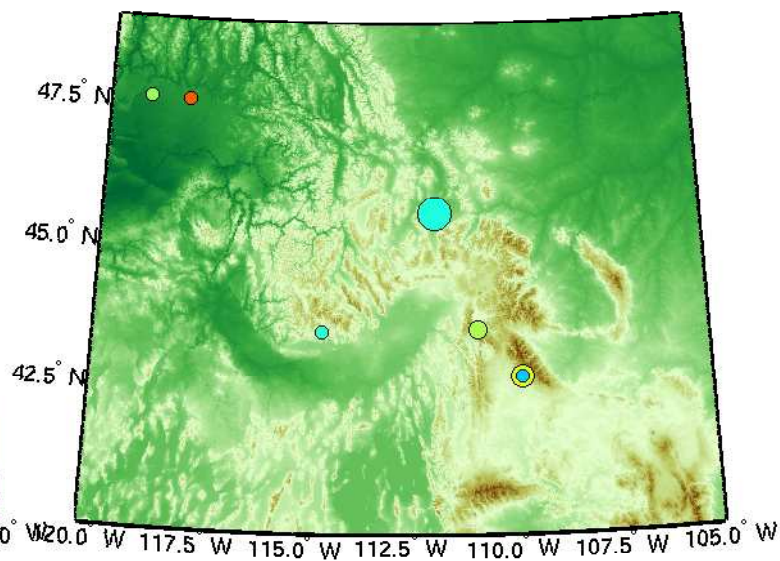
Baz = 310.4609  
Mean xcor value = 0.77571  
Range of  $t^*$  values is 0.67429  
Median  $t^*$  err is 0.38202  
Slope = 0.043717 +/- 0.1431



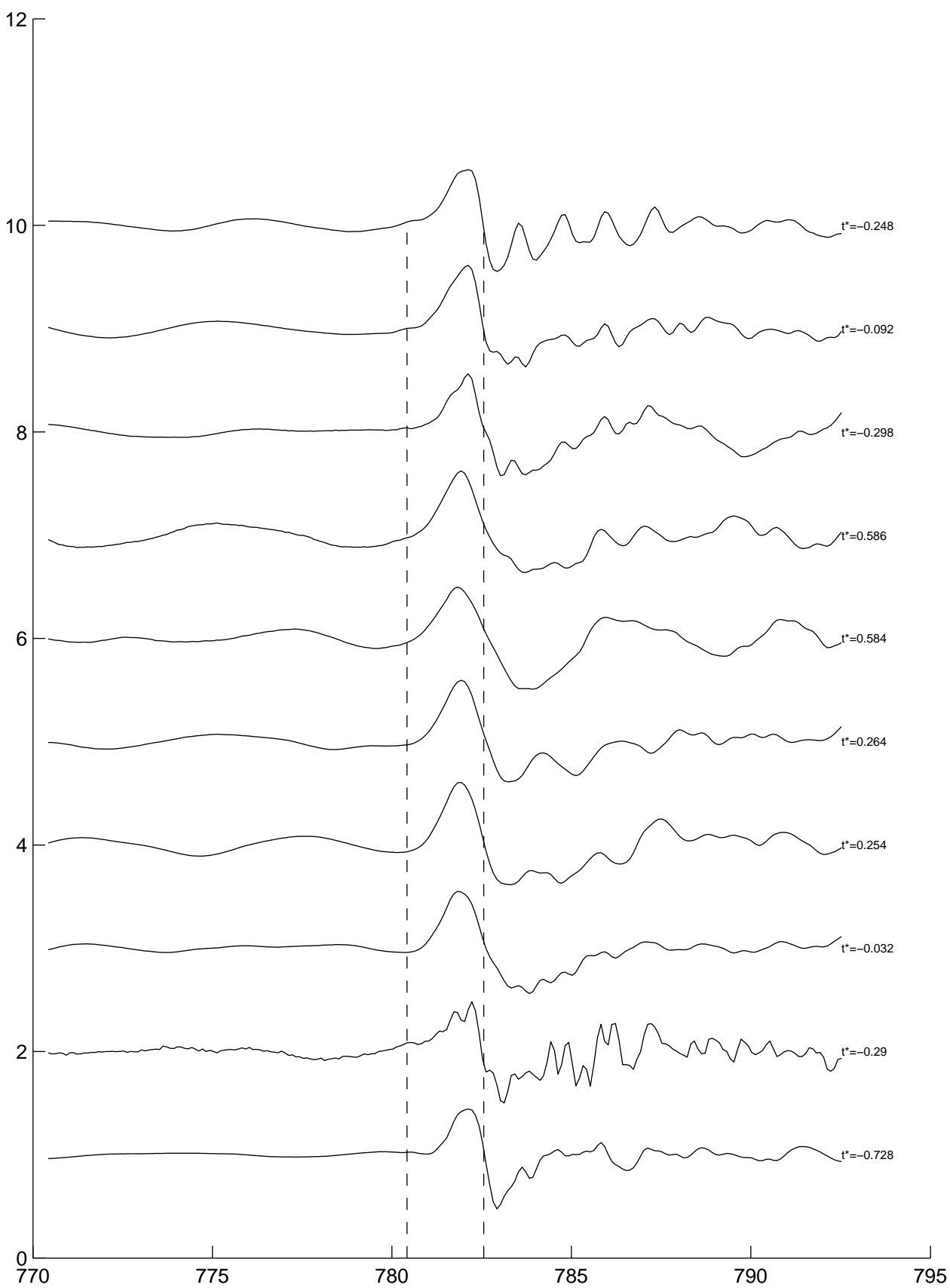
travel time residuals



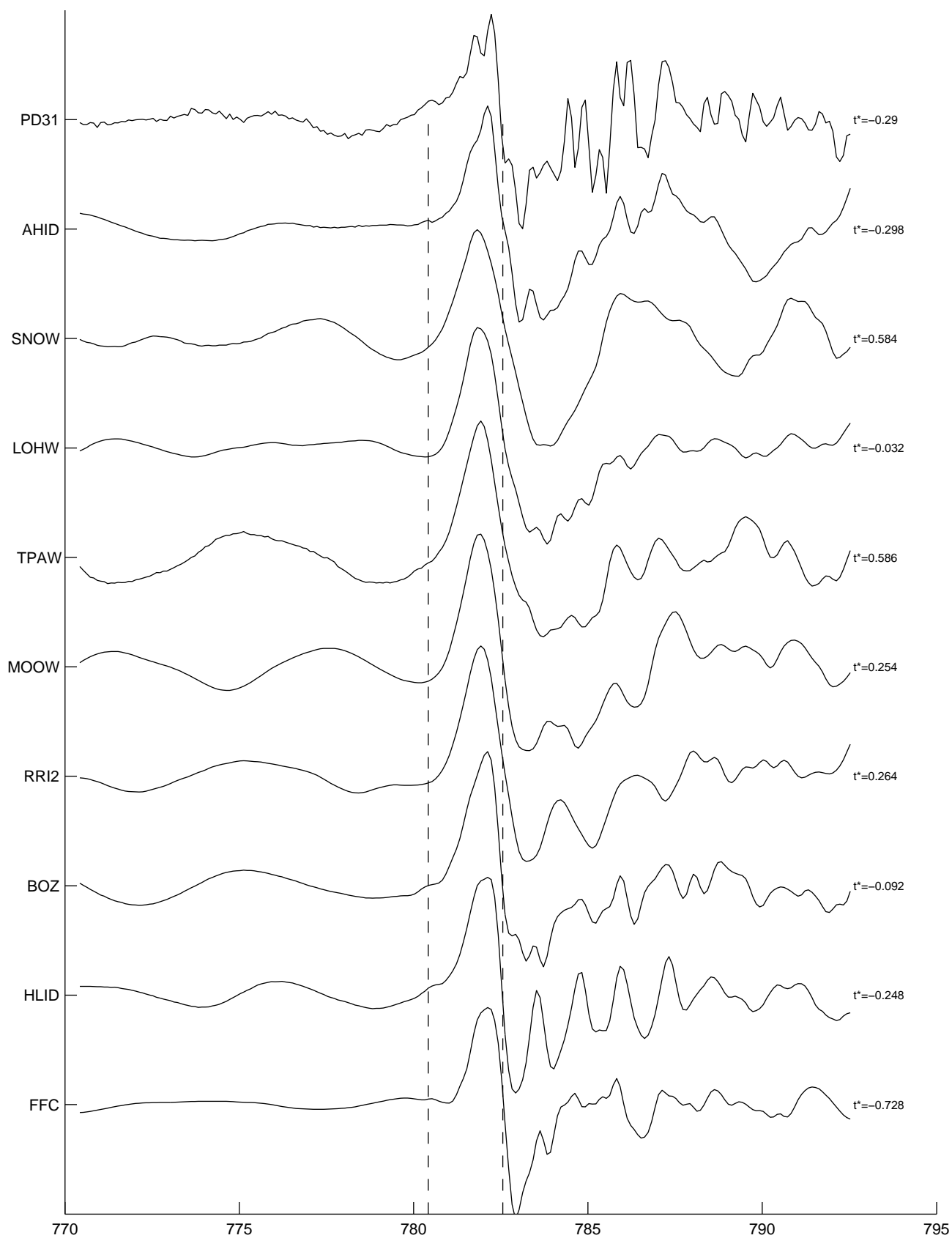
$t^*$  values



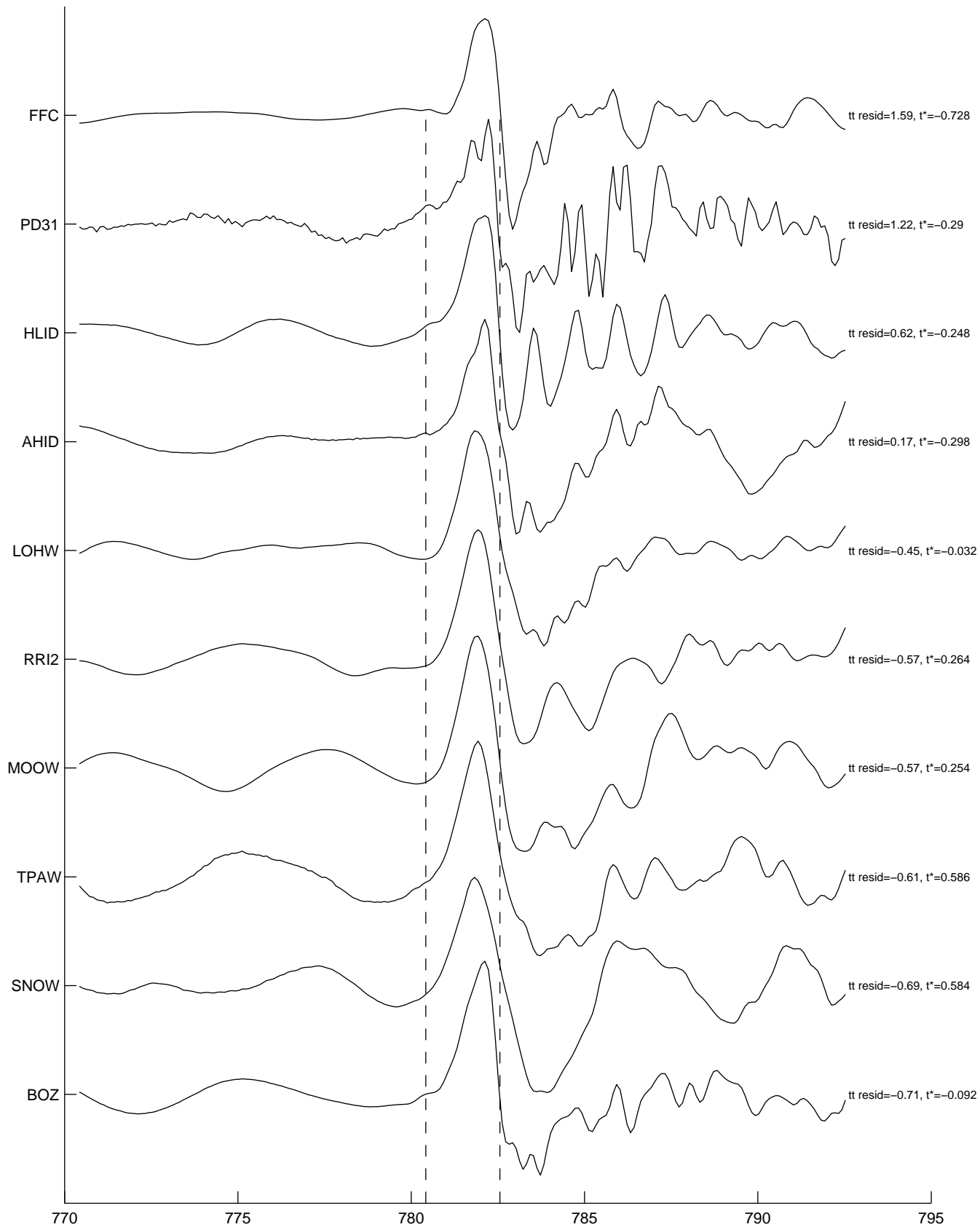
# Event\_2005\_288\_15\_51\_07



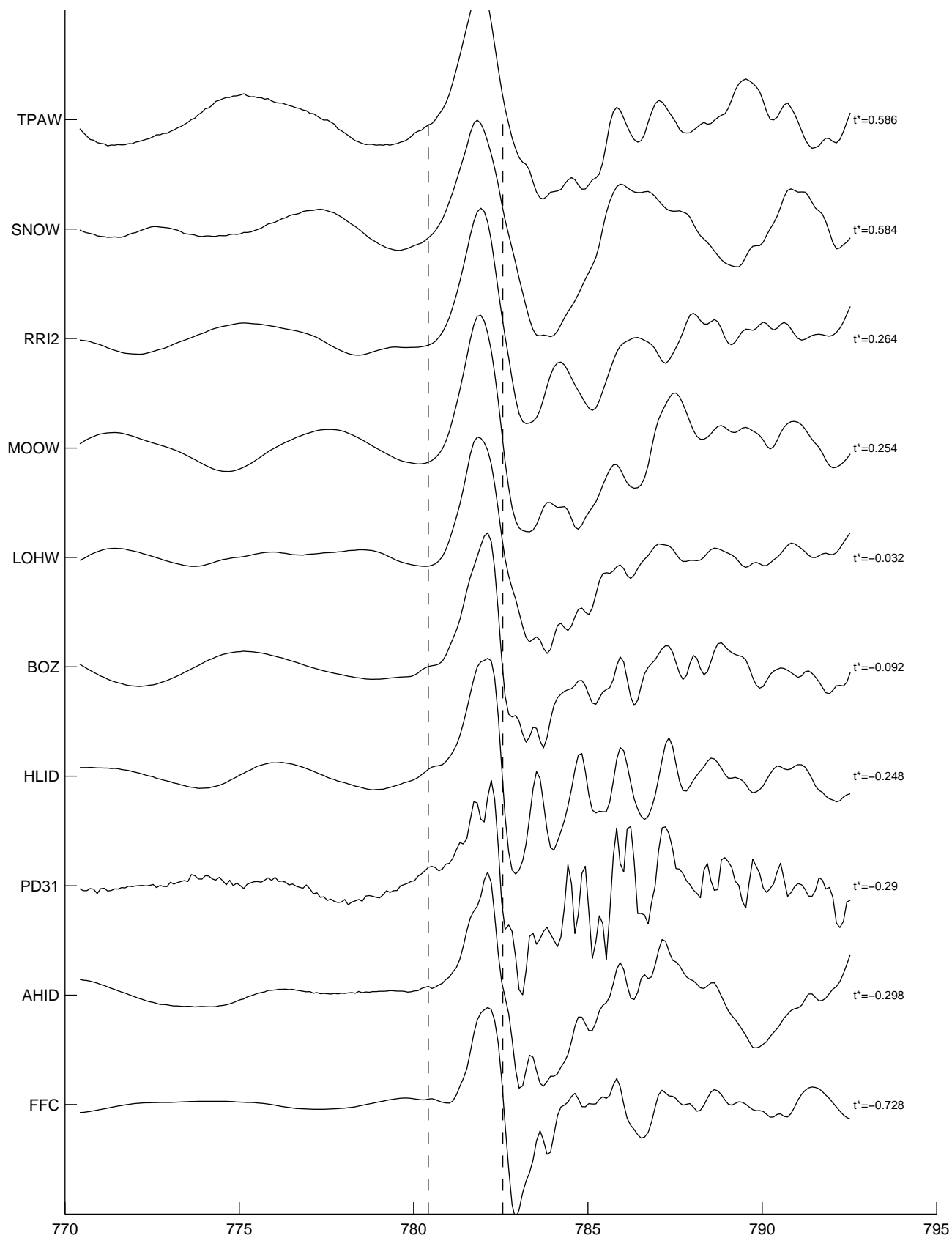
# Sorted by Delta:Event\_2005\_288\_15\_51\_07



# Sorted by travel time:Event\_2005\_288\_15\_51\_07



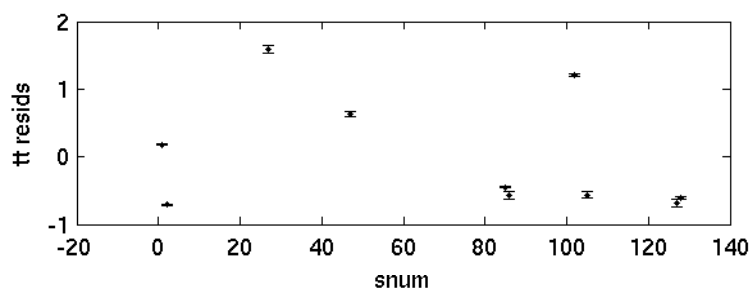
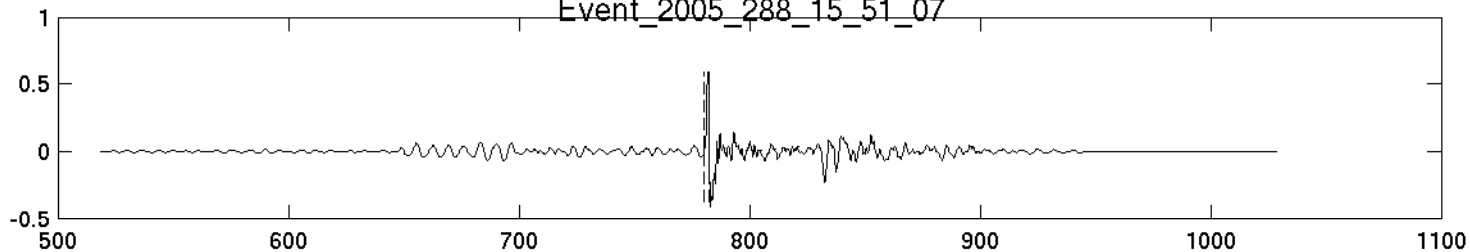
Sorted by  $t^*$ :Event\_2005\_288\_15\_51\_07



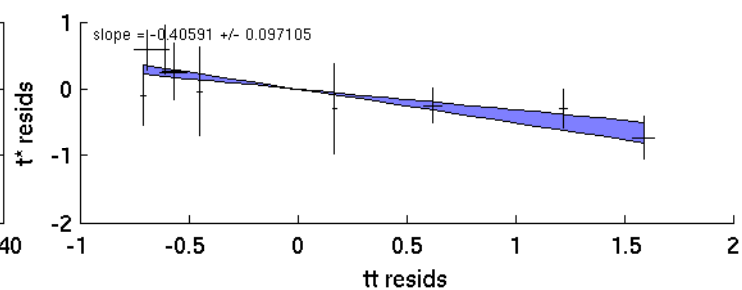
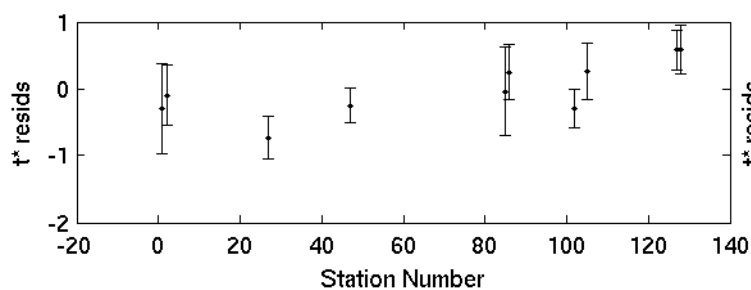


# Event\_2005\_288\_15\_51\_07

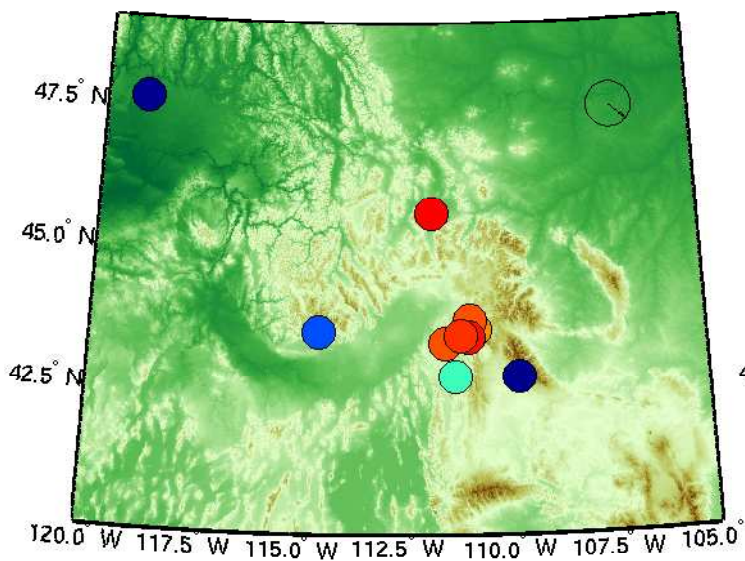
Stack



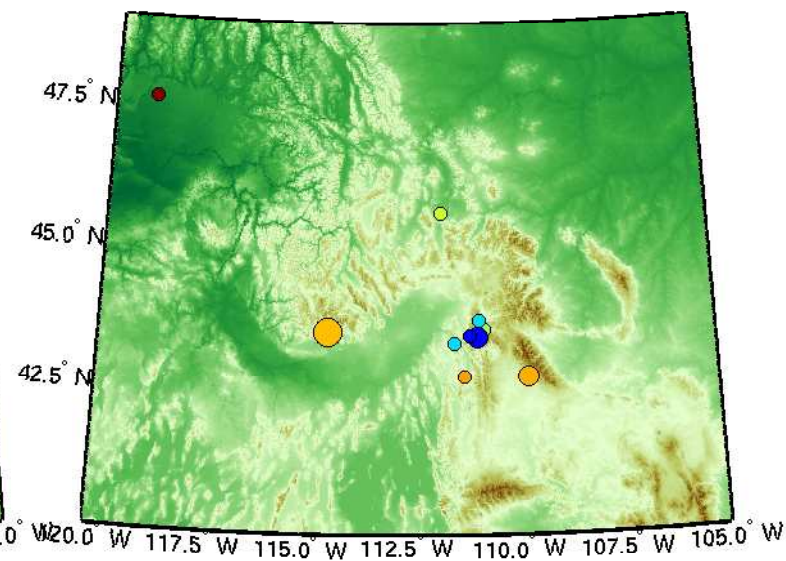
Baz = 312.8643  
Mean xcor value = 0.693  
Range of  $t^*$  values is 1.314  
Median  $t^*$  err is 0.3919  
Slope =  $-0.40591 \pm 0.097105$



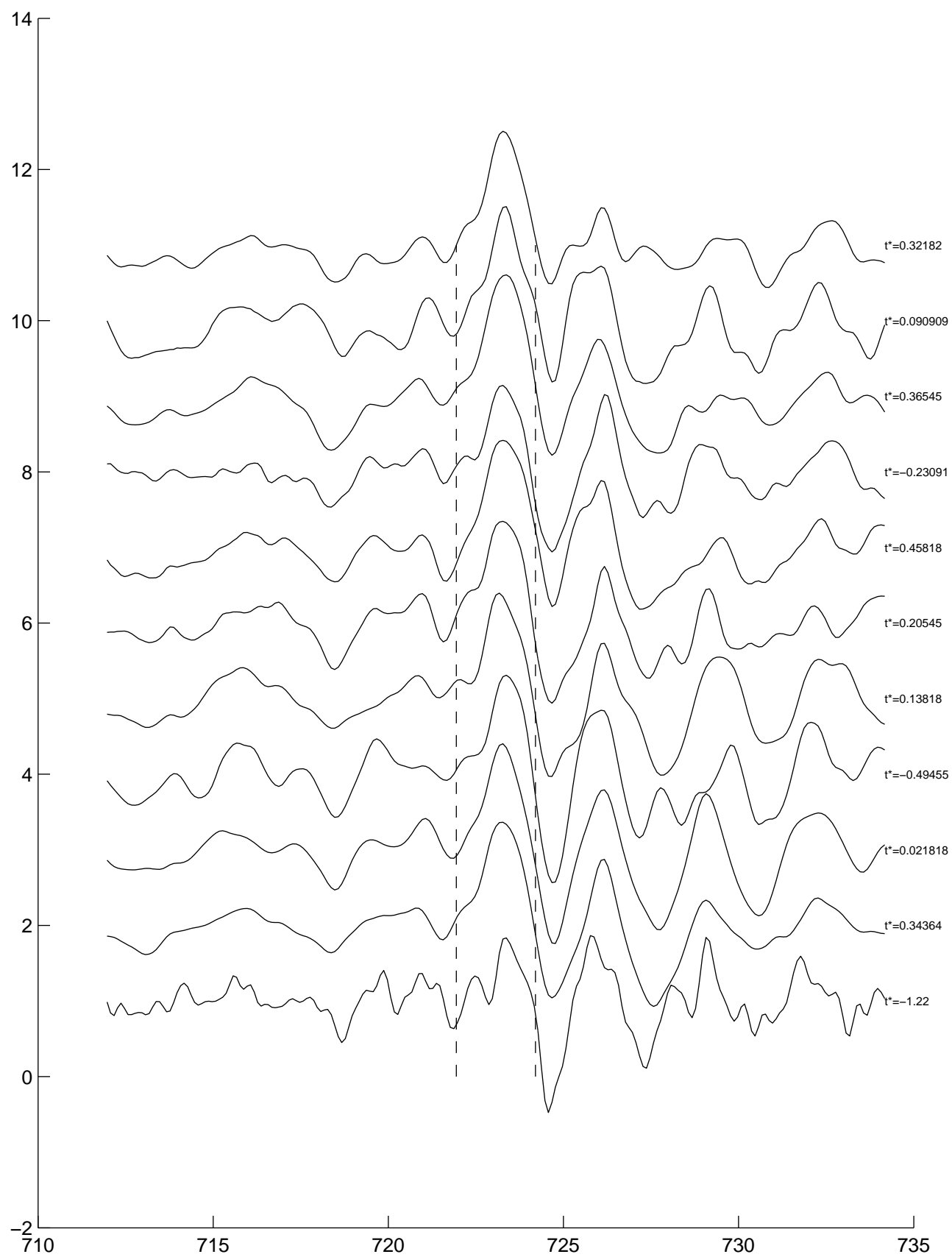
travel time residuals



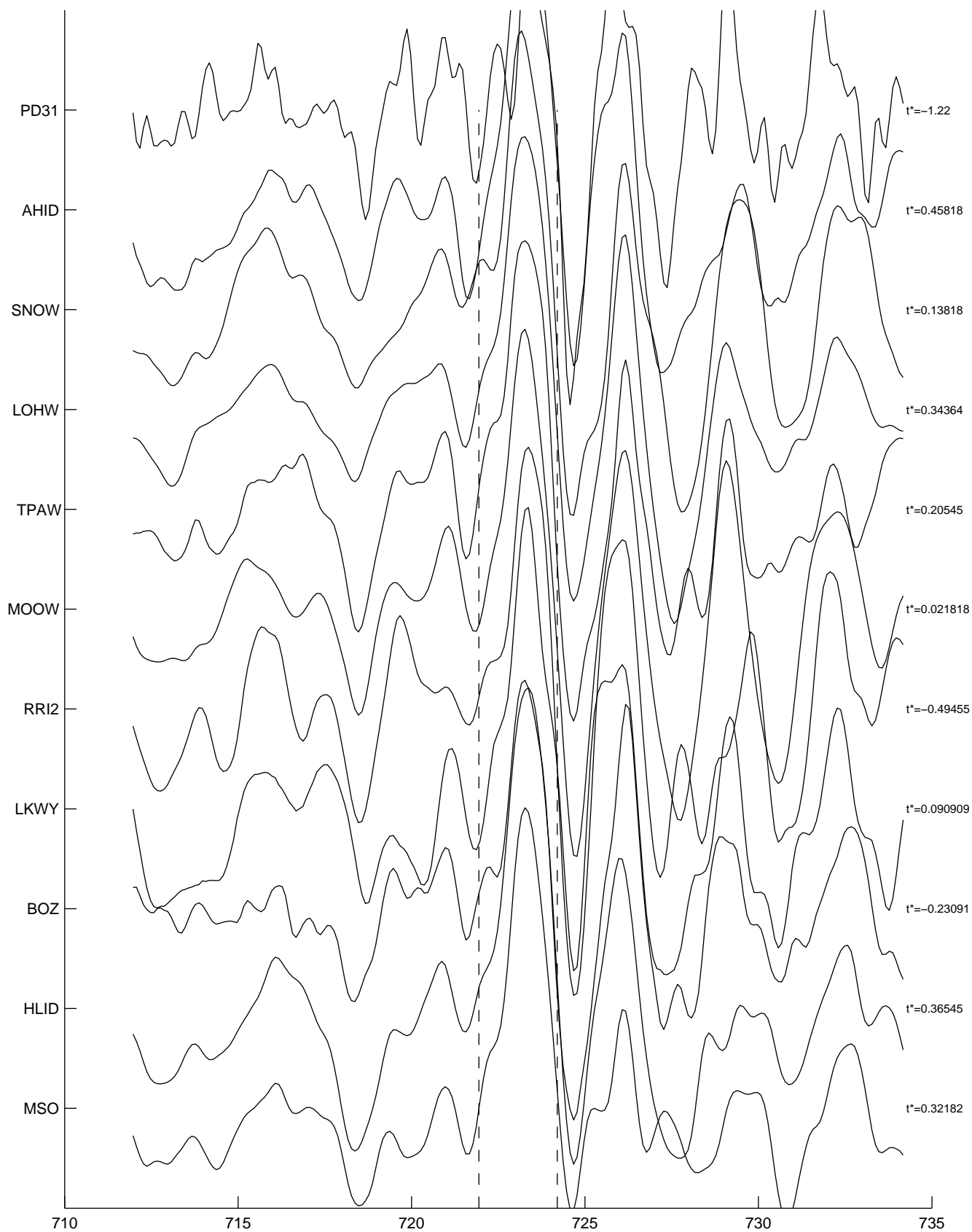
$t^*$  values



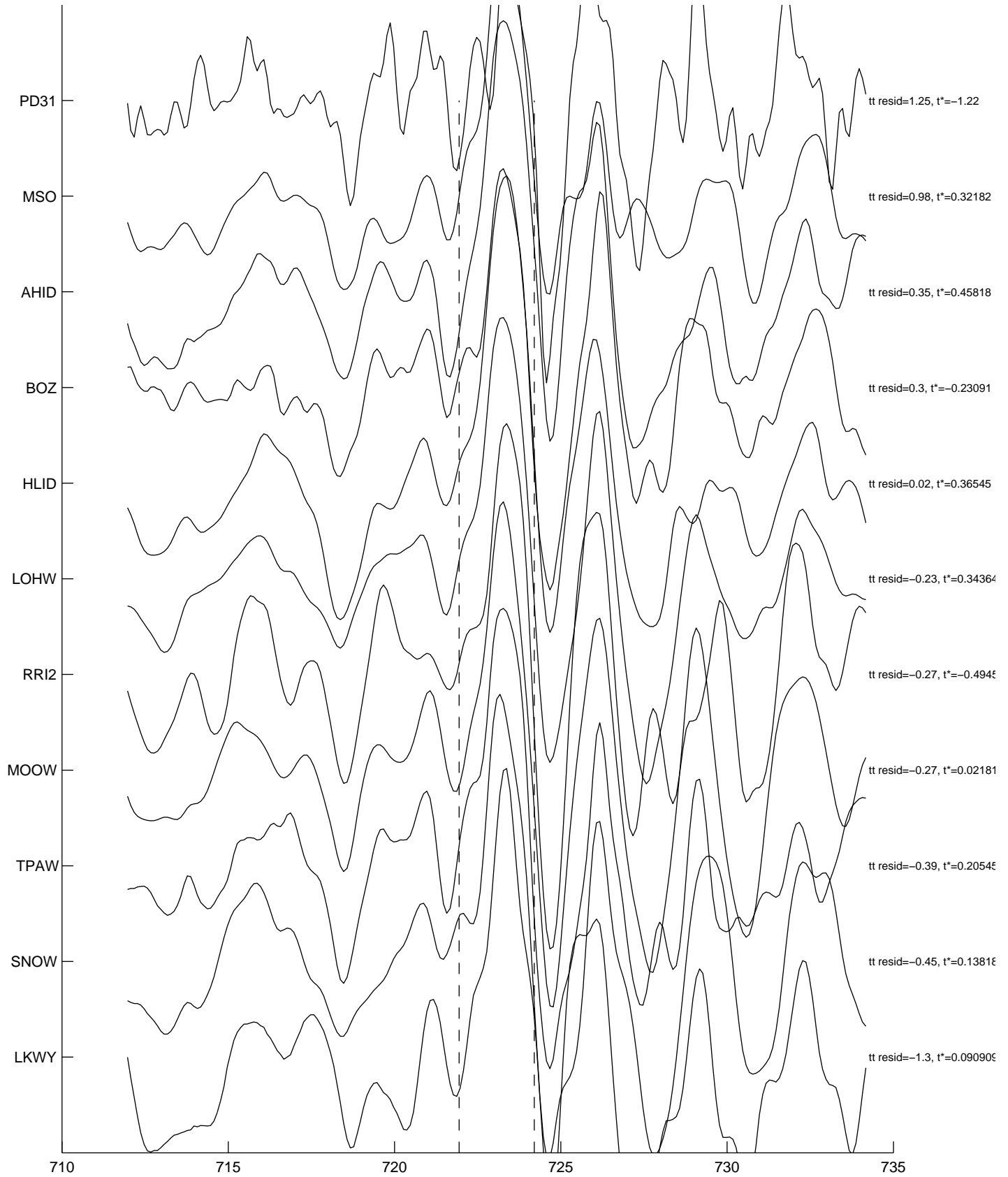
# Event\_2005\_292\_11\_44\_42



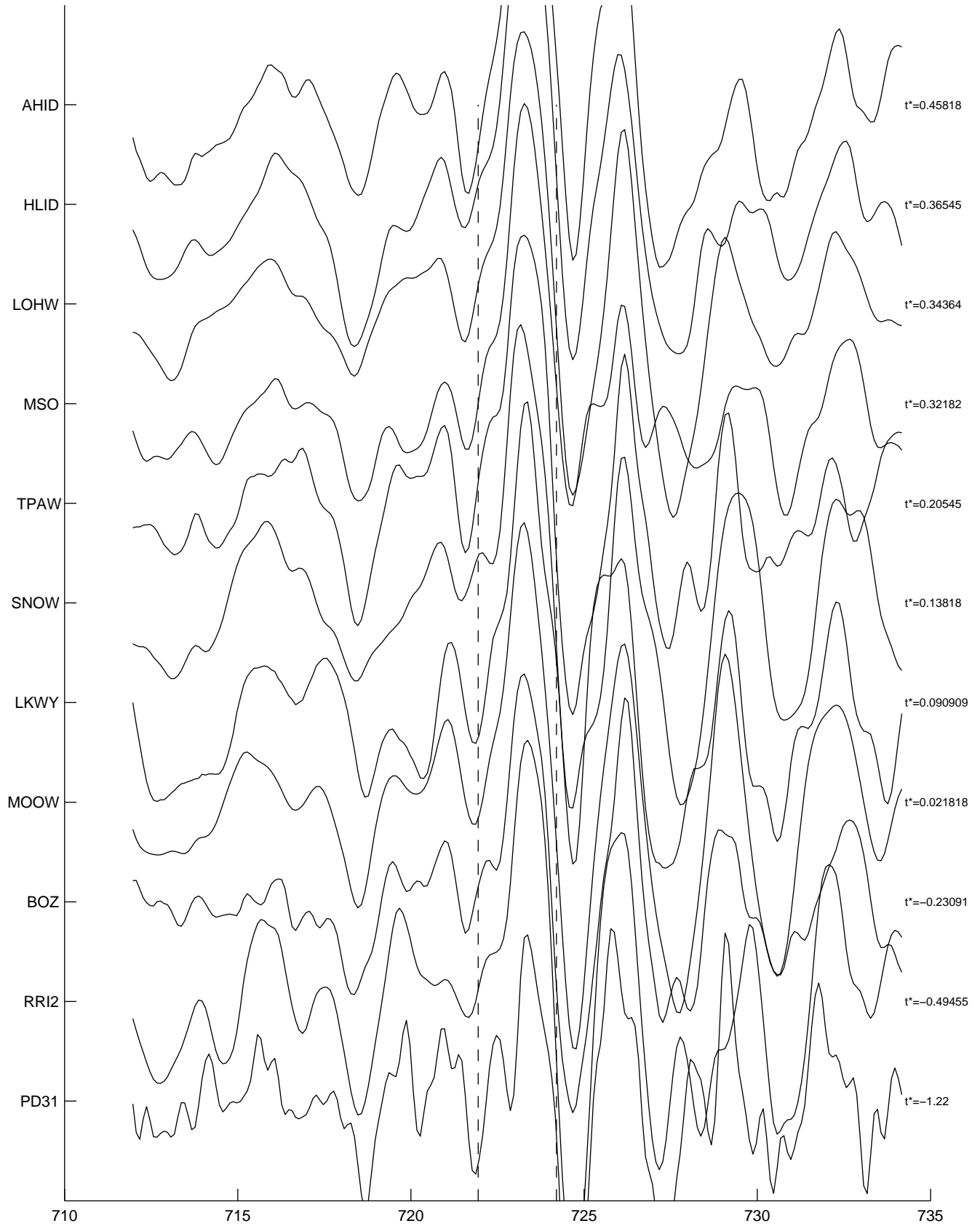
# Sorted by Delta:Event\_2005\_292\_11\_44\_42



# Sorted by travel time: Event\_2005\_292\_11\_44\_42

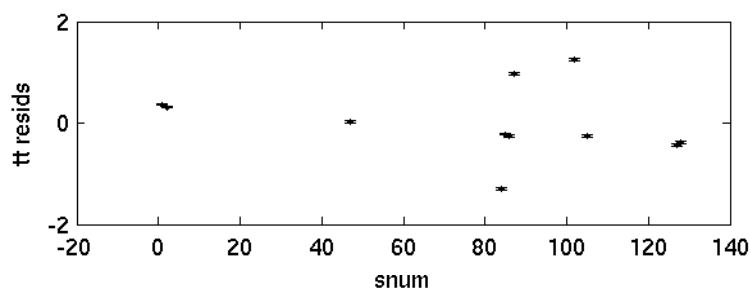
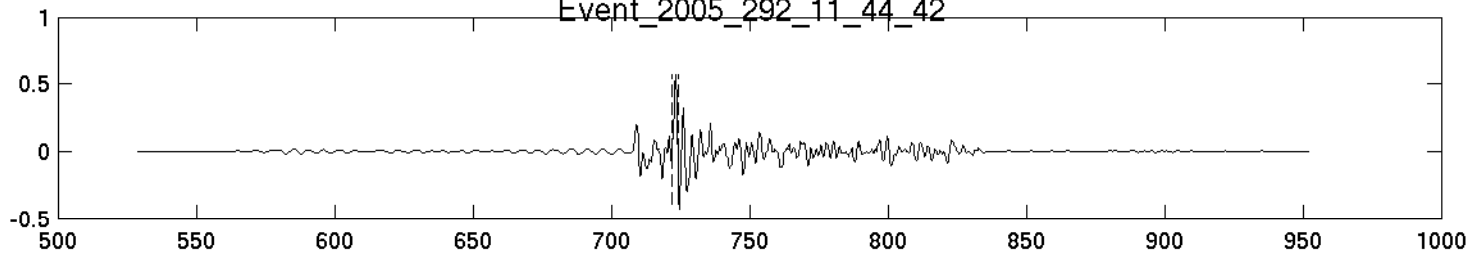


Sorted by  $t^*$ :Event\_2005\_292\_11\_44\_42

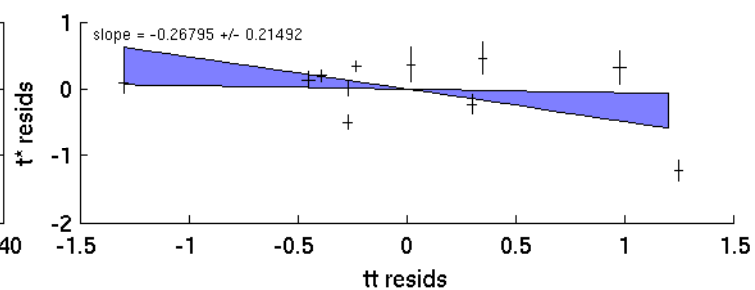
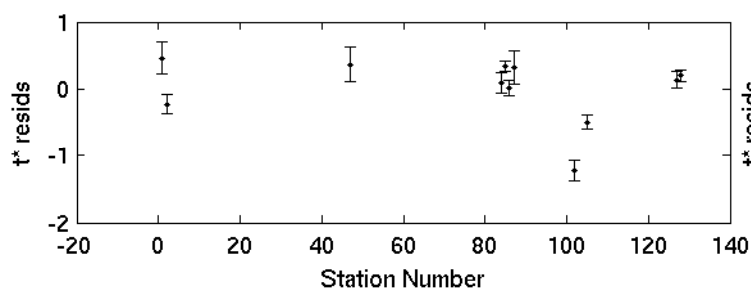


# Event\_2005\_292\_11\_44\_42

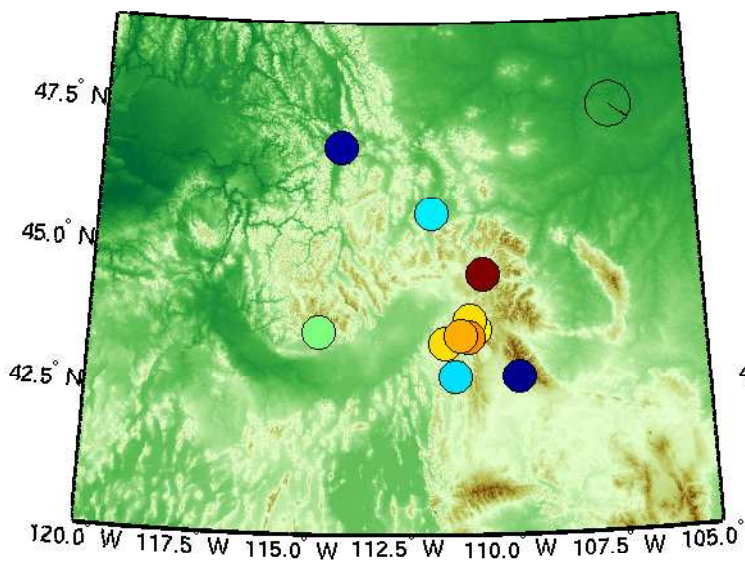
Stack



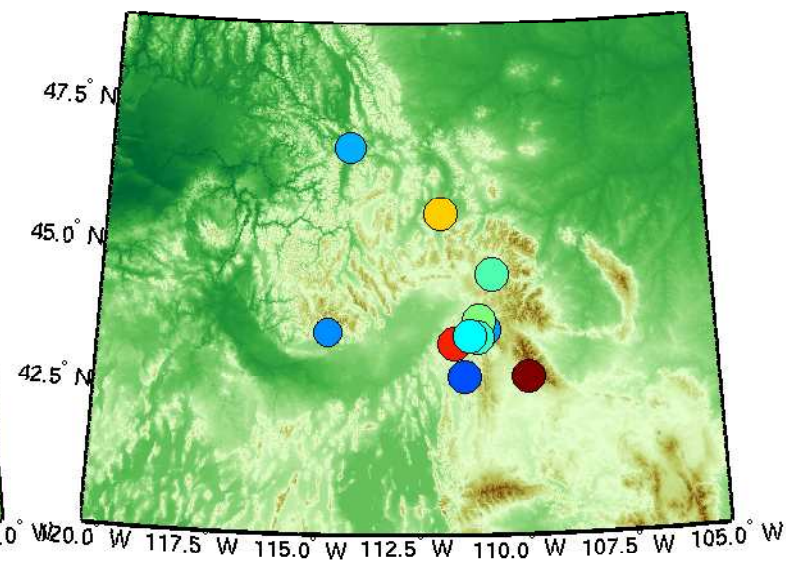
Baz = 307.9269  
Mean xcor value = 0.83273  
Range of  $t^*$  values is 1.6782  
Median  $t^*$  err is 0.14309  
Slope =  $-0.26795 \pm 0.21492$



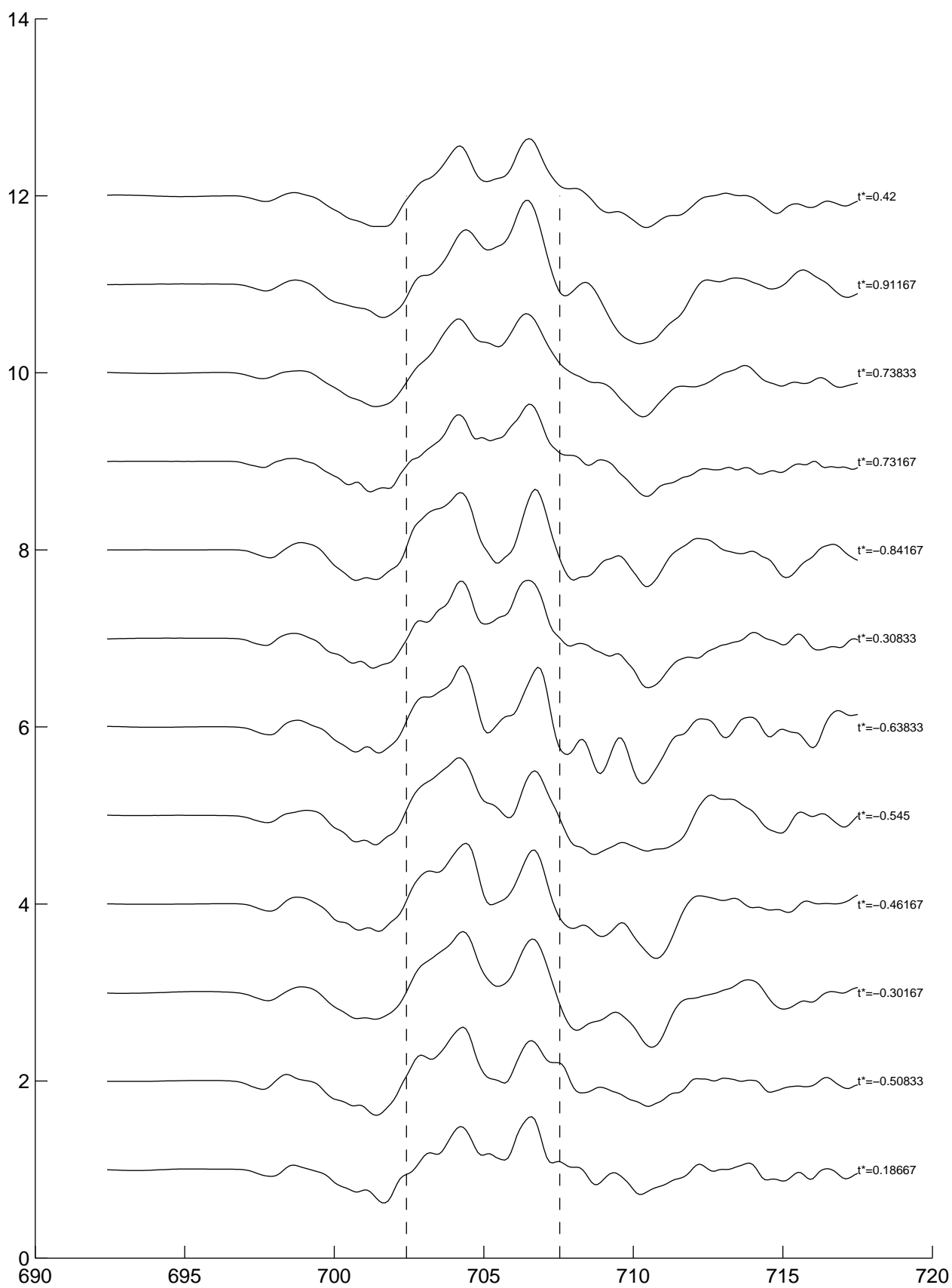
travel time residuals



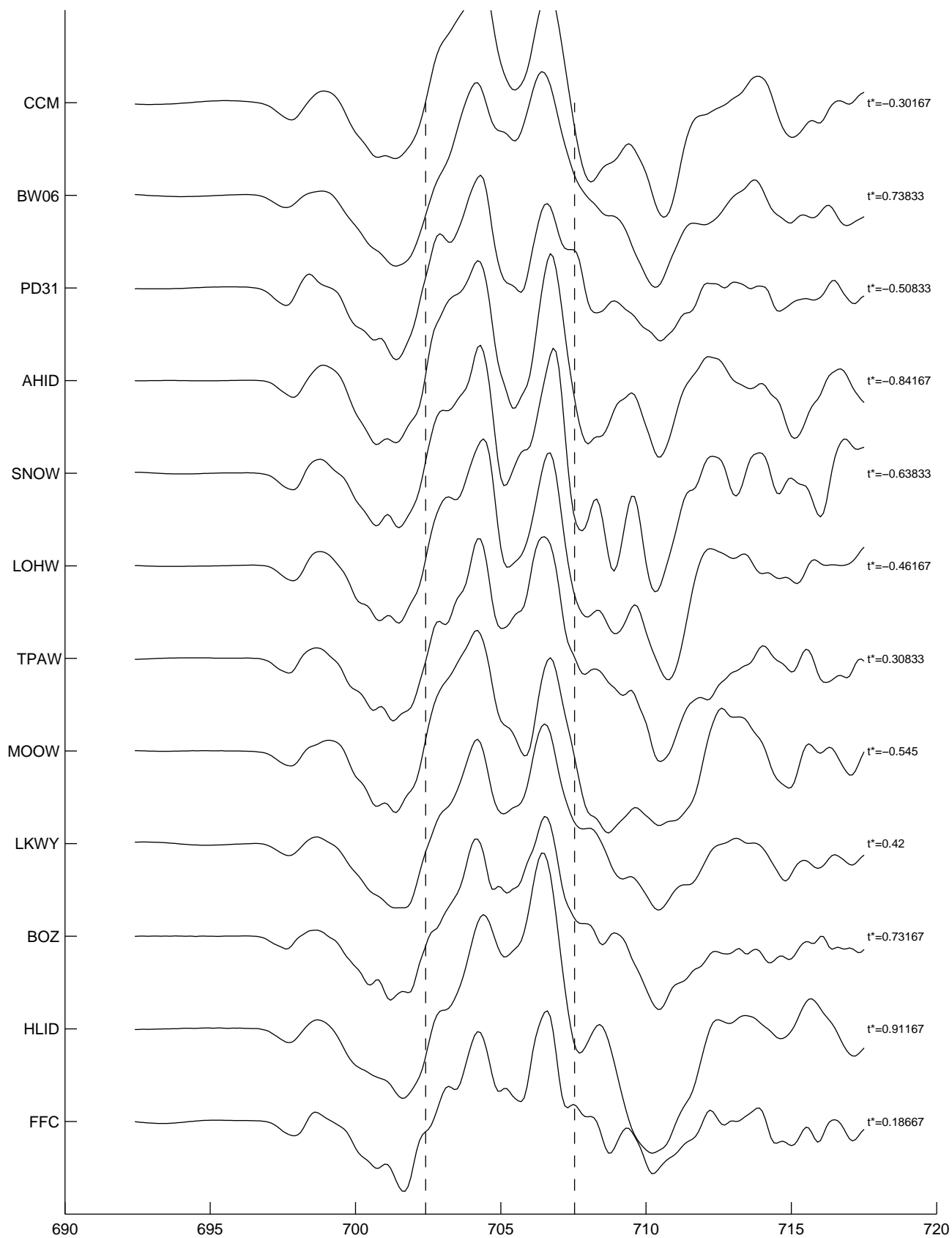
$t^*$  values



# Event\_2005\_318\_21\_38\_51

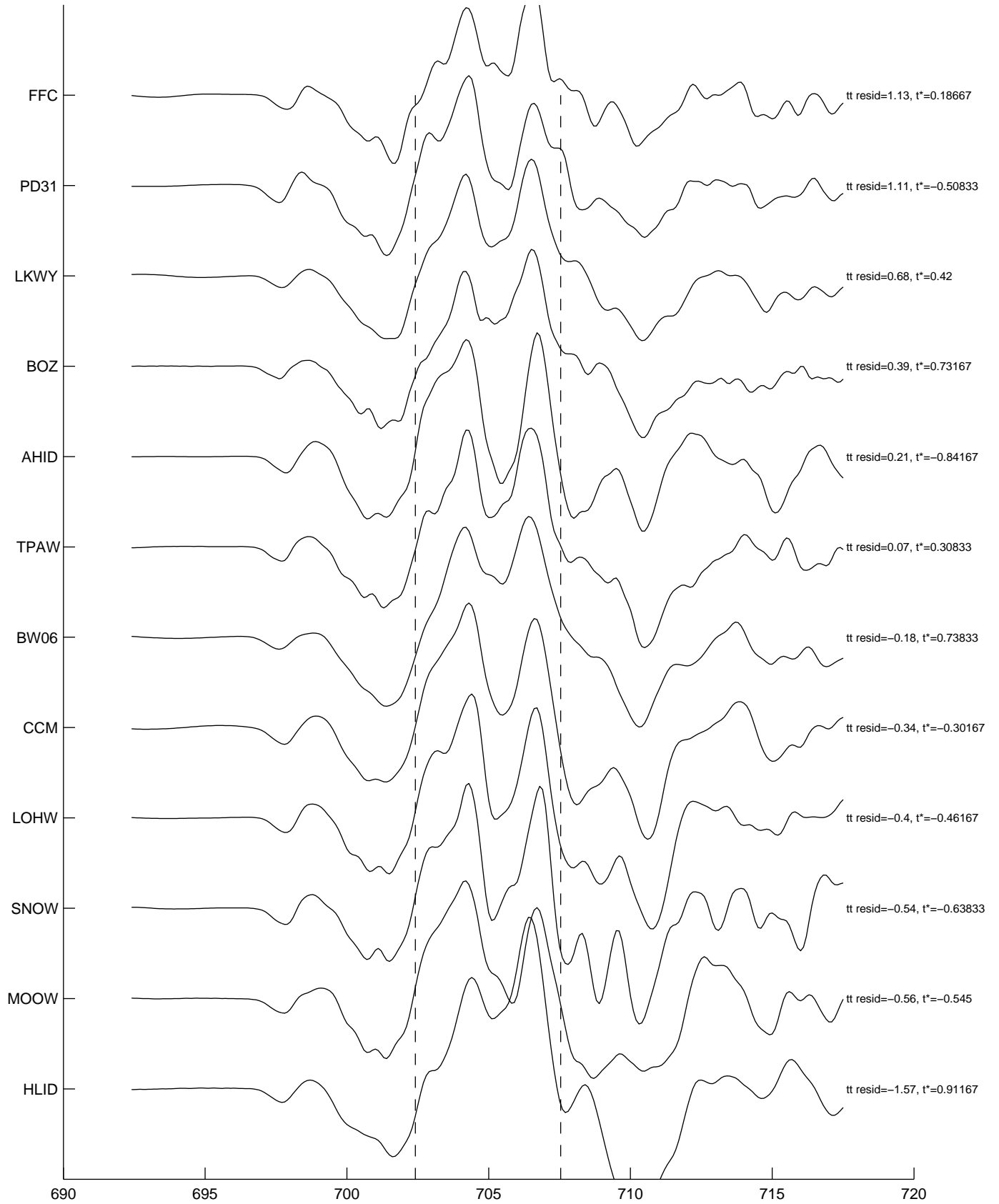


# Sorted by Delta:Event\_2005\_318\_21\_38\_51

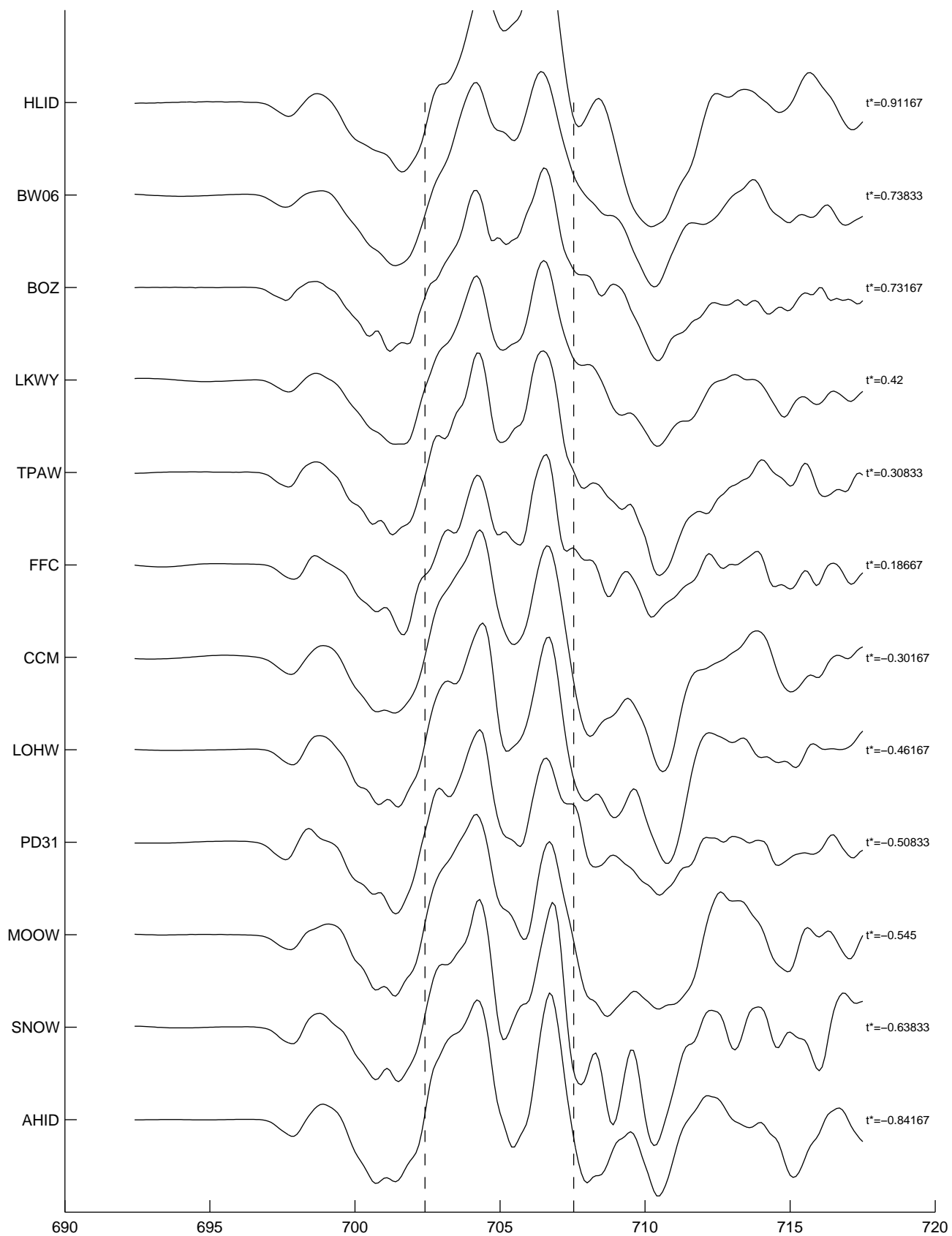




# Sorted by travel time:Event\_2005\_318\_21\_38\_51

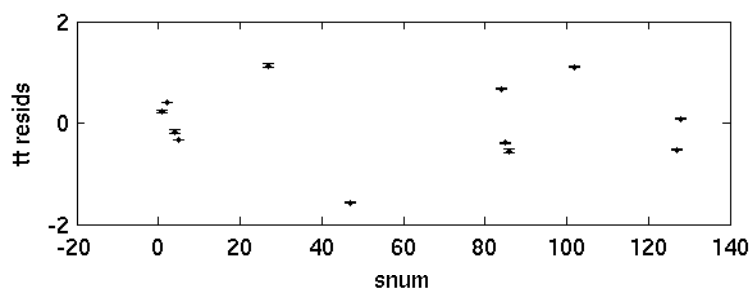
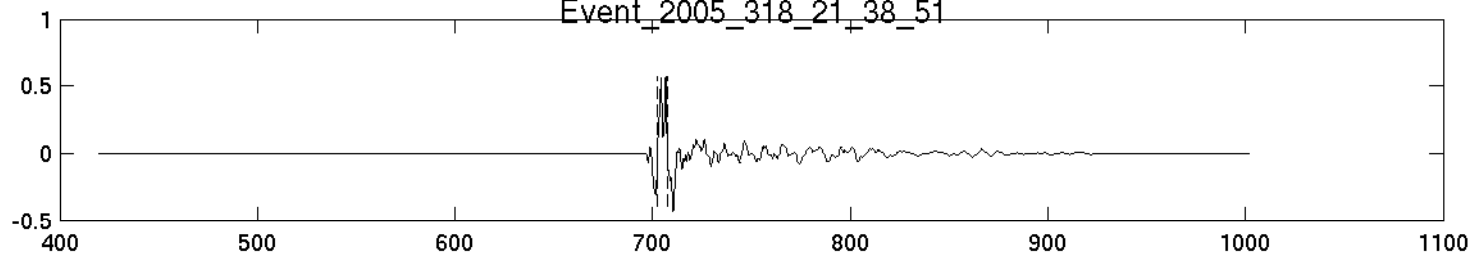


Sorted by  $t^*$ :Event\_2005\_318\_21\_38\_51

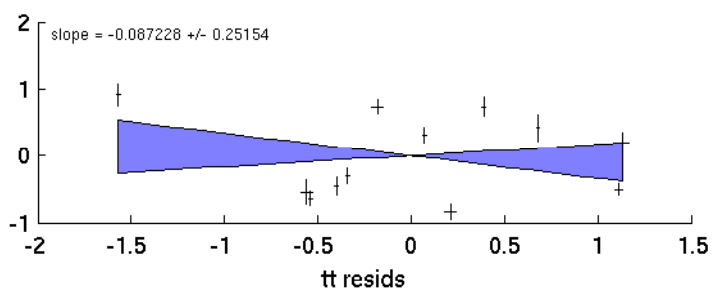
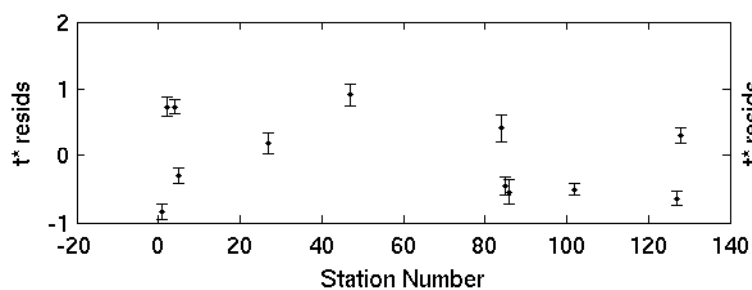


# Event\_2005\_318\_21\_38\_51

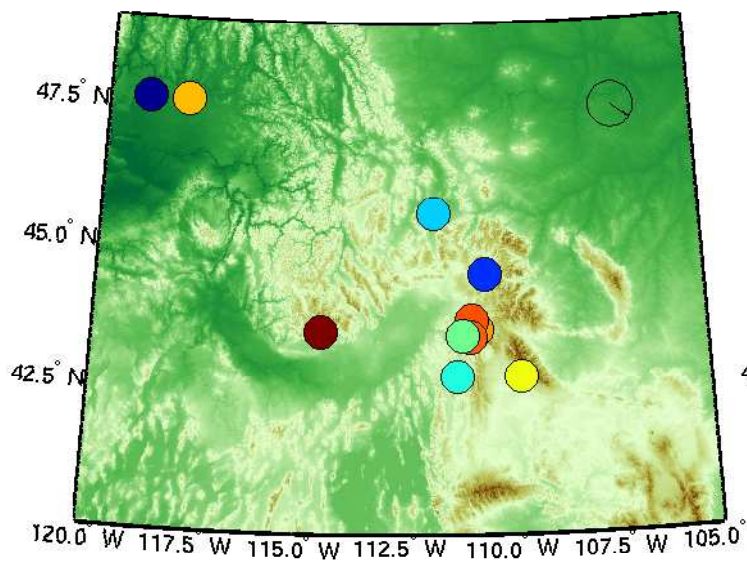
Stack



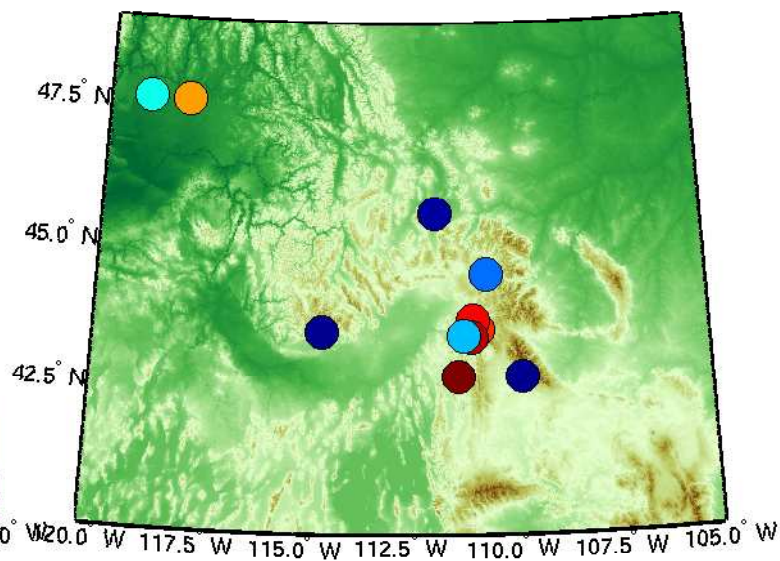
Baz = 308.1424  
Mean xcor value = 0.85417  
Range of  $t^*$  values is 1.7533  
Median  $t^*$  err is 0.12621  
Slope = -0.087228 +/- 0.25154



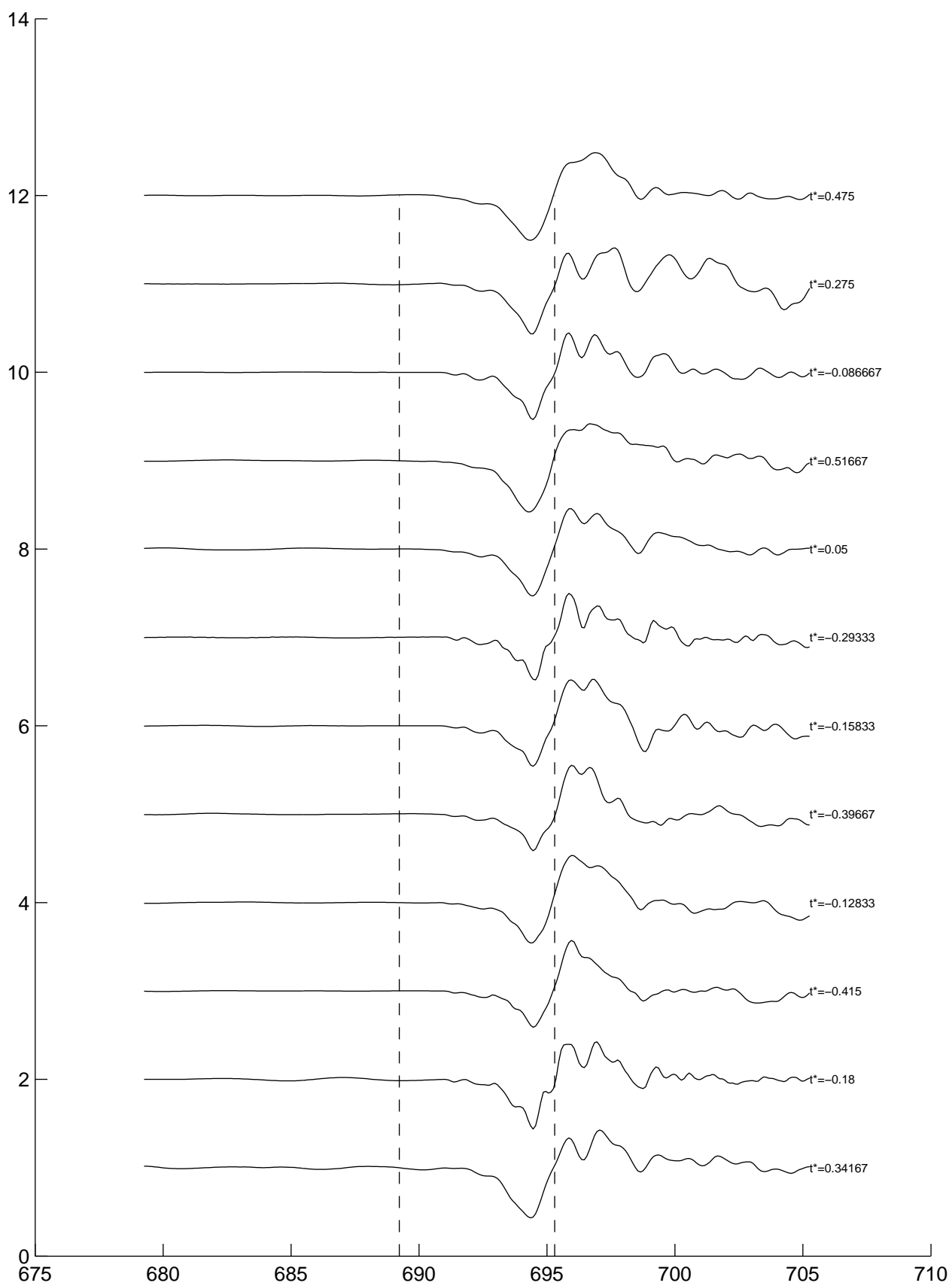
travel time residuals



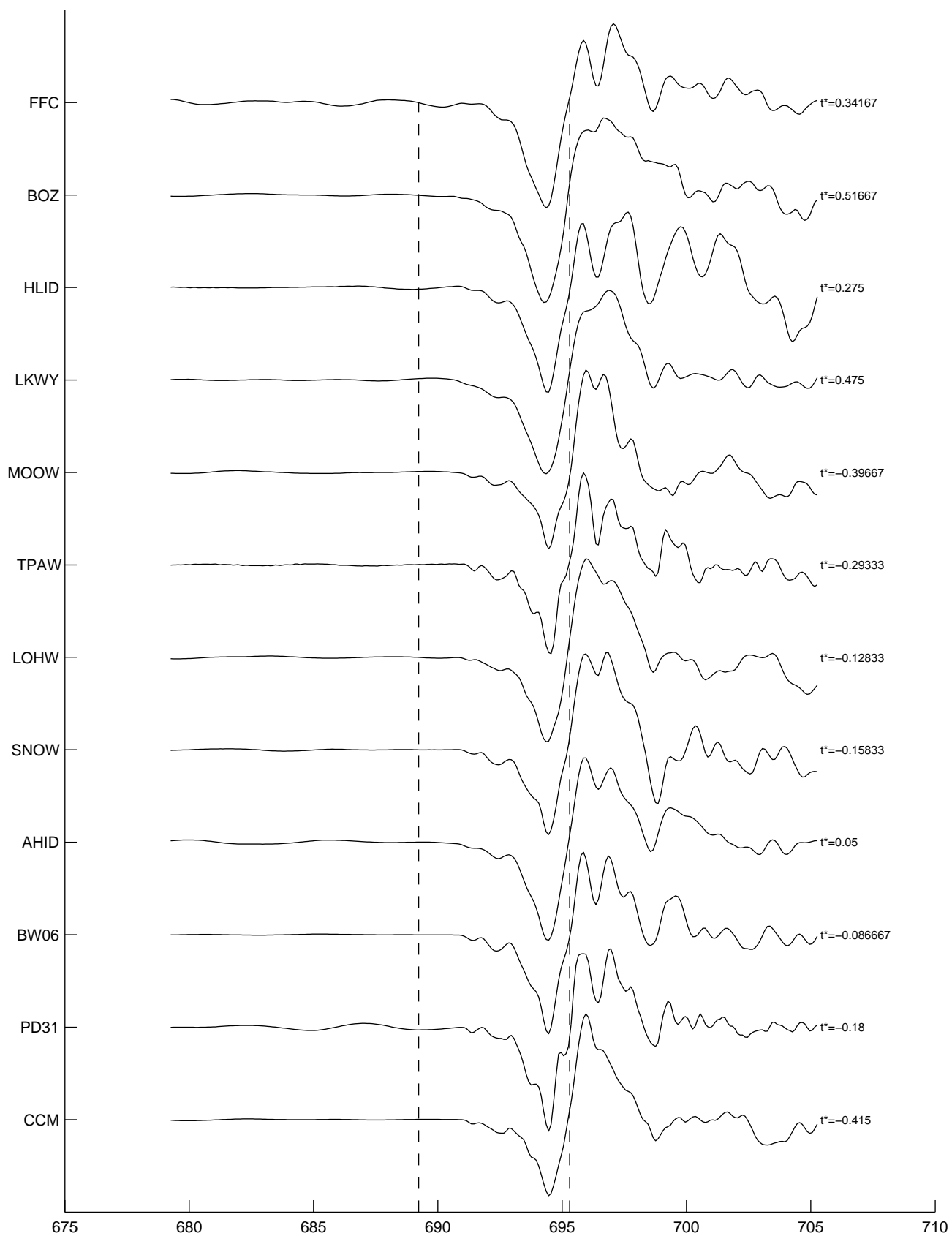
$t^*$  values



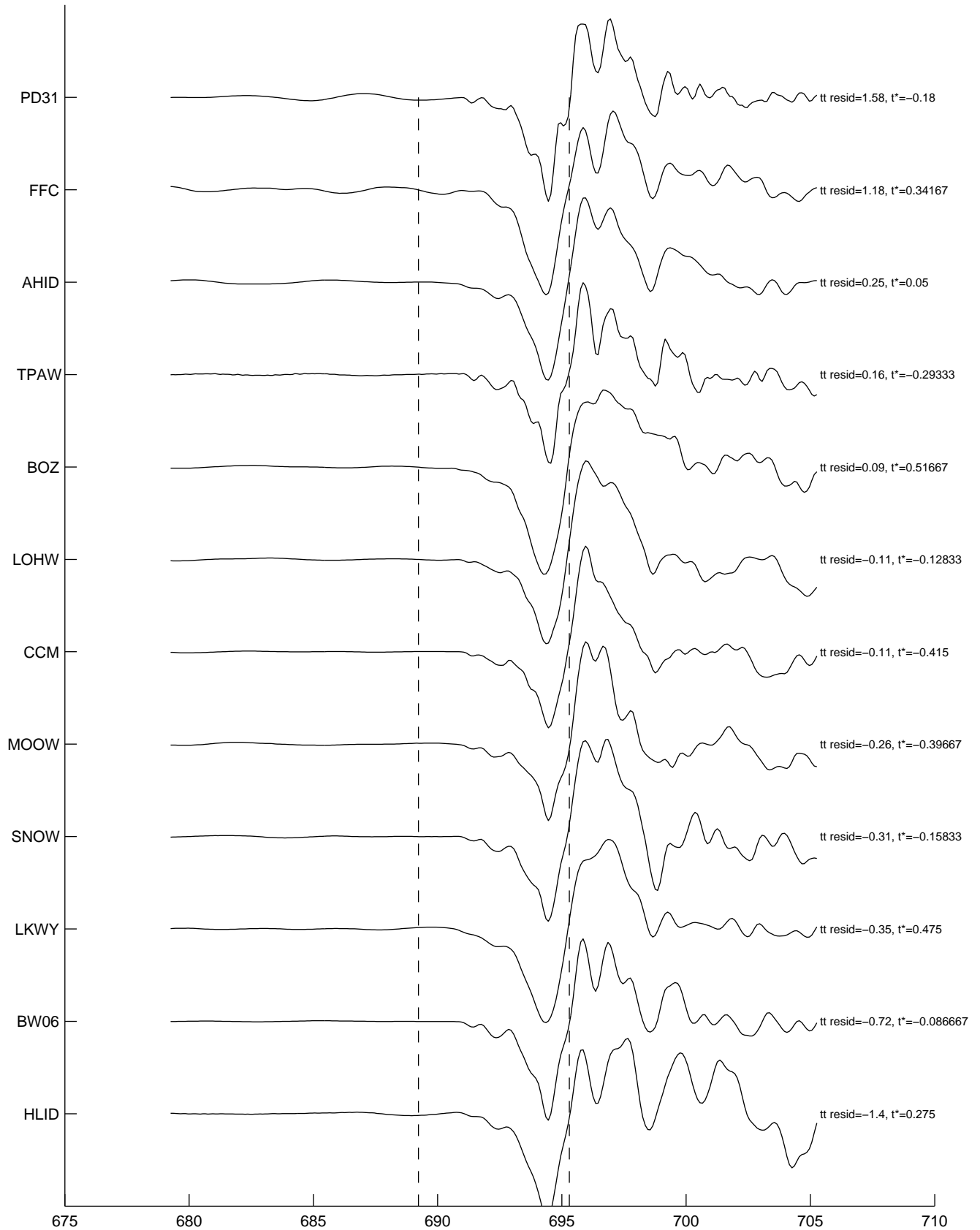
# Event\_2005\_321\_19\_26\_56



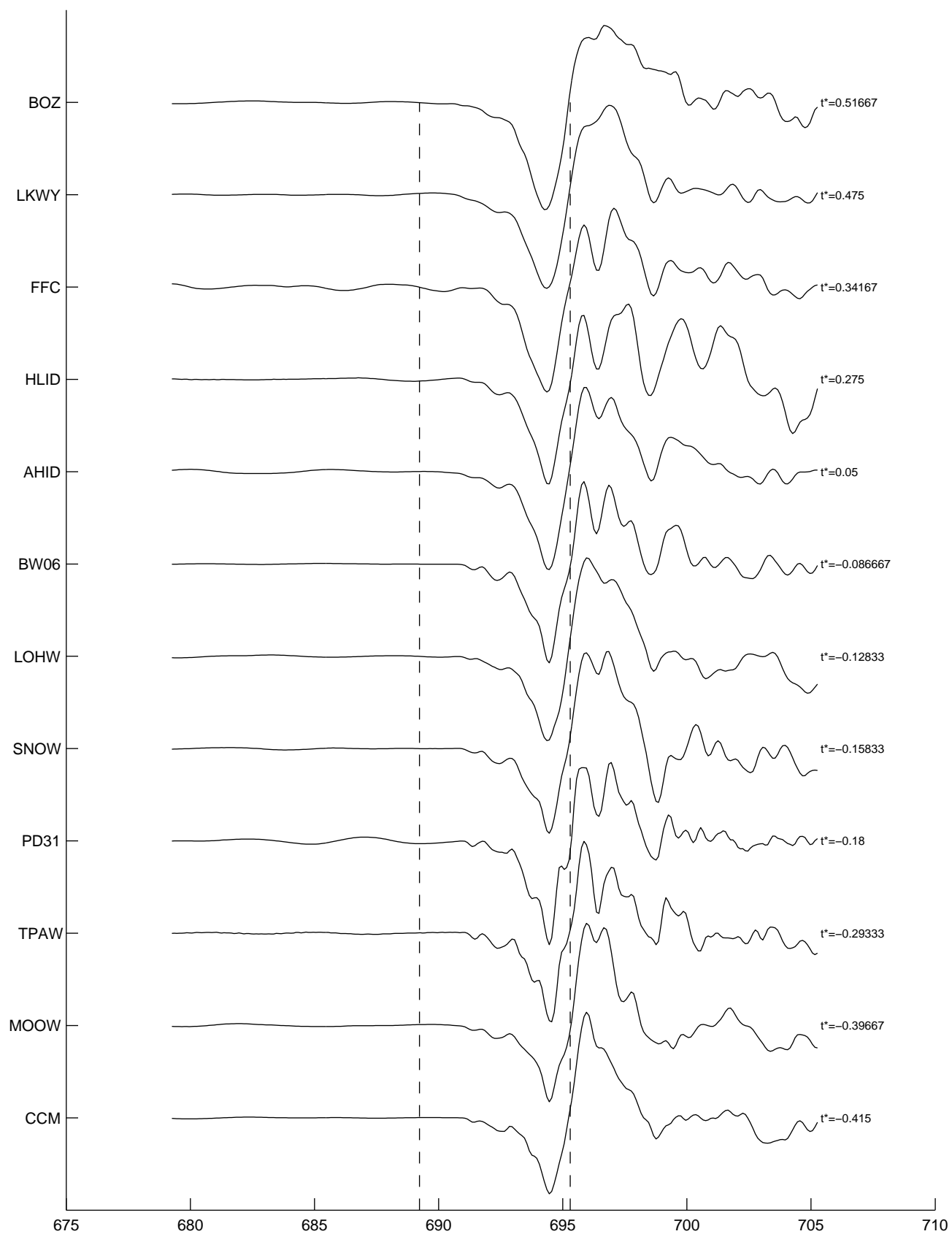
# Sorted by Delta:Event\_2005\_321\_19\_26\_56



# Sorted by travel time: Event\_2005\_321\_19\_26\_56

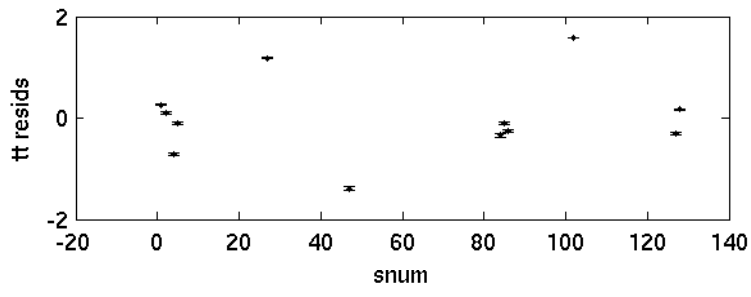


Sorted by  $t^*$ :Event\_2005\_321\_19\_26\_56

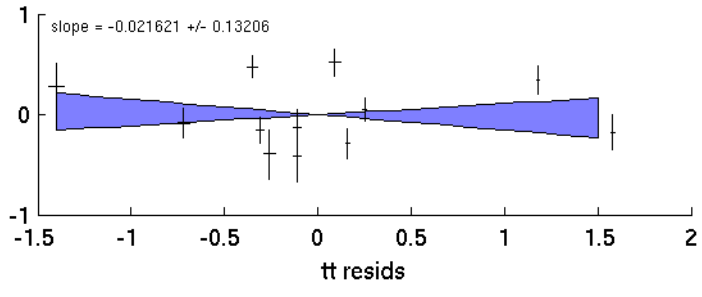
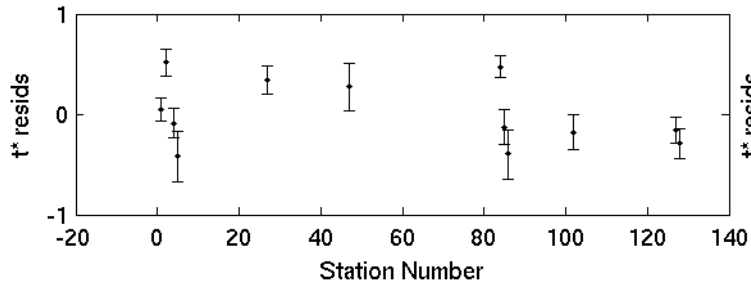


Event\_2005\_321\_19\_26\_56

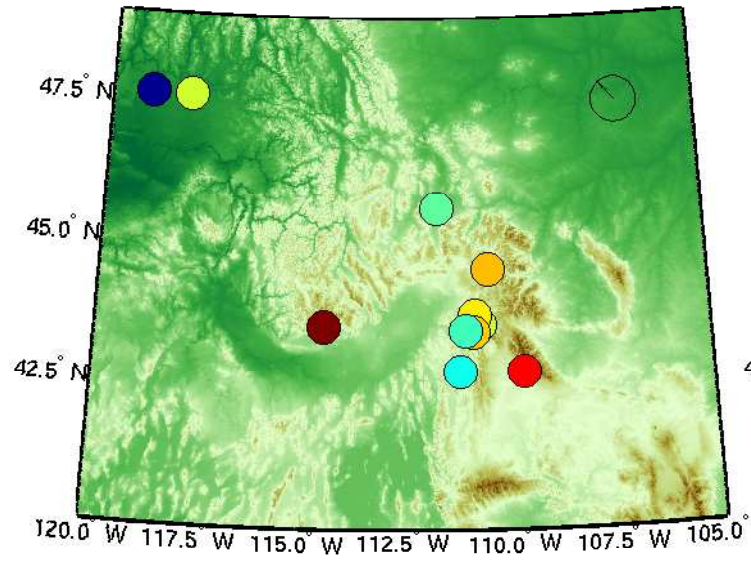
Stack



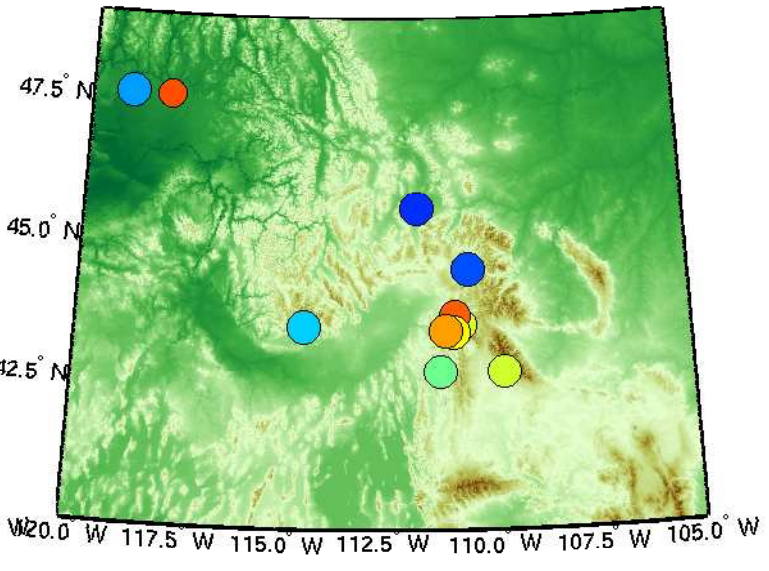
Baz = 141.3426  
Mean xcor value = 0.8475  
Range of  $t^*$  values is 0.93167  
Median  $t^*$  err is 0.15172  
Slope = -0.021621 +/- 0.13206



travel time residuals

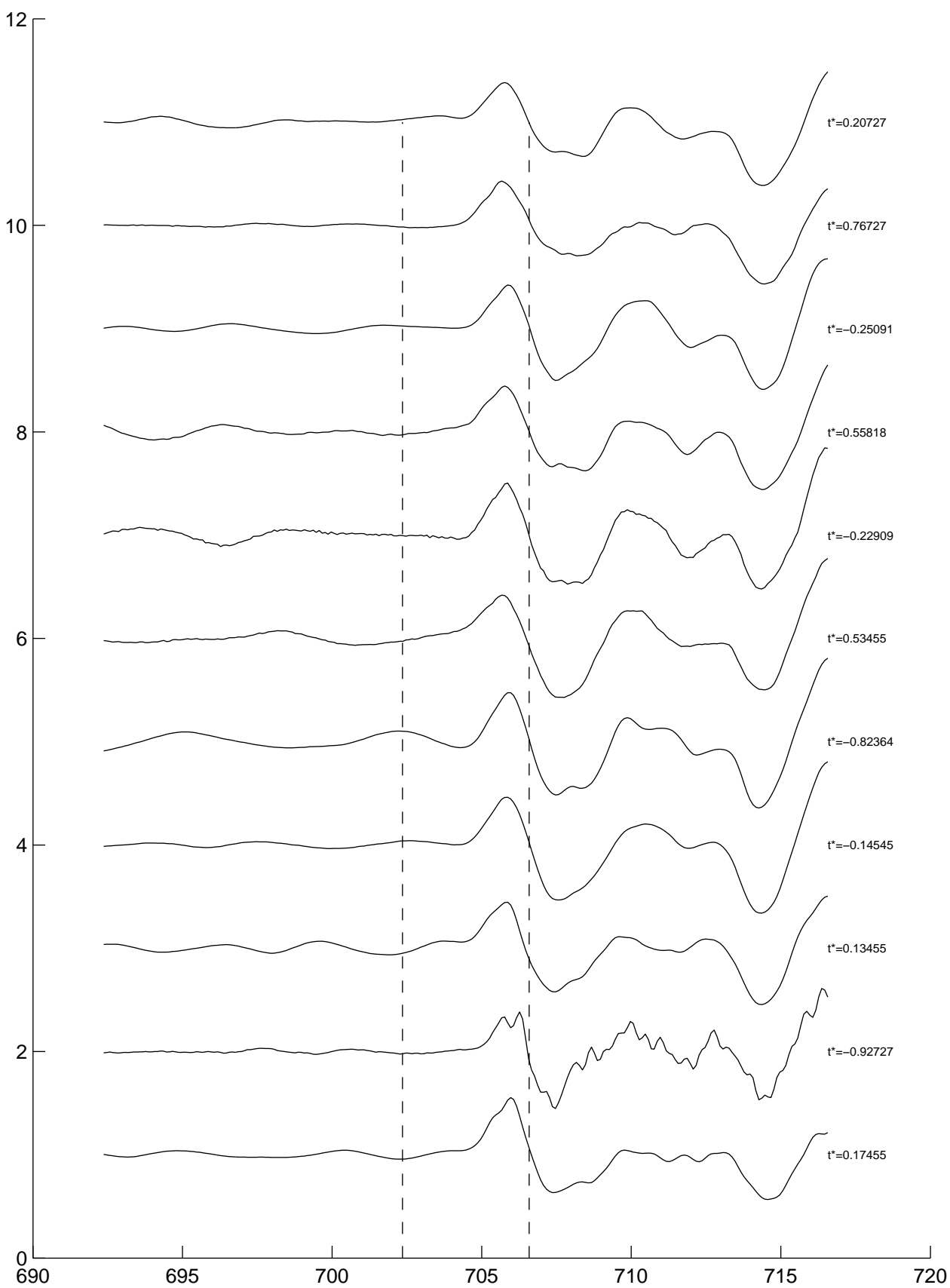


$t^*$  values

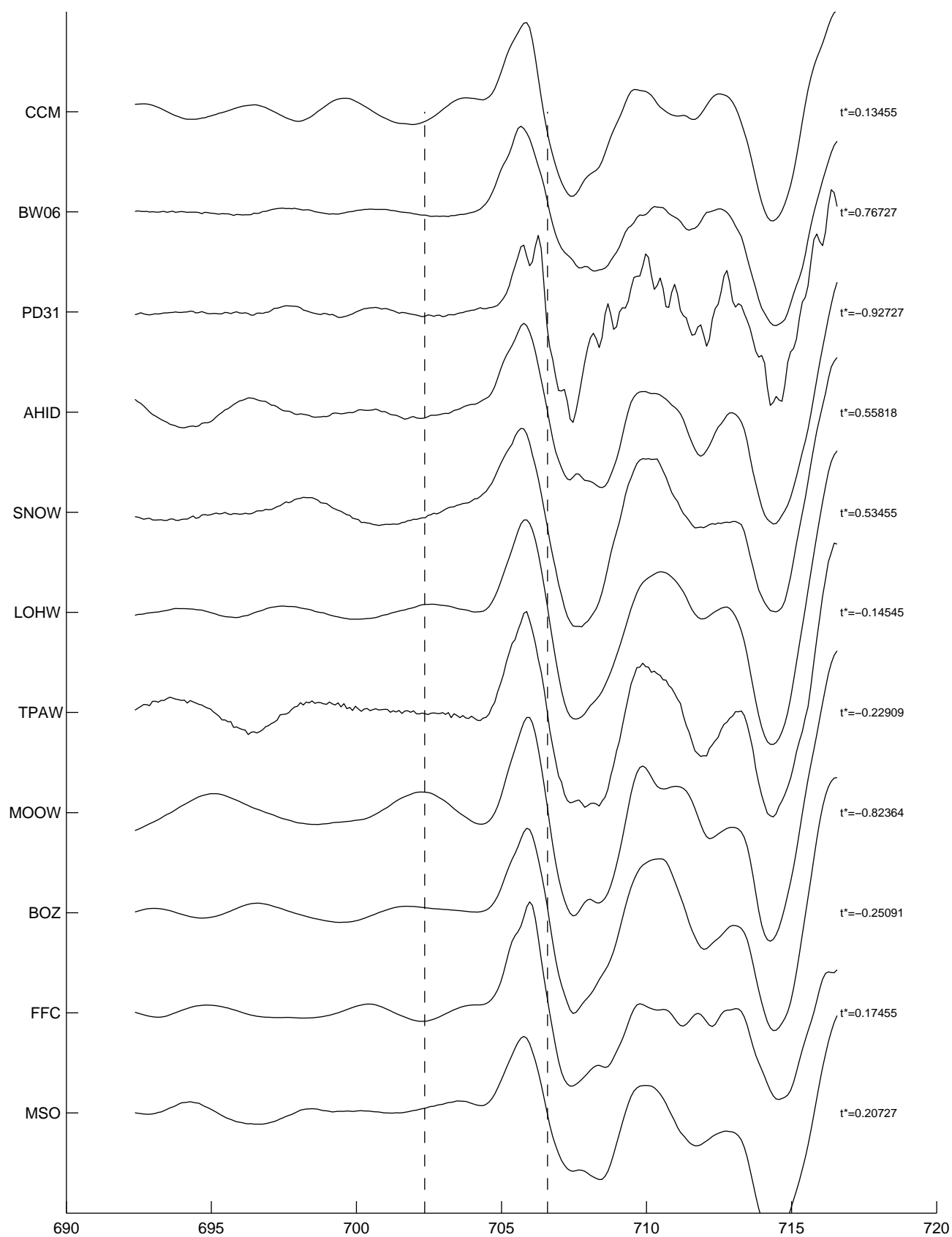




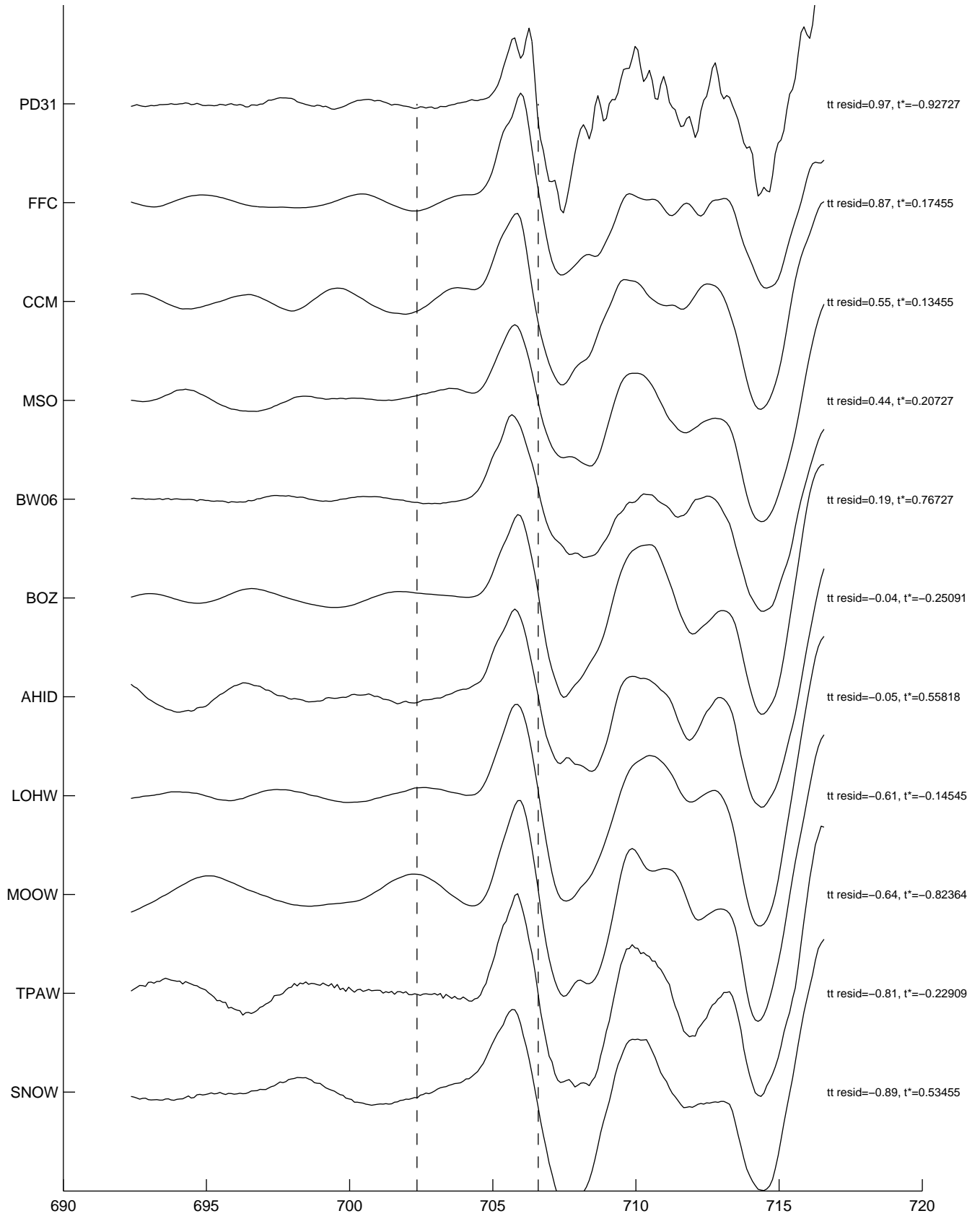
# Event\_2005\_336\_13\_13\_09



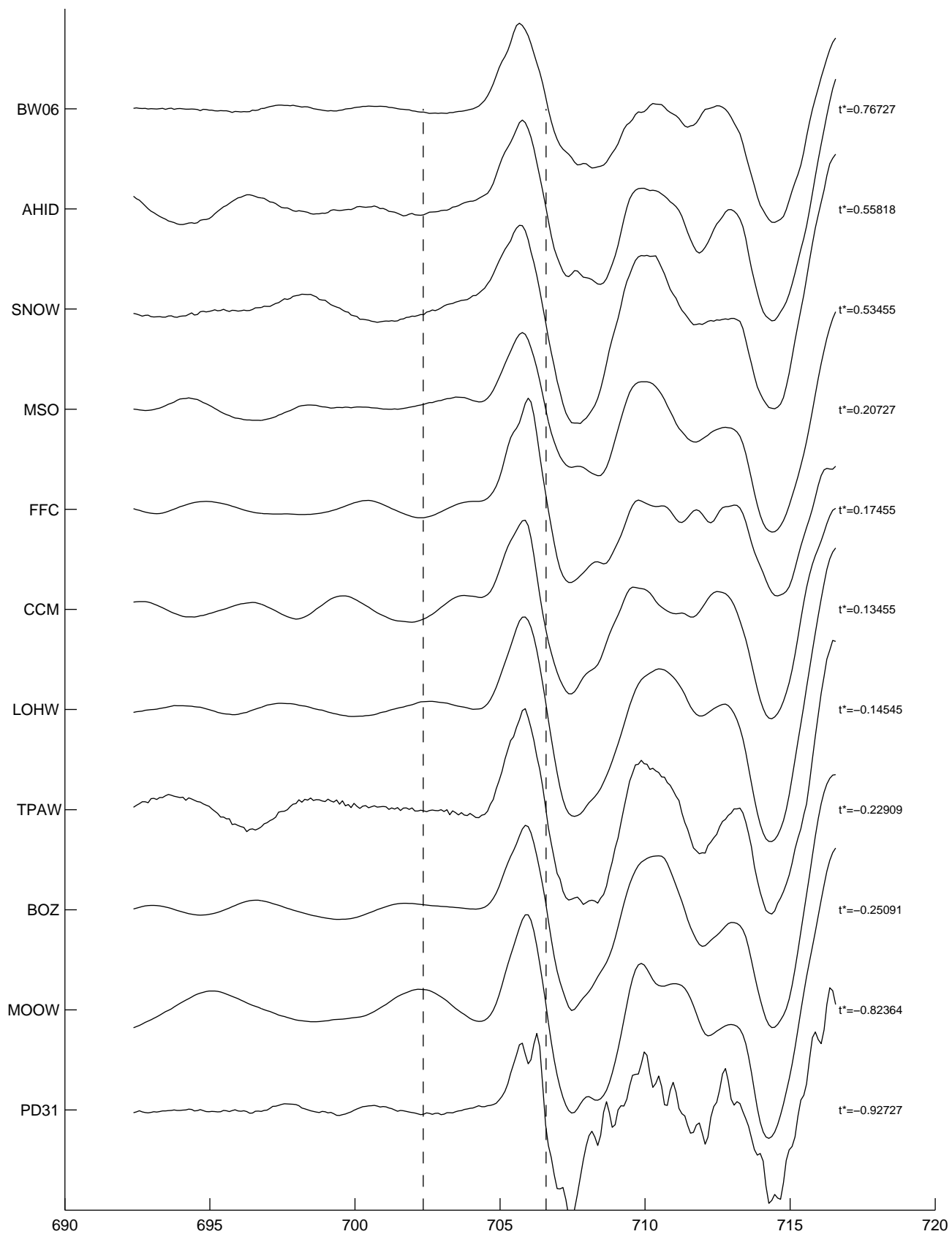
# Sorted by Delta:Event\_2005\_336\_13\_13\_09



# Sorted by travel time:Event\_2005\_336\_13\_13\_09

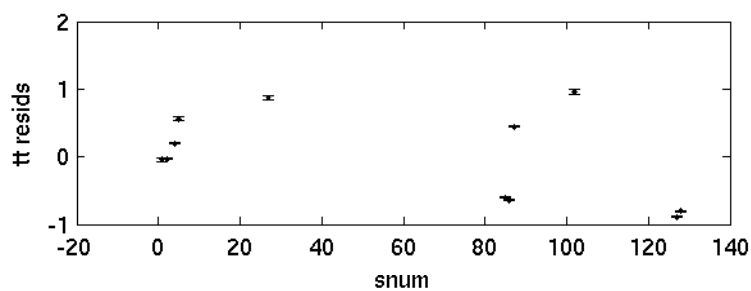
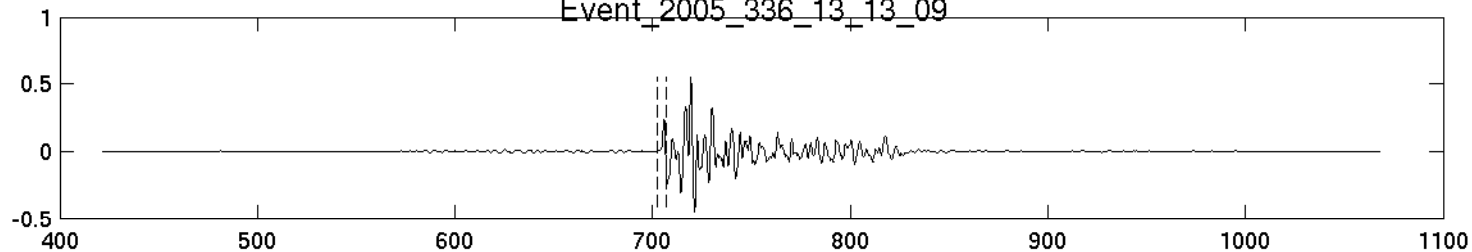


Sorted by  $t^*$ :Event\_2005\_336\_13\_13\_09

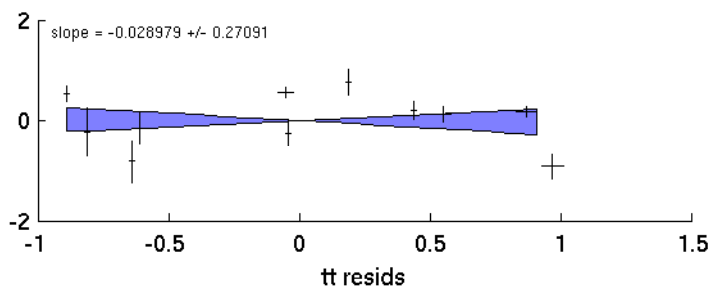
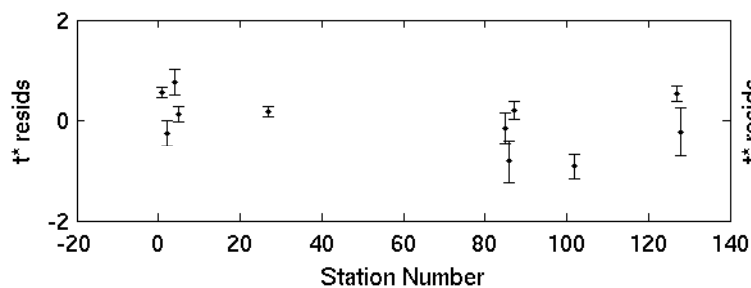


# Event 2005\_336\_13\_13\_09

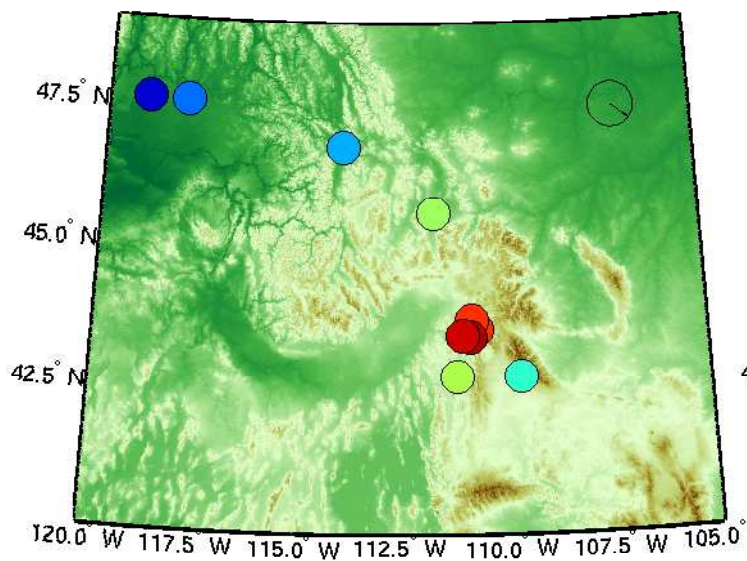
Stack



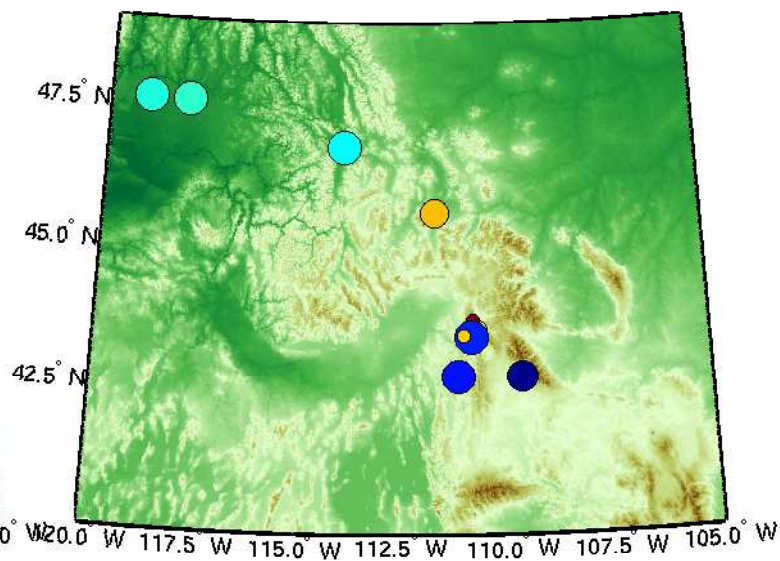
Baz = 310.0748  
Mean xcor value = 0.85636  
Range of t\* values is 1.6945  
Median t\* err is 0.25031  
Slope = -0.028979 +/- 0.27091



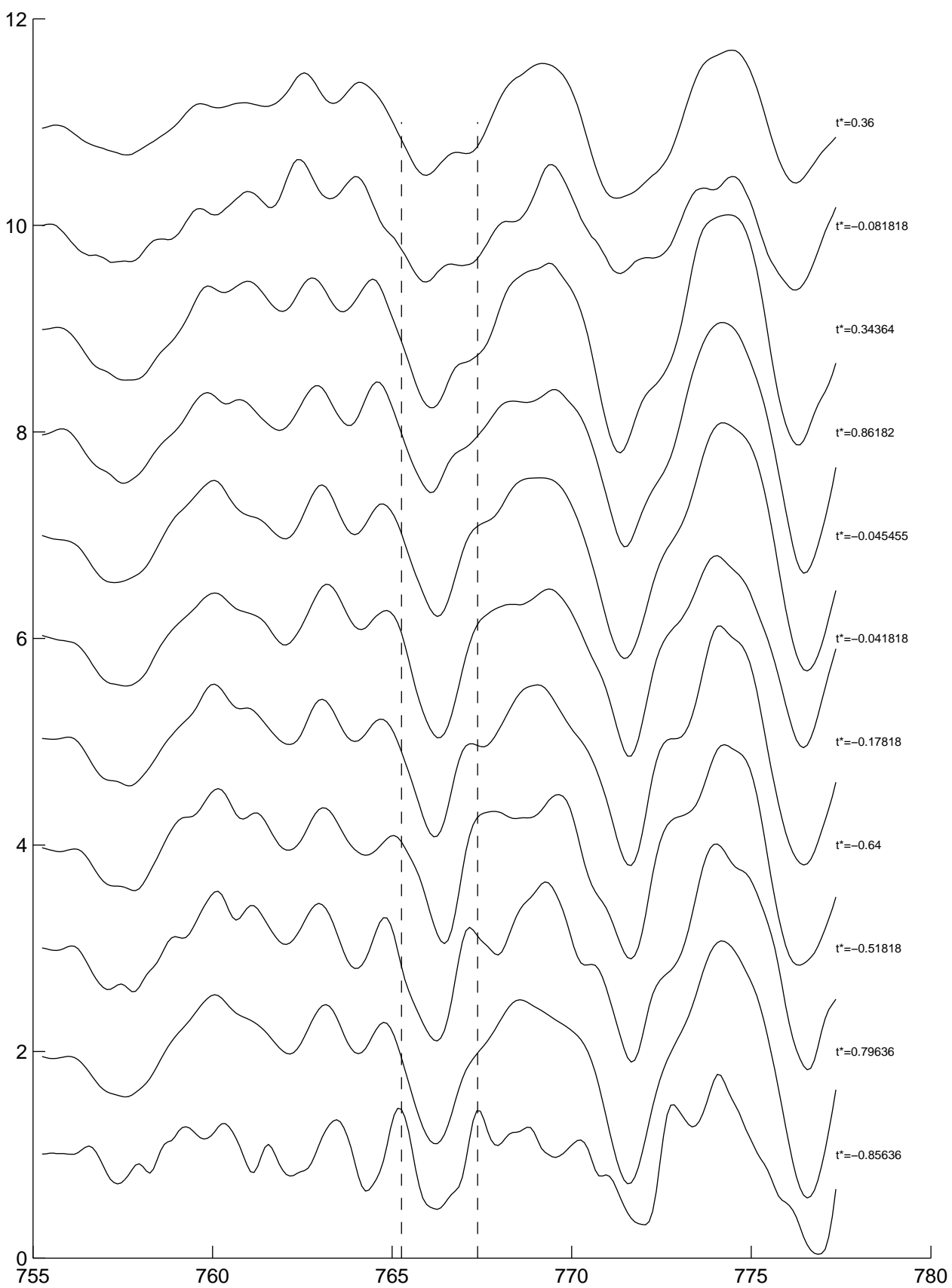
travel time residuals



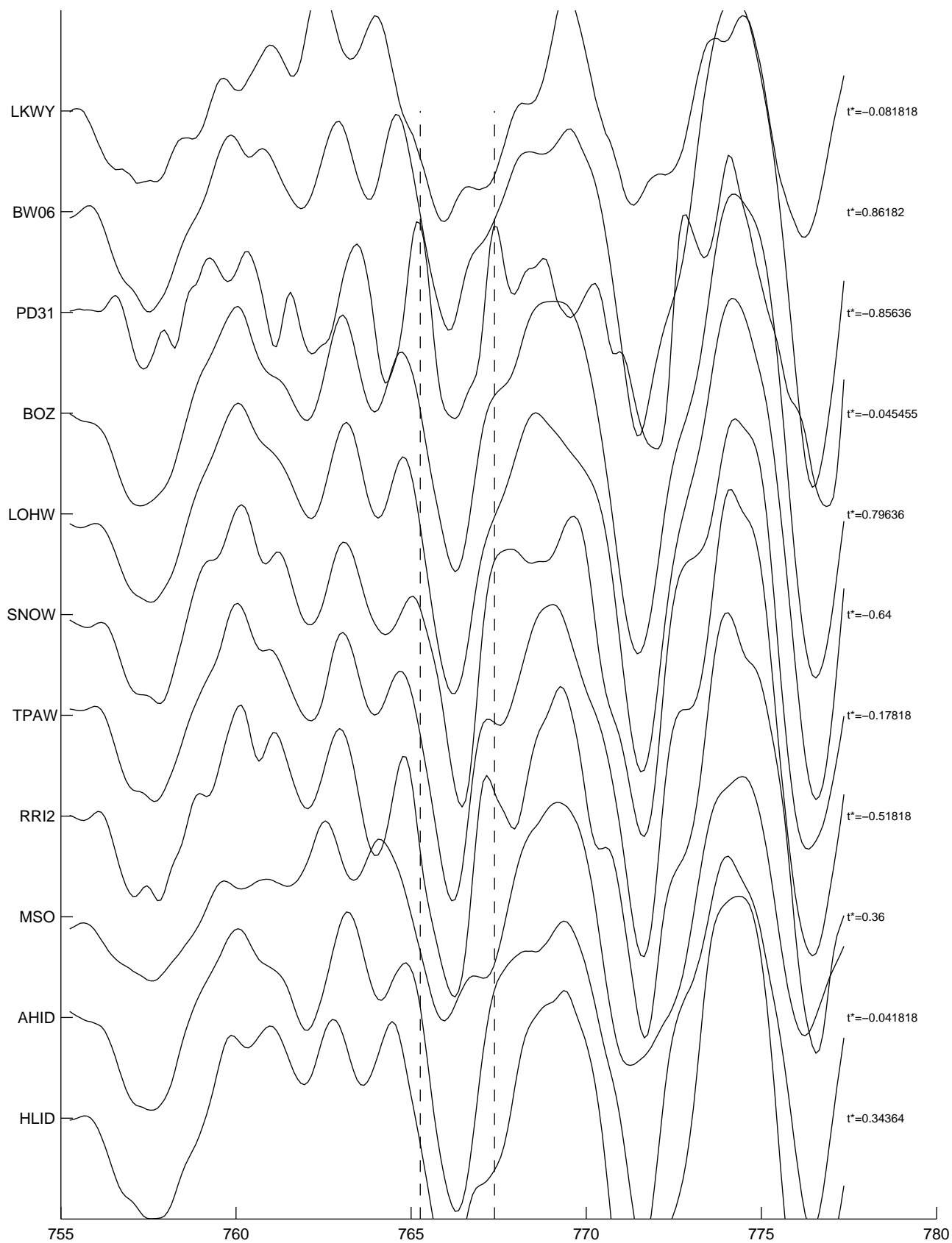
t\* values



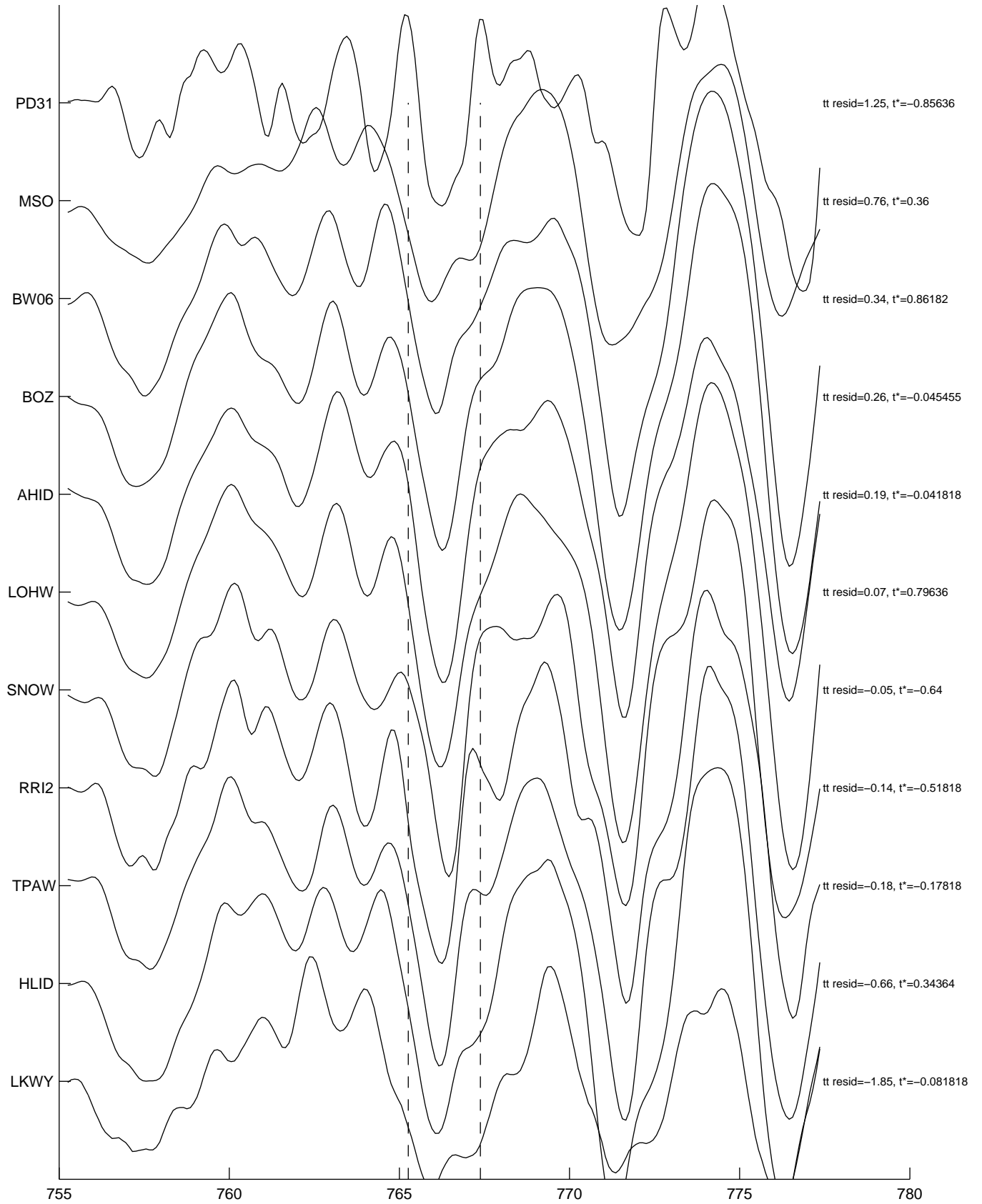
# Event\_2005\_347\_03\_16\_06



# Sorted by Delta:Event\_2005\_347\_03\_16\_06

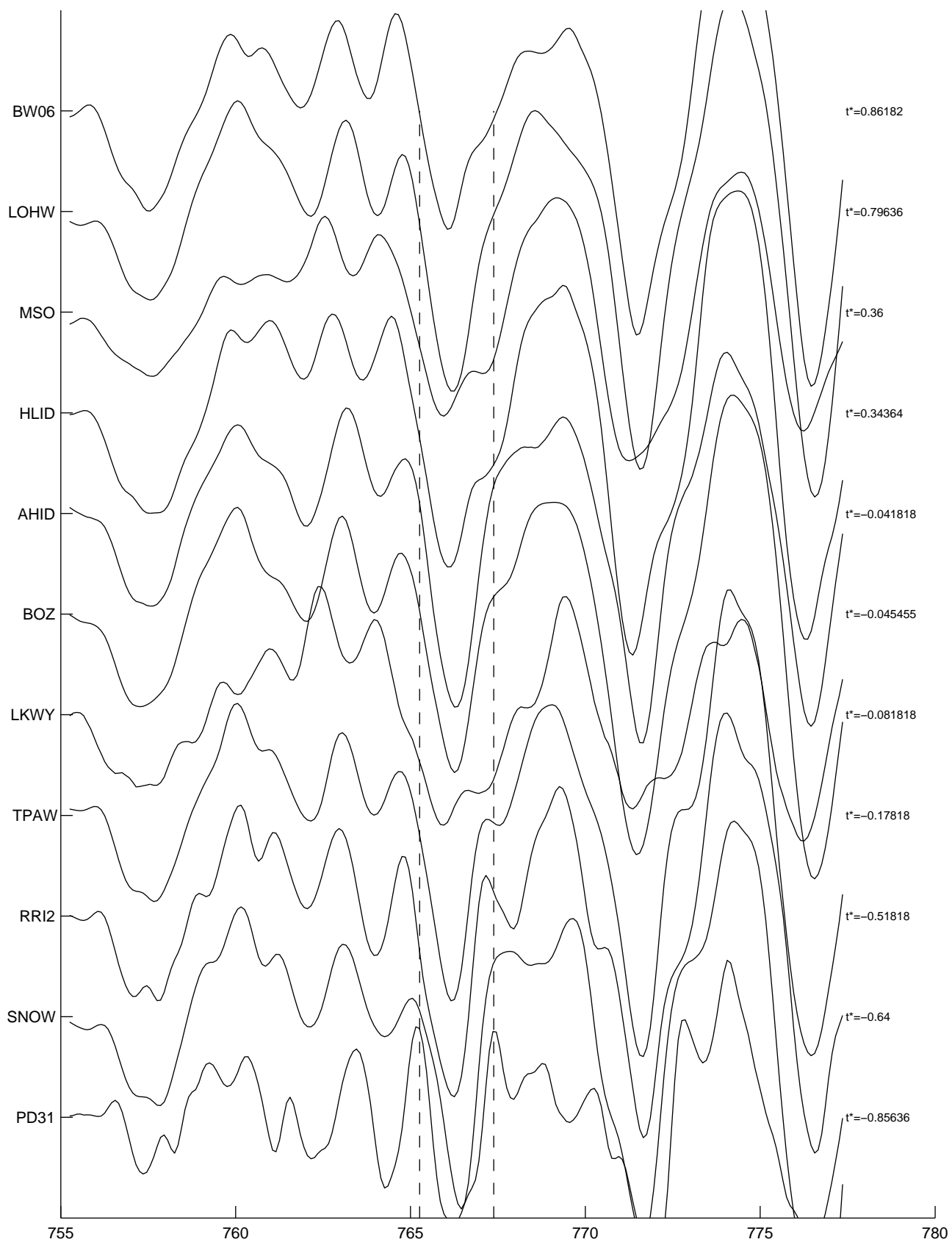


# Sorted by travel time:Event\_2005\_347\_03\_16\_06



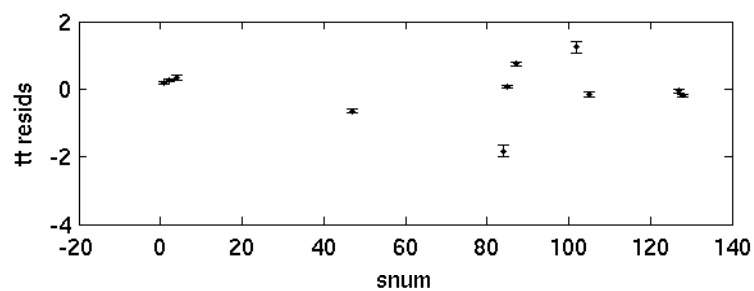
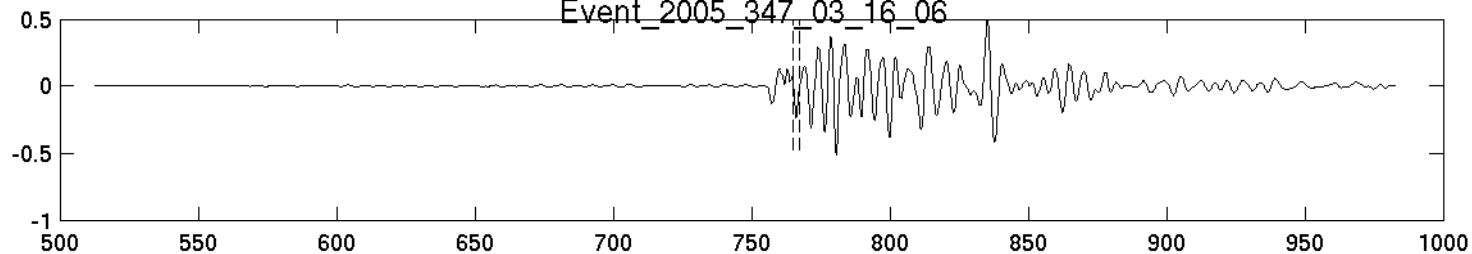


Sorted by  $t^*$ :Event\_2005\_347\_03\_16\_06

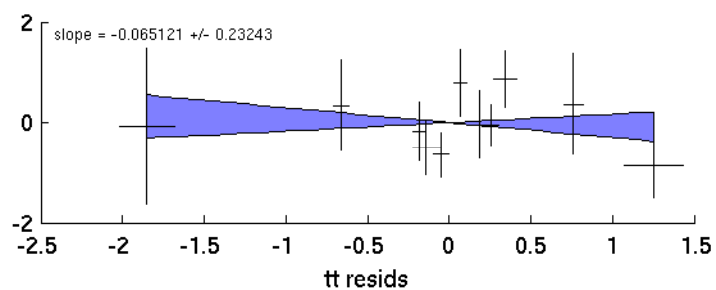
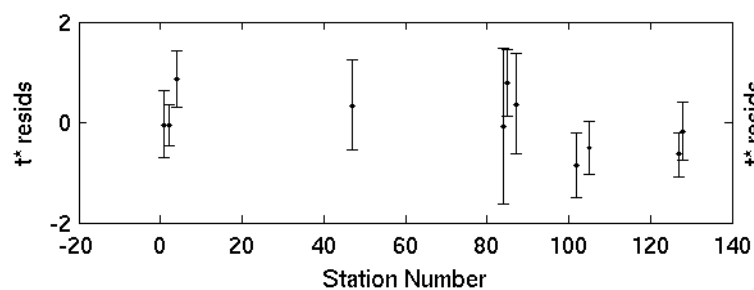


Event\_2005\_347\_03\_16\_06

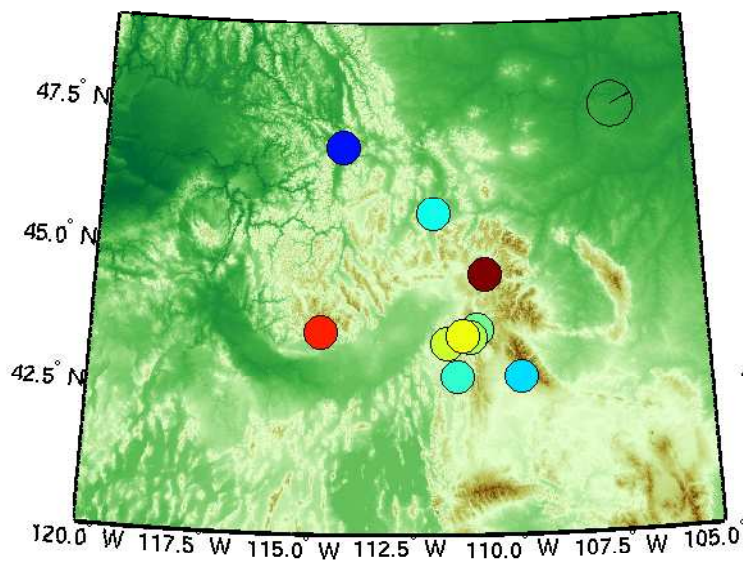
Stack



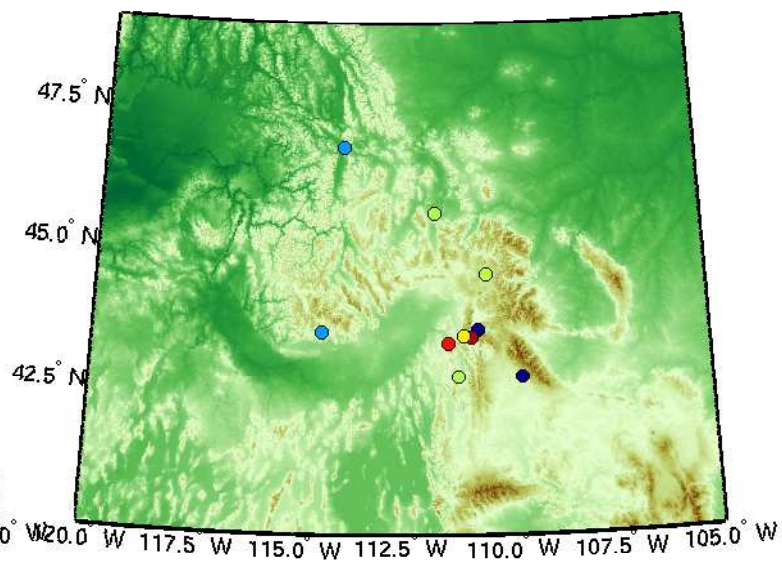
Baz = 243.2627  
Mean xcor value = 0.83727  
Range of  $t^*$  values is 1.7182  
Median  $t^*$  err is 0.65335  
Slope =  $-0.065121 \pm 0.23243$



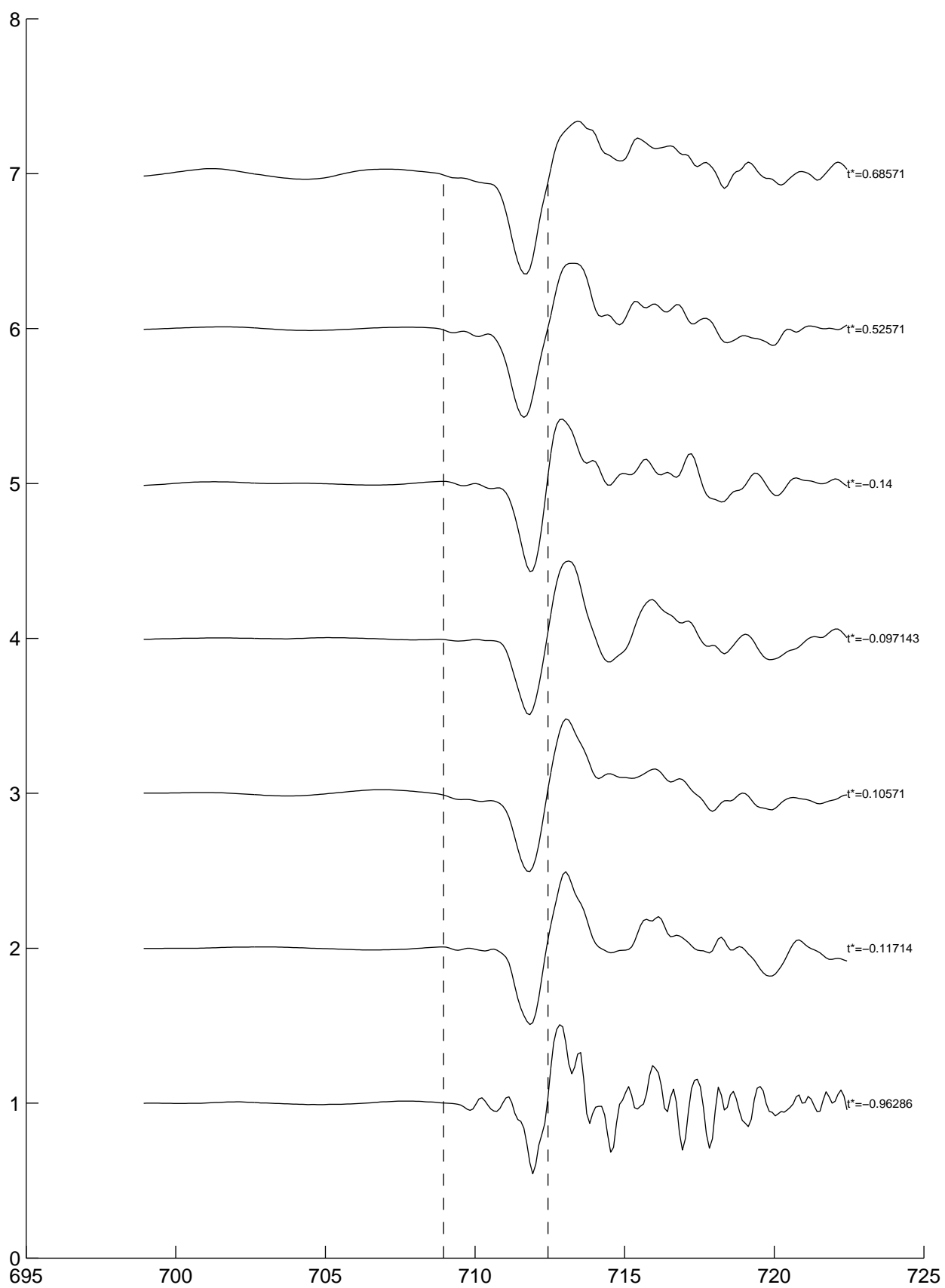
travel time residuals



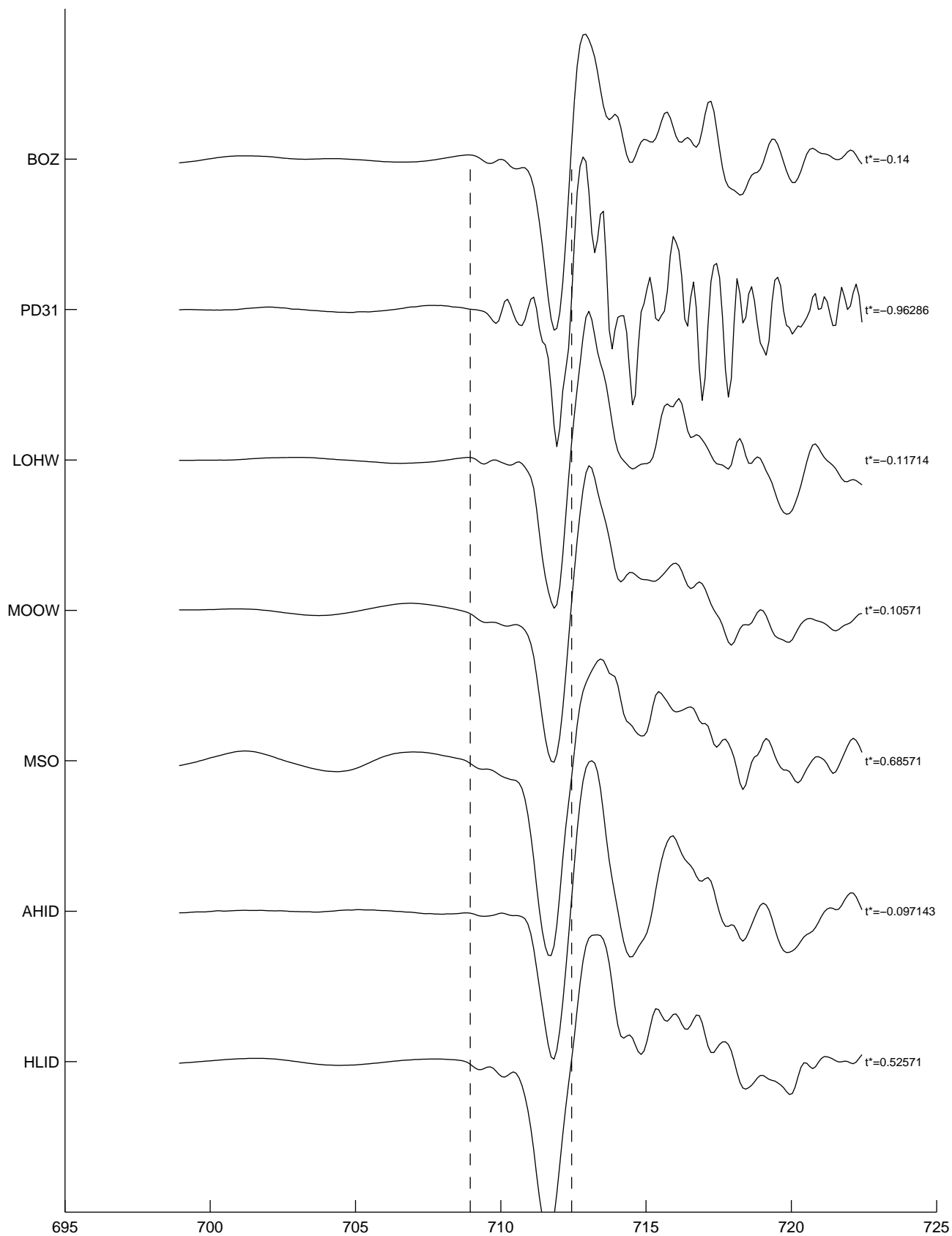
$t^*$  values



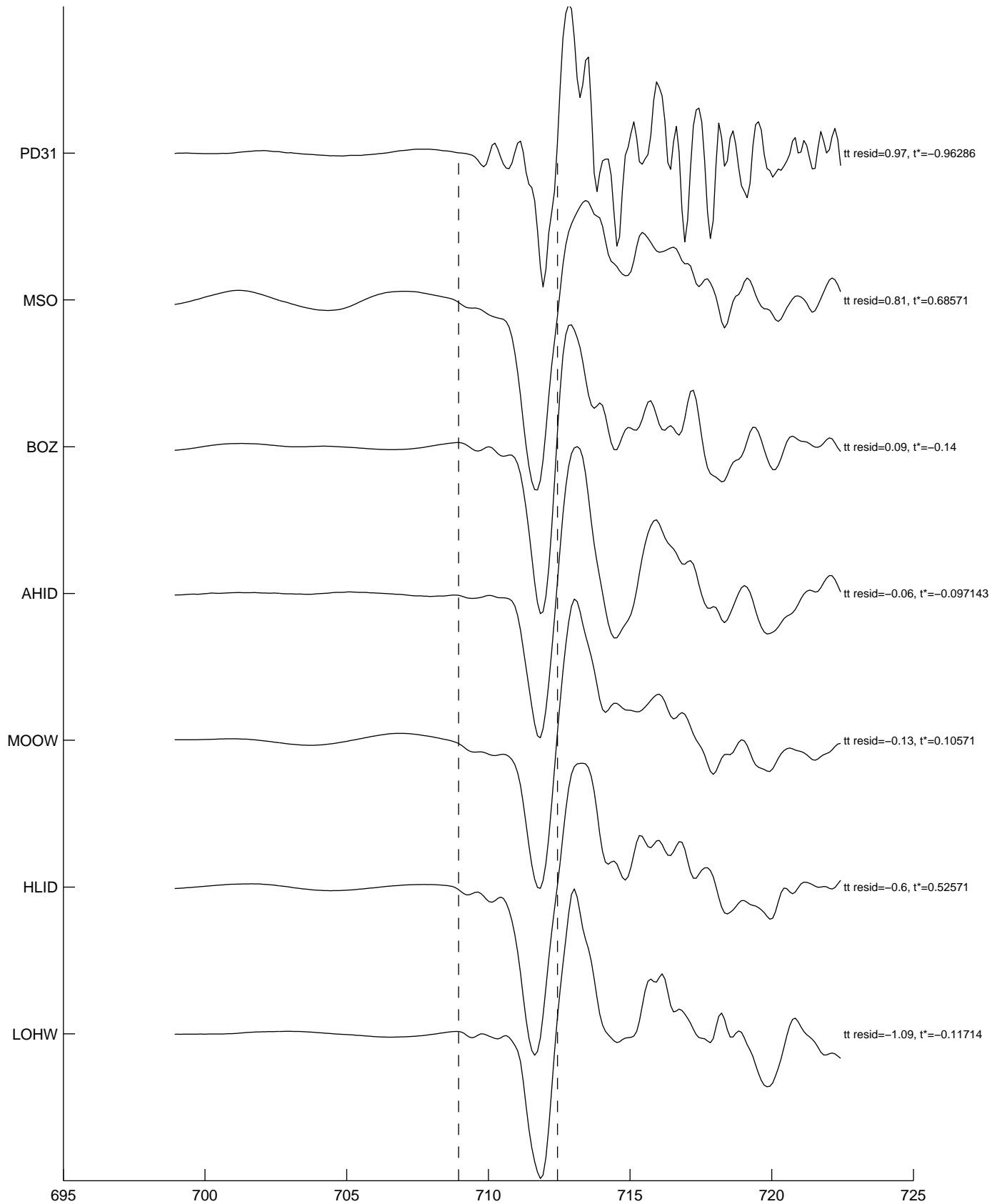
# Event\_2006\_002\_22\_13\_40



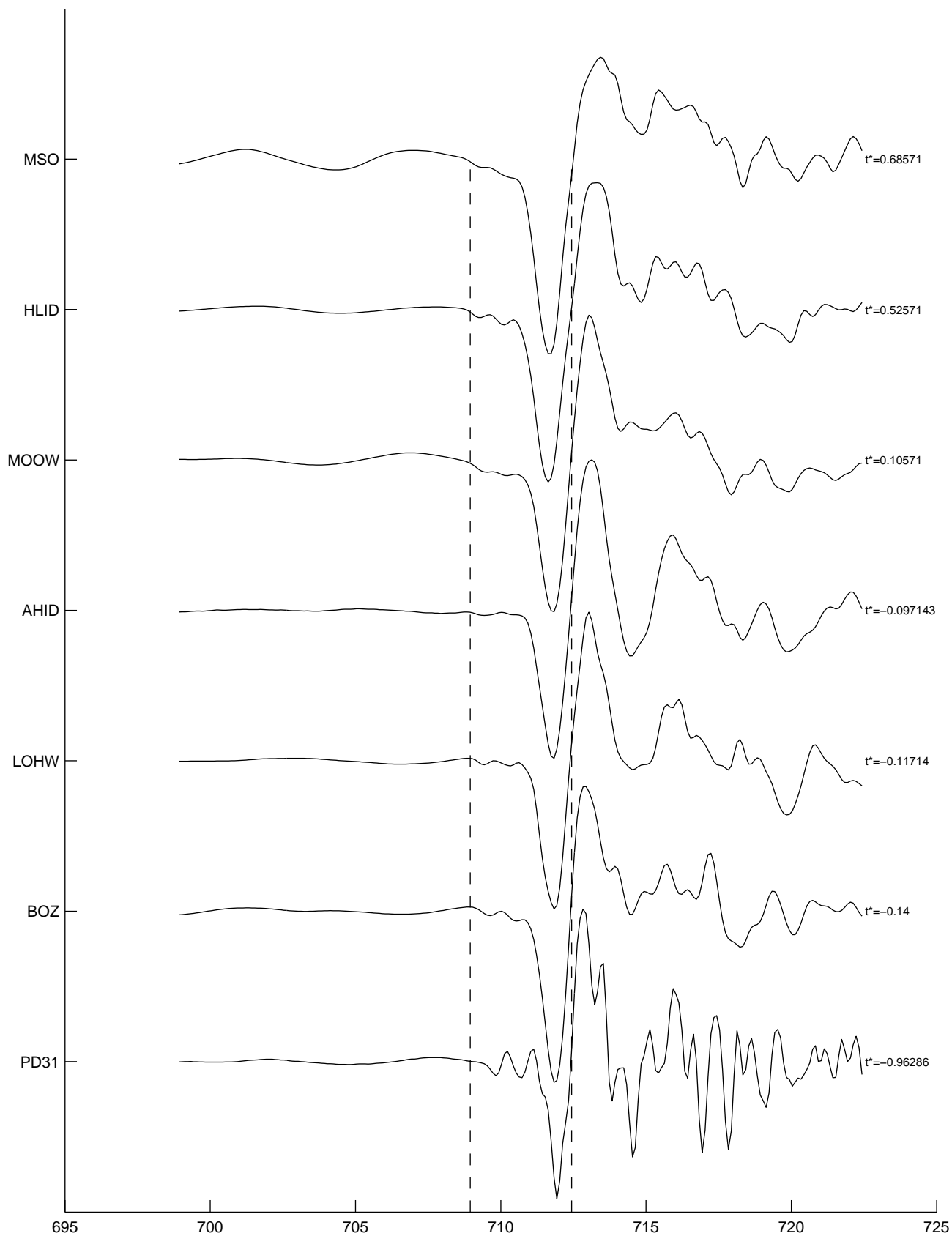
# Sorted by Delta:Event\_2006\_002\_22\_13\_40



# Sorted by travel time:Event\_2006\_002\_22\_13\_40

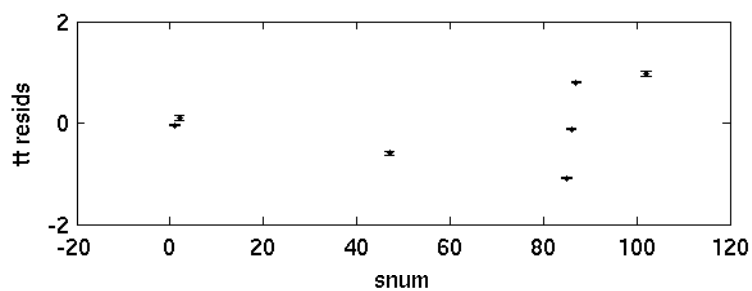
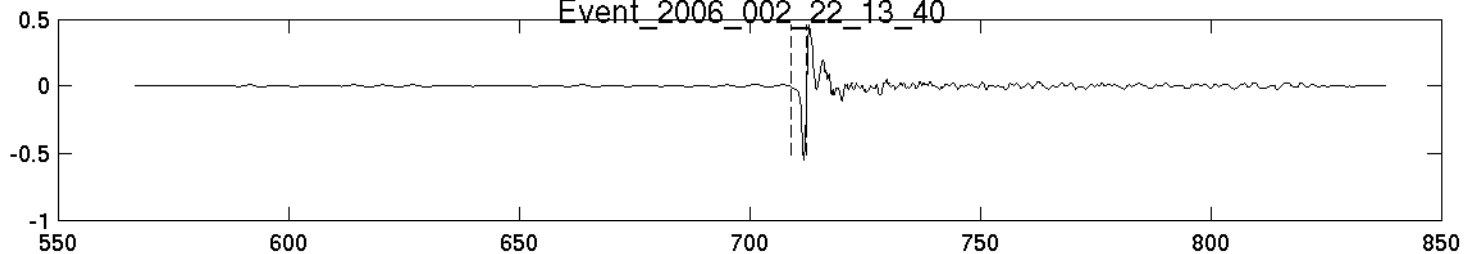


Sorted by  $t^*$ :Event\_2006\_002\_22\_13\_40

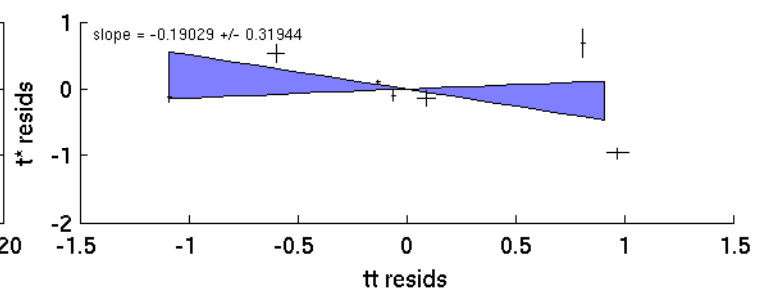
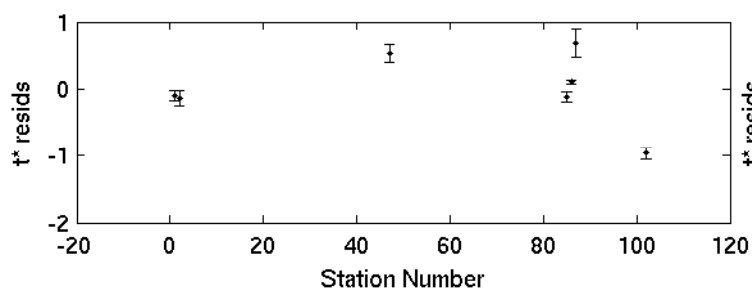


Event\_2006\_002\_22\_13\_40

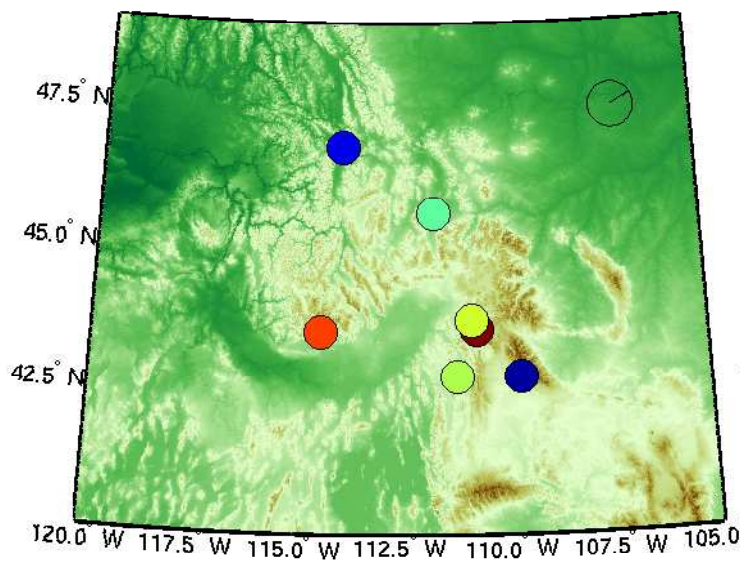
Stack



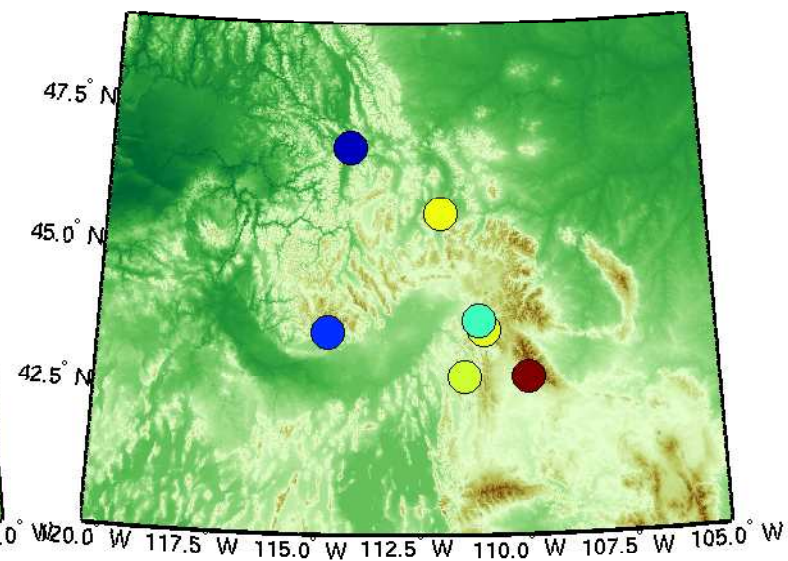
Baz = 239.5744  
Mean xcor value = 0.80571  
Range of  $t^*$  values is 1.6486  
Median  $t^*$  err is 0.082887  
Slope = -0.19029 +/- 0.31944



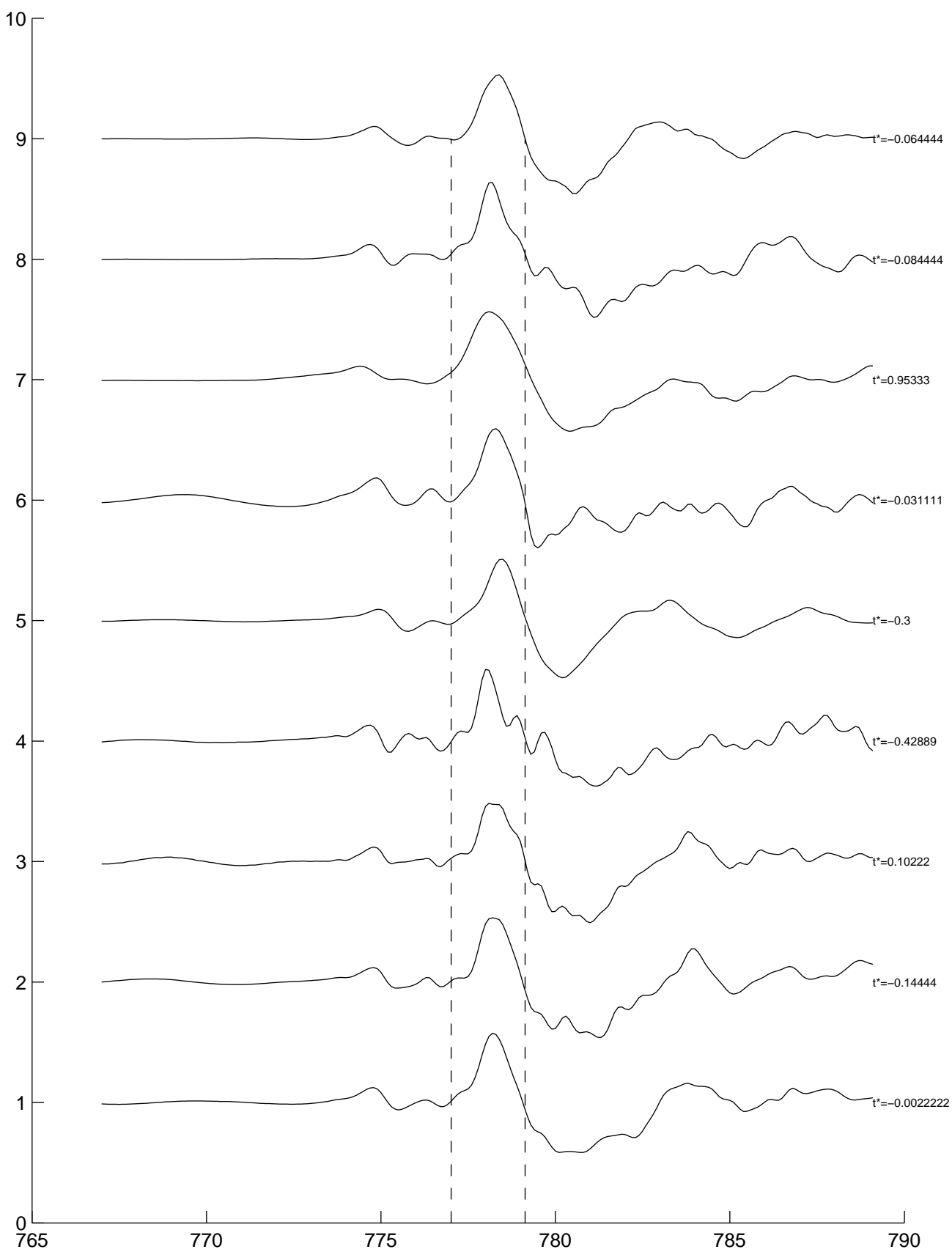
travel time residuals



$t^*$  values

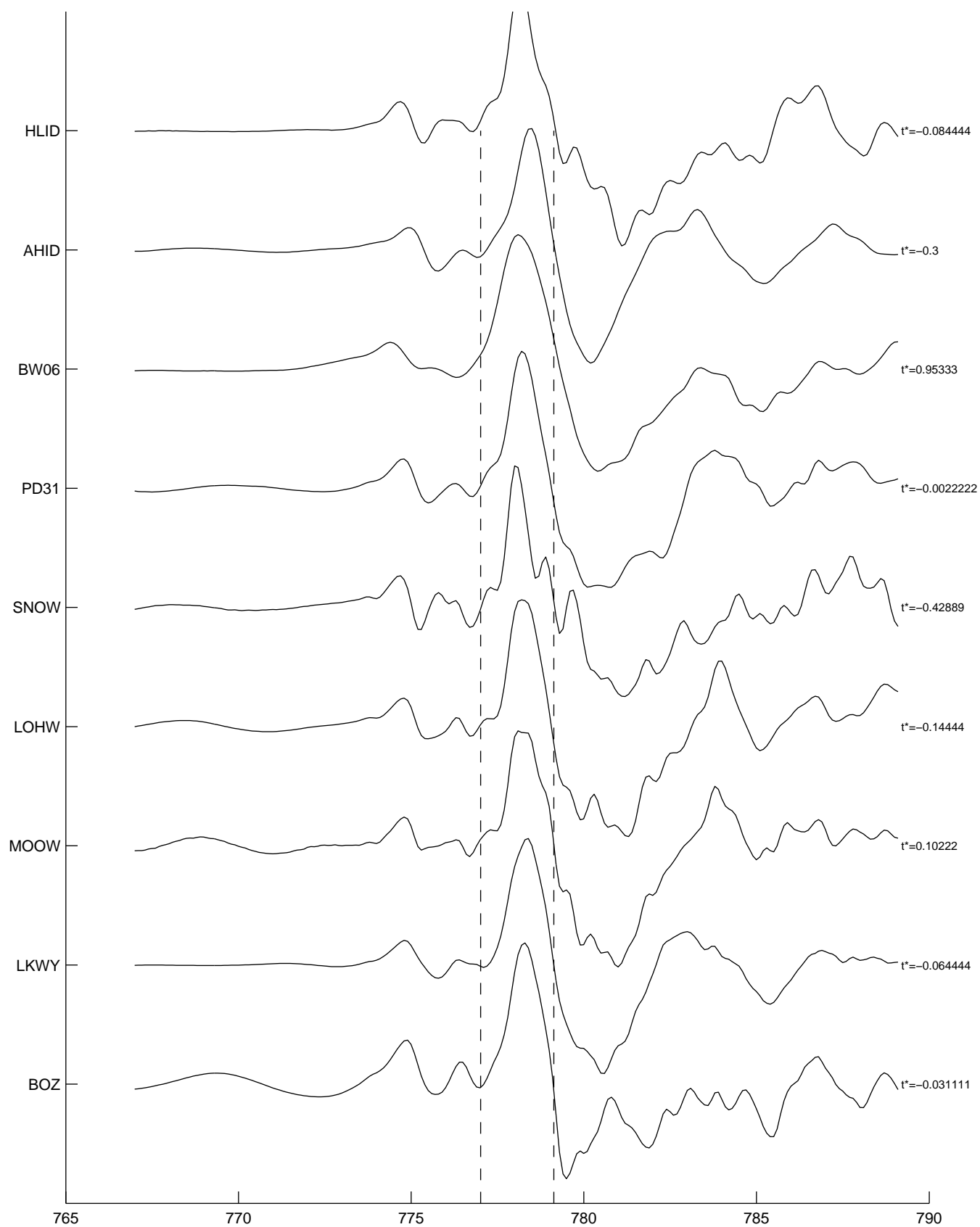


# Event\_2006\_008\_11\_34\_55

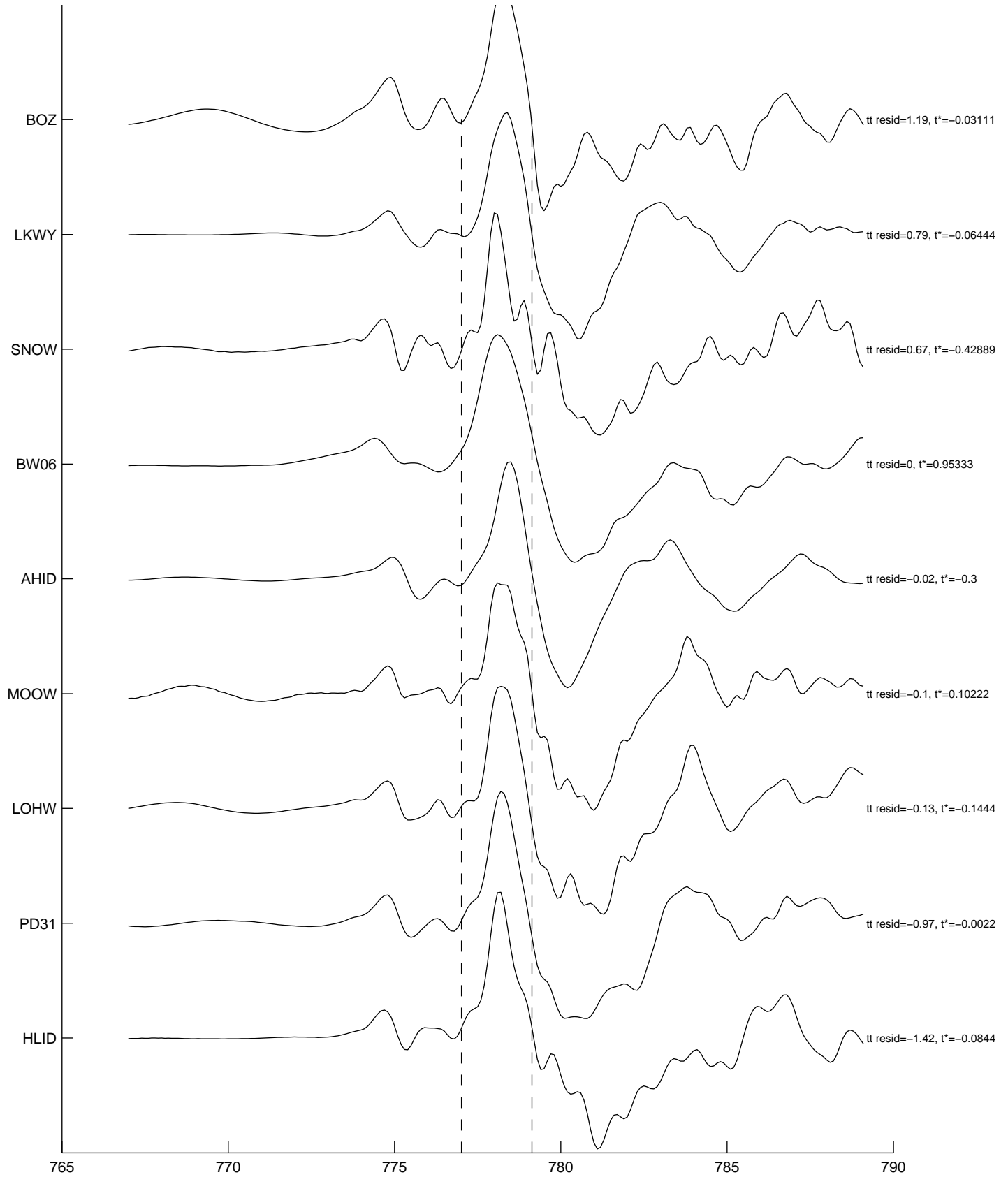




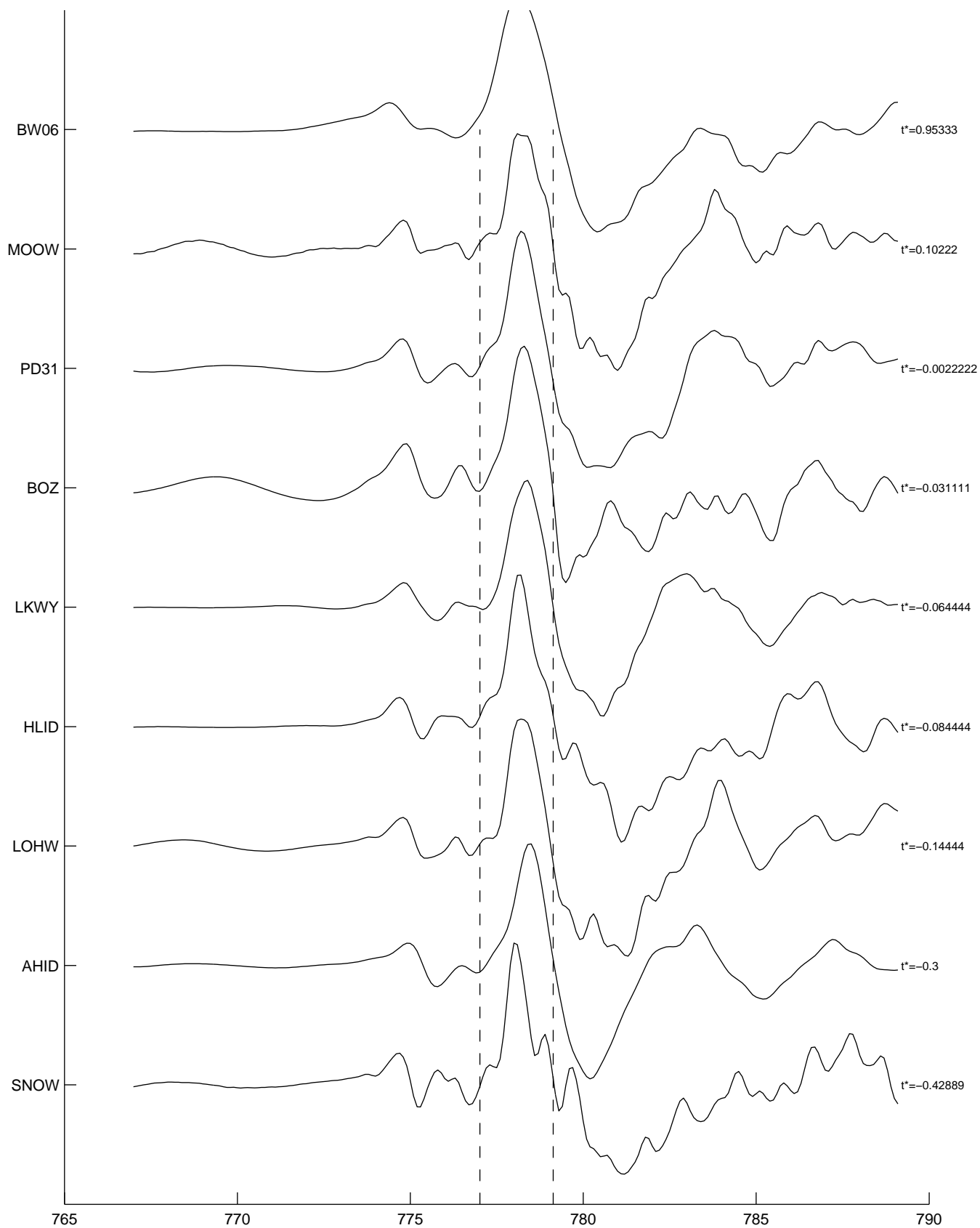
# Sorted by Delta:Event\_2006\_008\_11\_34\_55



# Sorted by travel time:Event\_2006\_008\_11\_34\_55

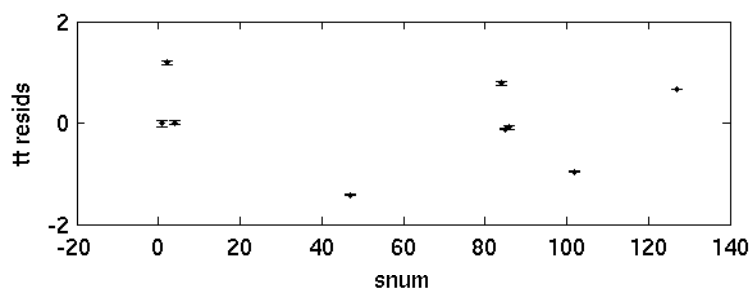
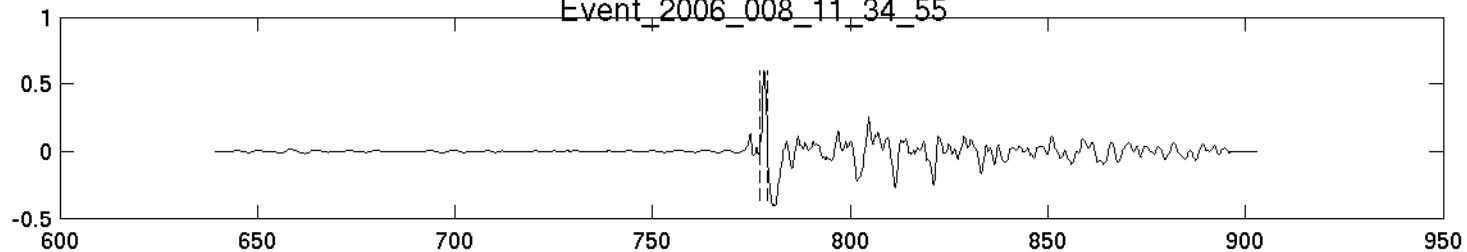


Sorted by  $t^*$ :Event\_2006\_008\_11\_34\_55

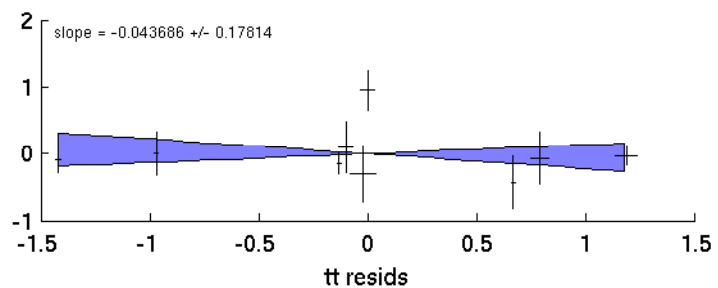
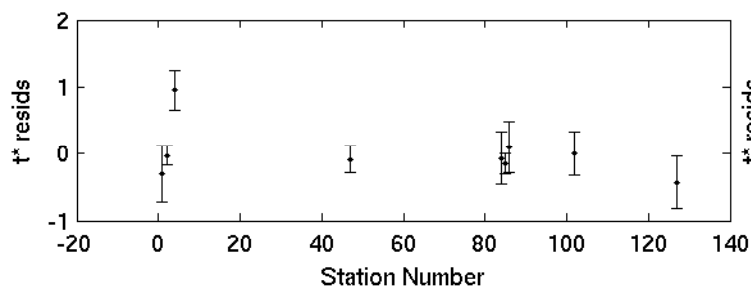


# Event\_2006\_008\_11\_34\_55

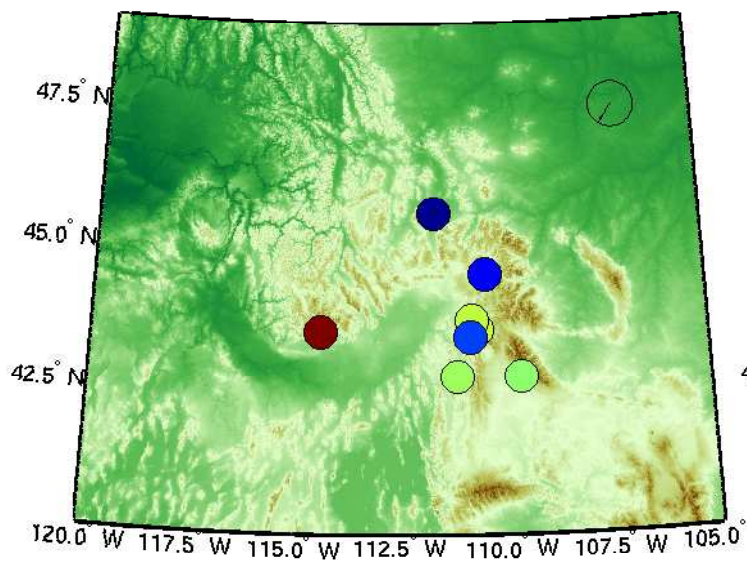
Stack



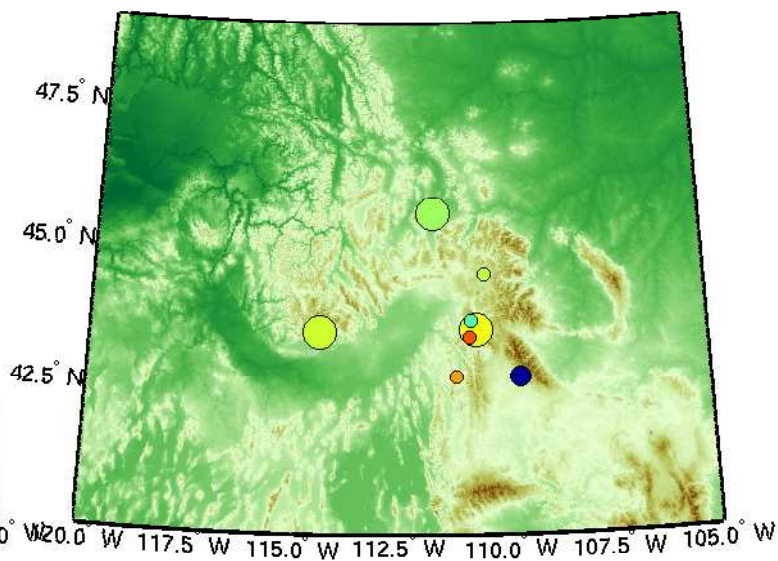
Baz = 35.0912  
Mean xcor value = 0.76444  
Range of  $t^*$  values is 1.3822  
Median  $t^*$  err is 0.32311  
Slope = -0.043686 +/- 0.17814



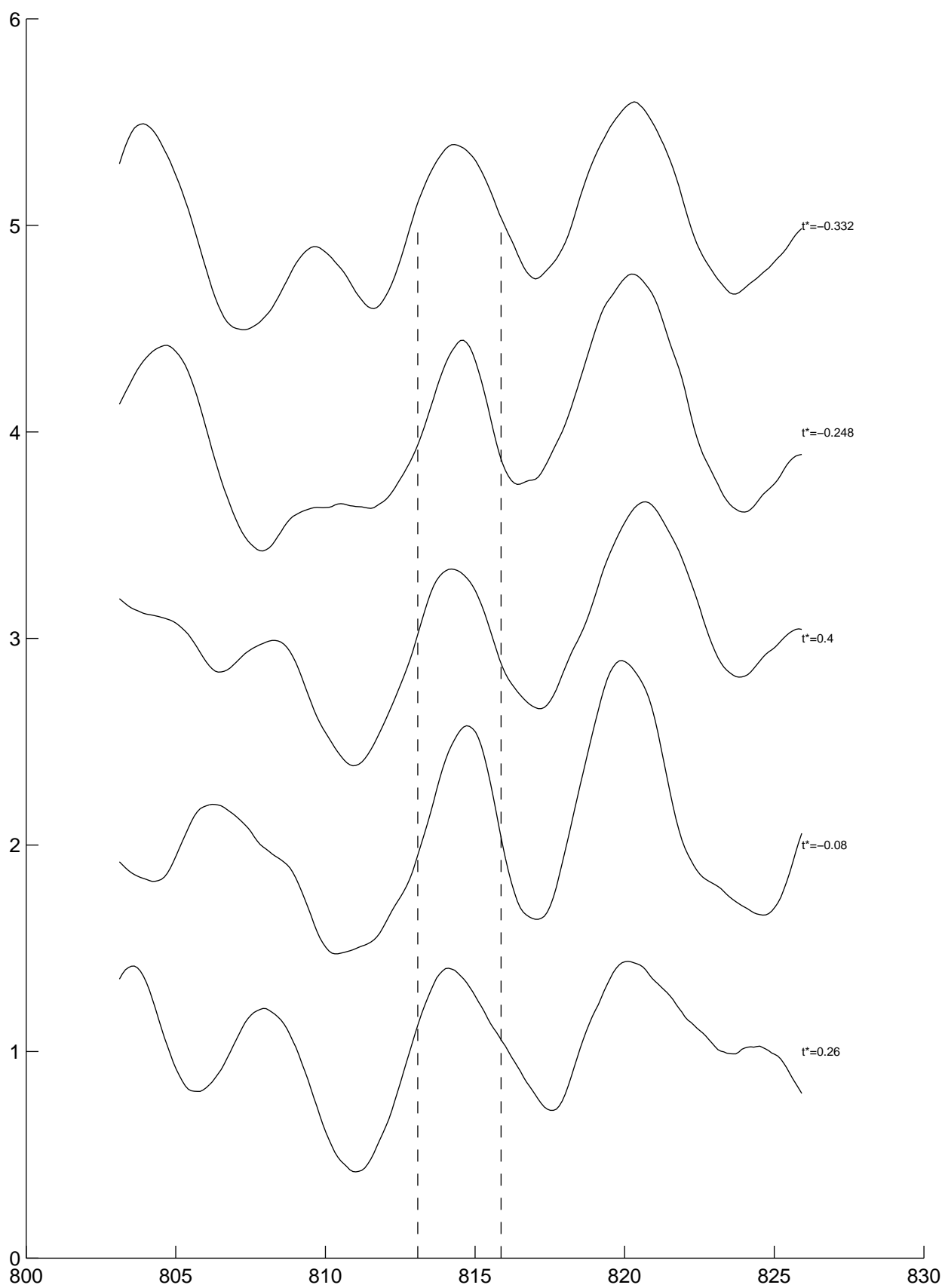
travel time residuals



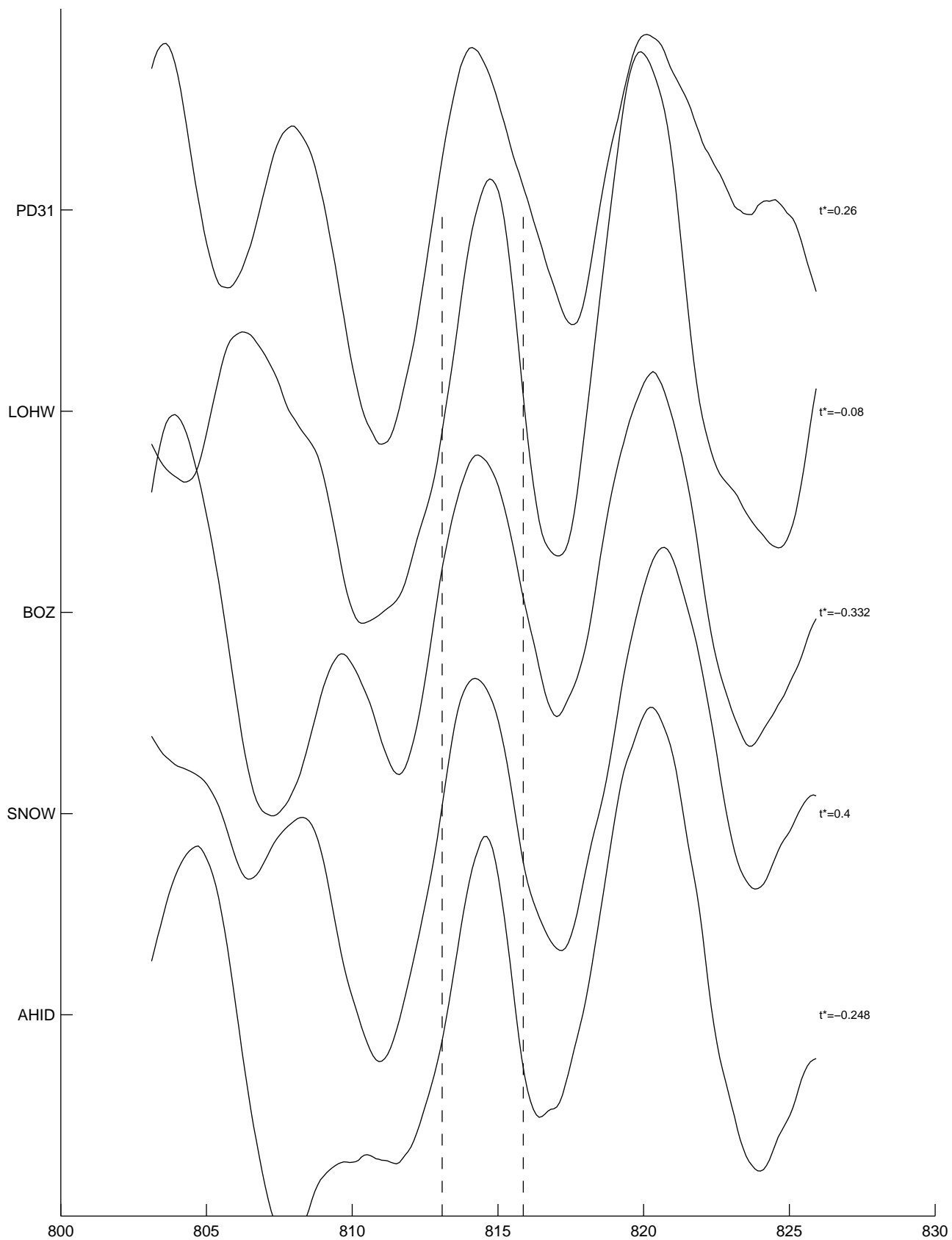
$t^*$  values



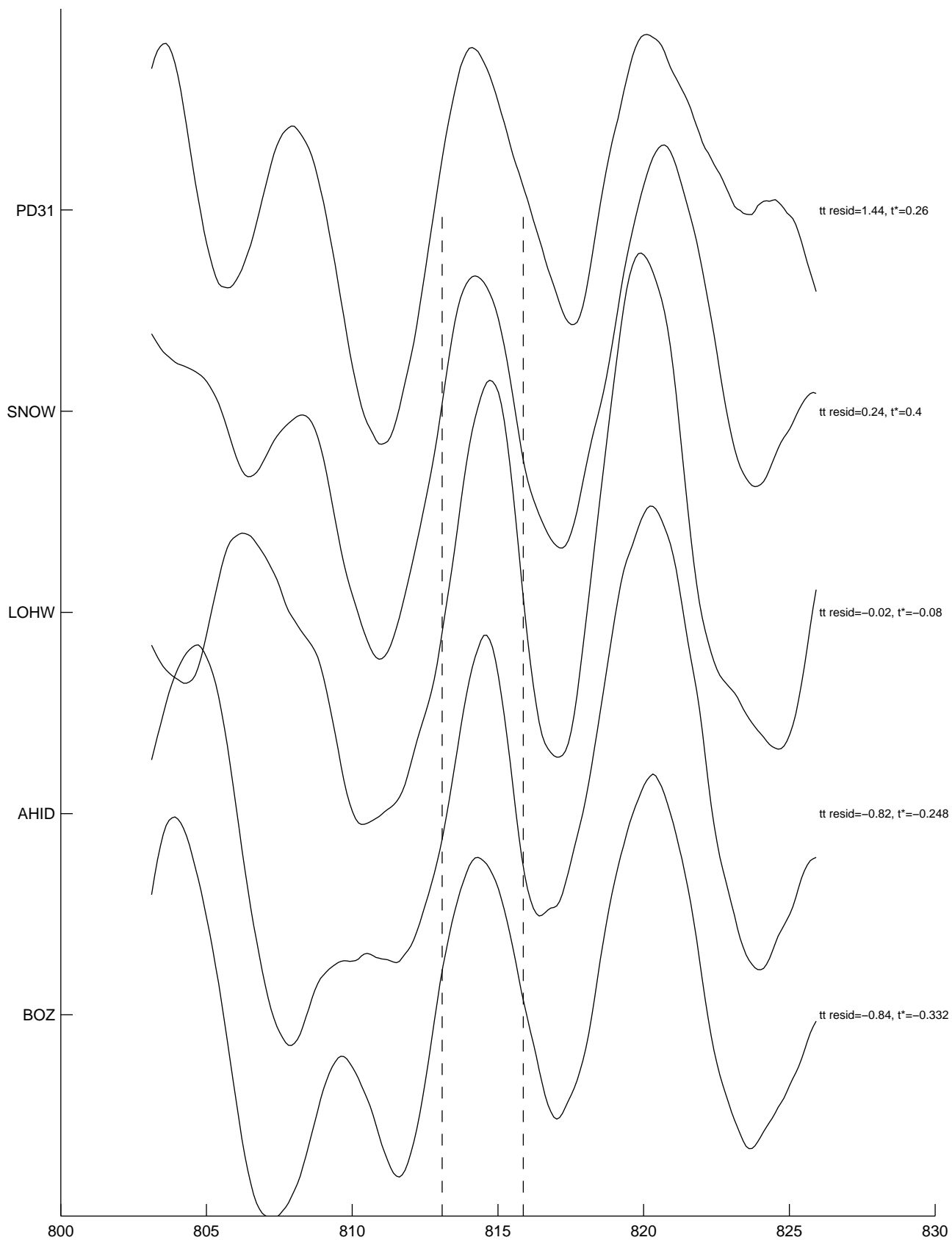
# Event\_2006\_023\_06\_02\_59



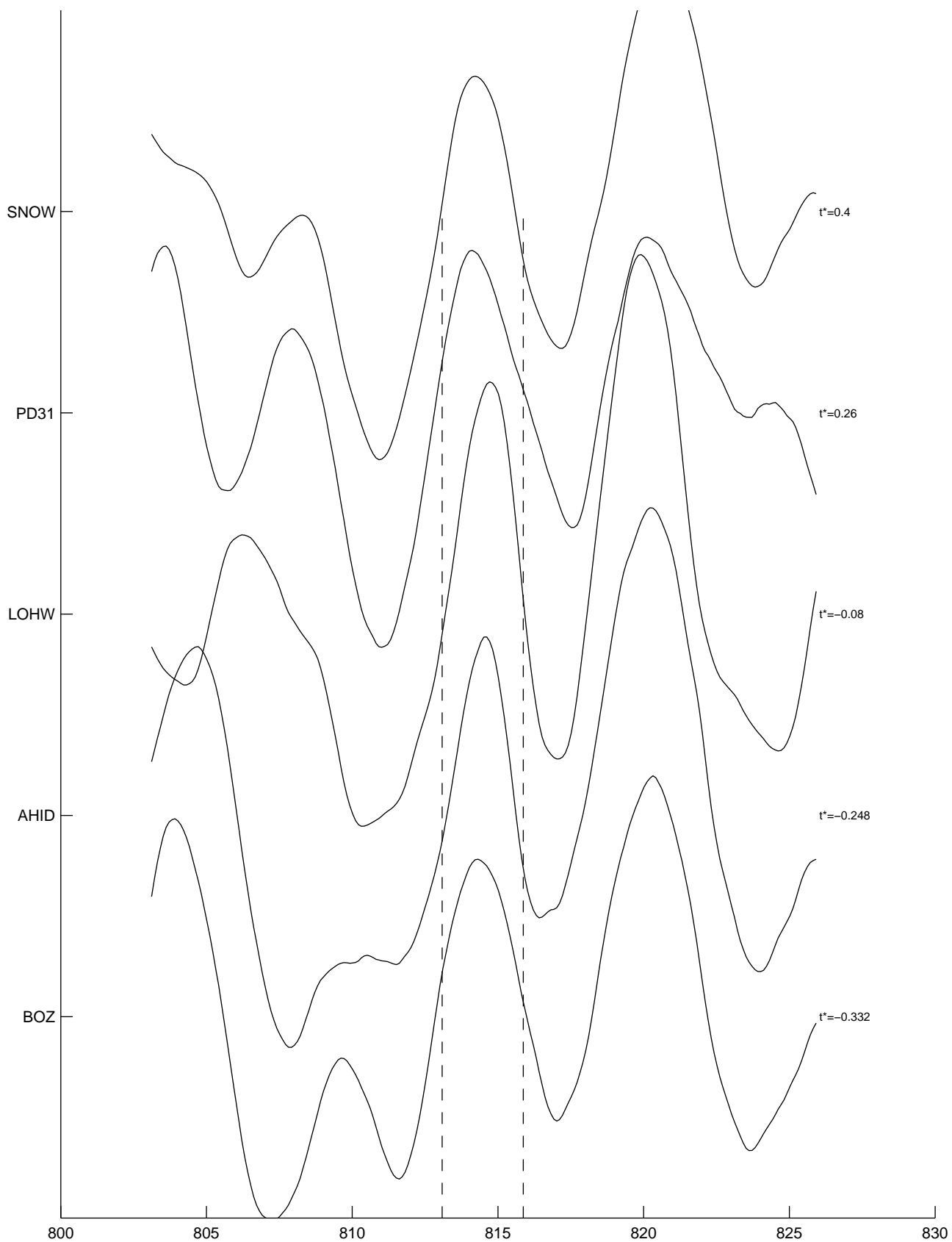
# Sorted by Delta:Event\_2006\_023\_06\_02\_59



# Sorted by travel time: Event\_2006\_023\_06\_02\_59



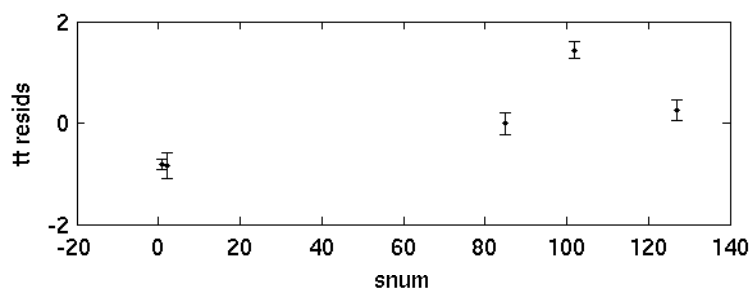
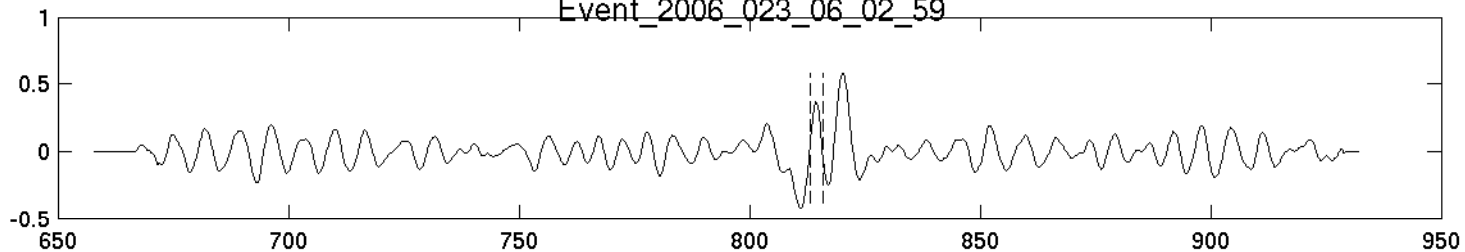
Sorted by t\*:Event\_2006\_023\_06\_02\_59



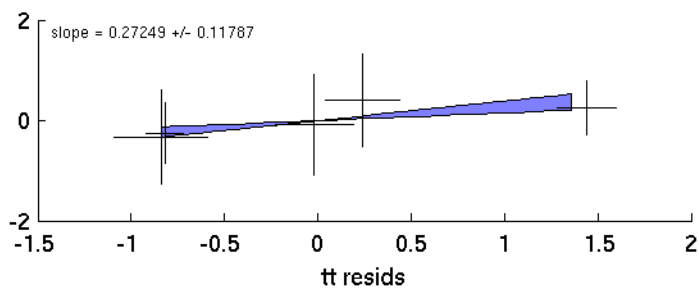
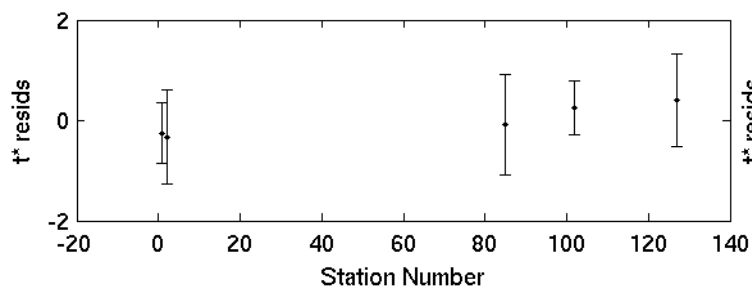


# Event\_2006\_023\_06\_02\_59

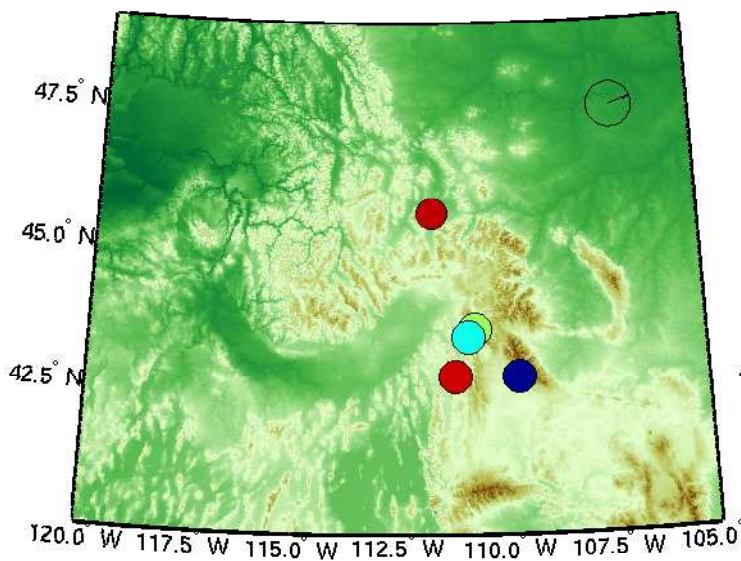
Stack



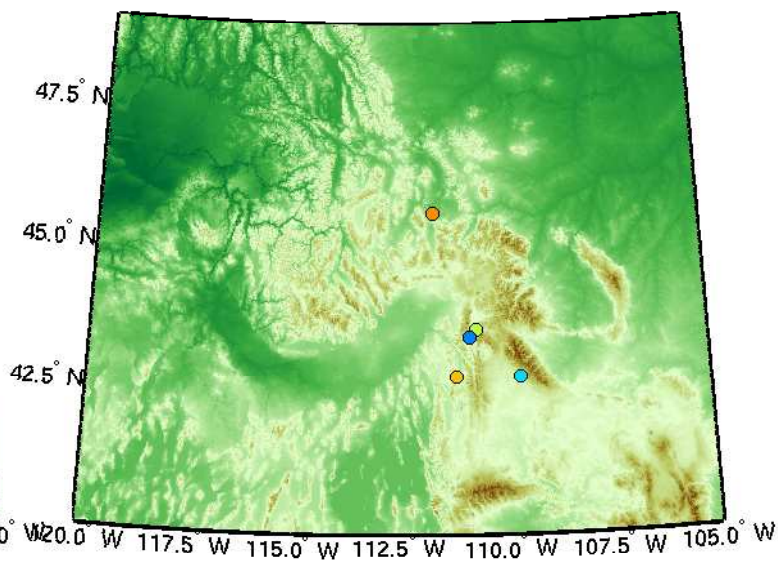
Baz = 251.1704  
Mean xcor value = 0.644  
Range of  $t^*$  values is 0.732  
Median  $t^*$  err is 0.92836  
Slope = 0.27249 +/- 0.11787



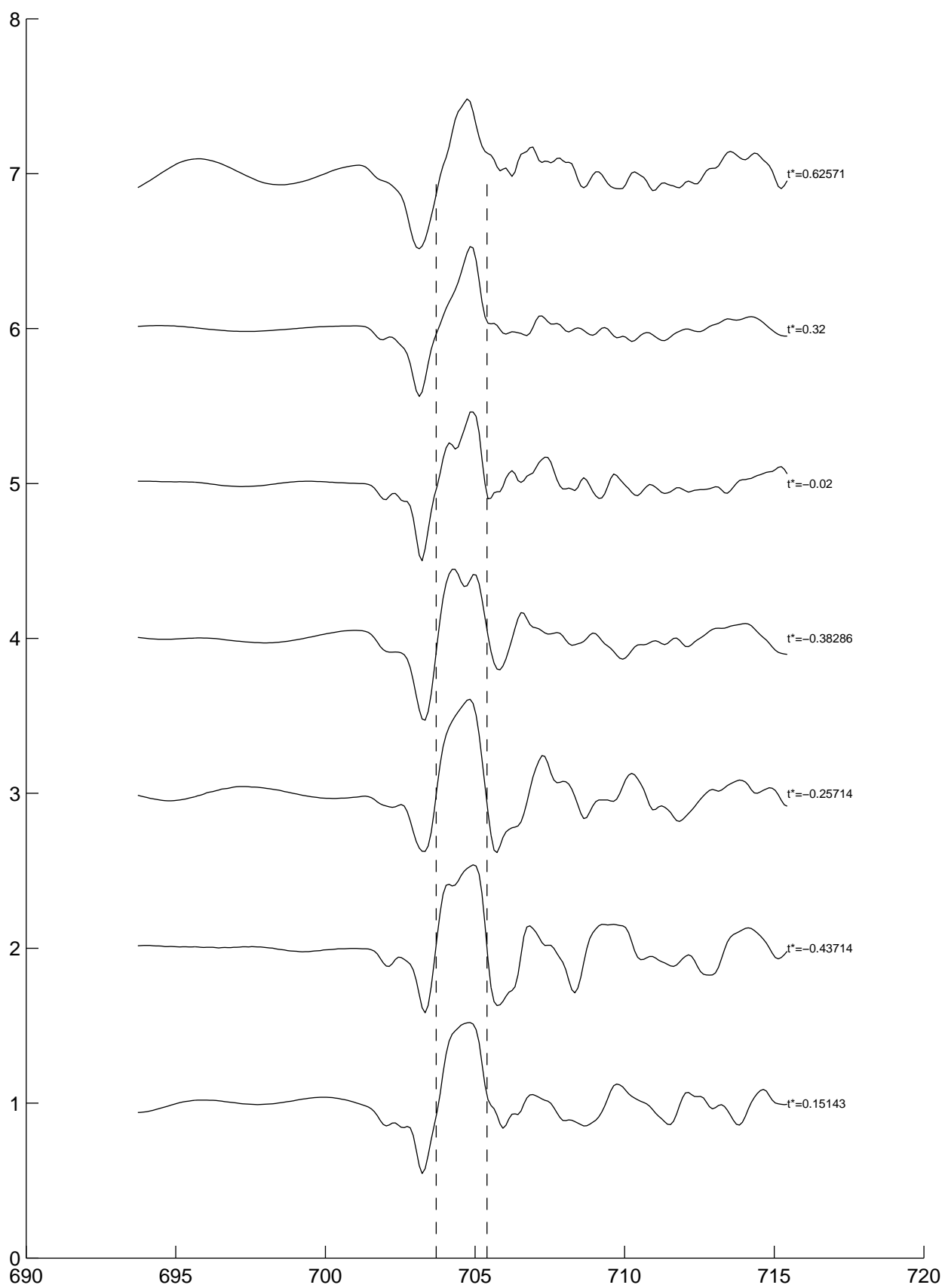
travel time residuals



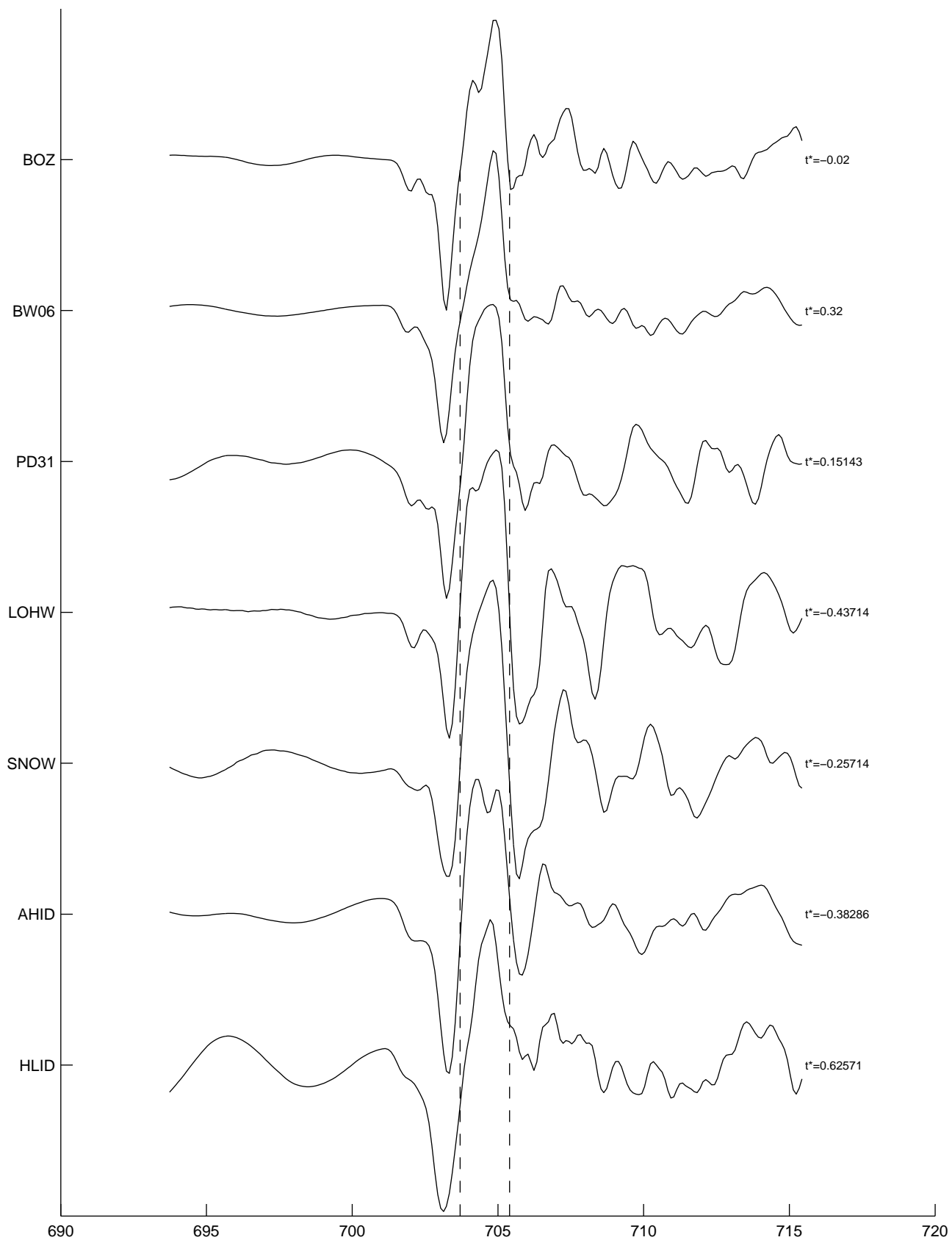
$t^*$  values



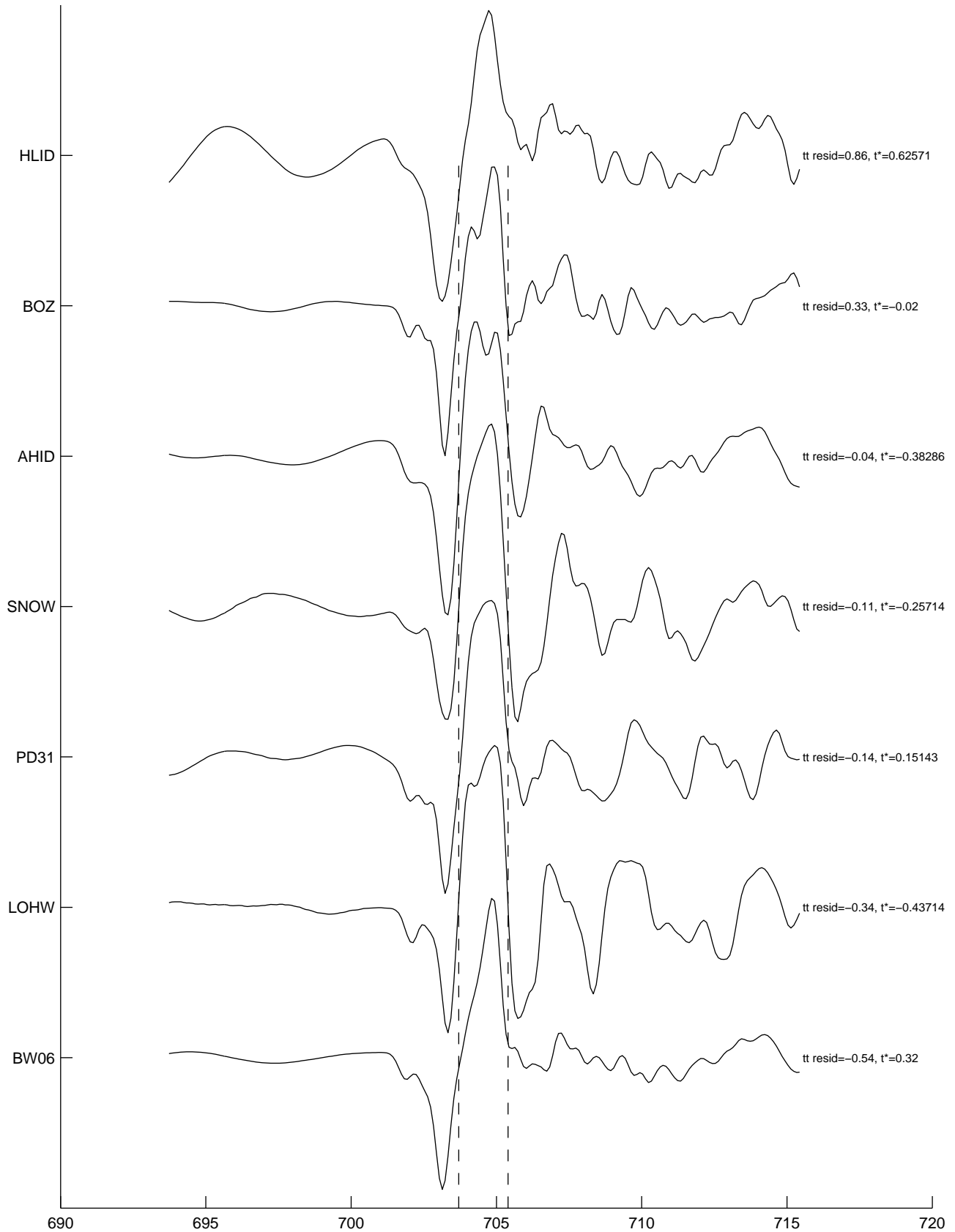
# Event\_2006\_033\_12\_48\_43



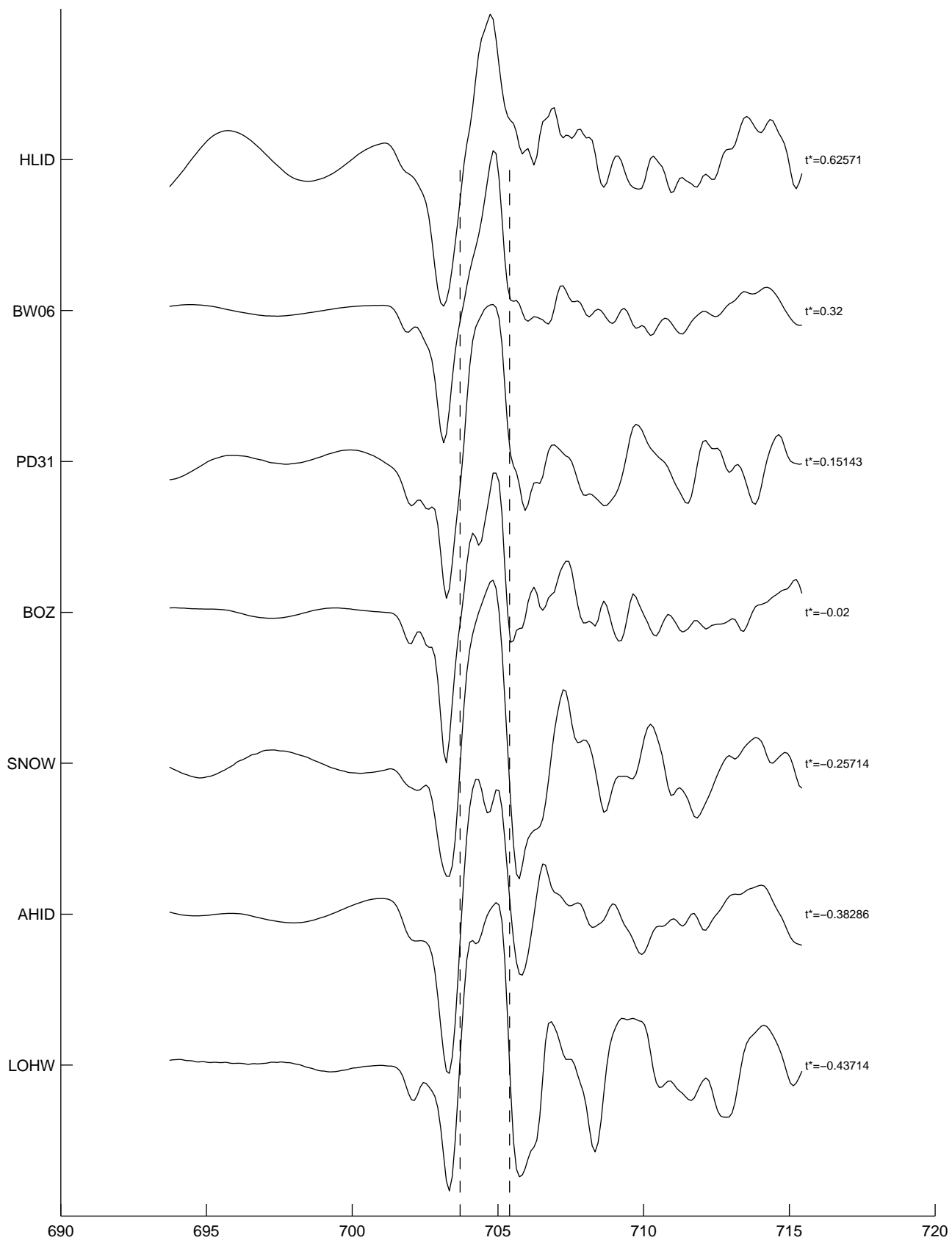
# Sorted by Delta:Event\_2006\_033\_12\_48\_43



# Sorted by travel time:Event\_2006\_033\_12\_48\_43

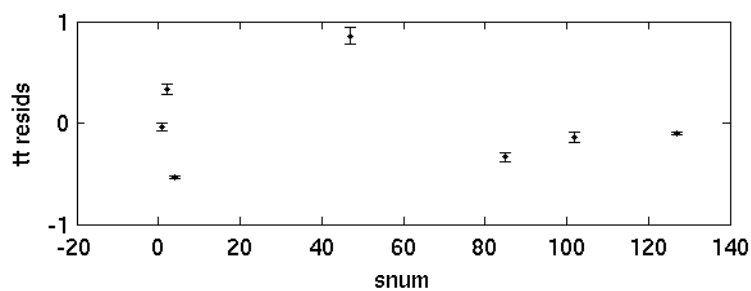
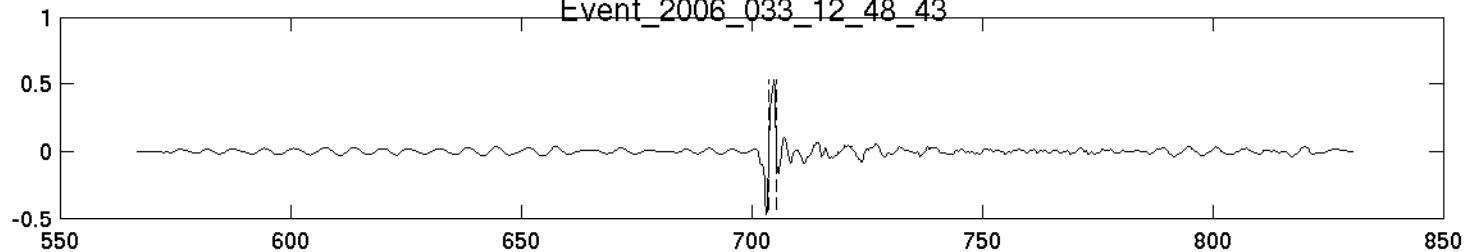


Sorted by  $t^*$ :Event\_2006\_033\_12\_48\_43

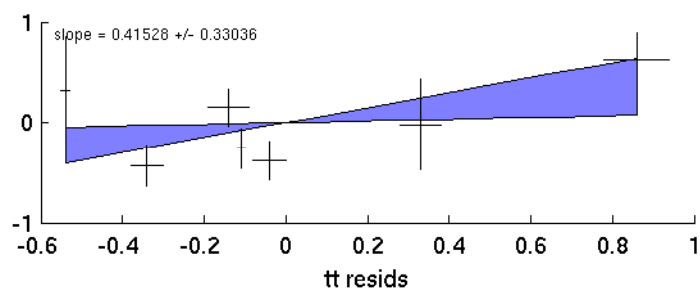
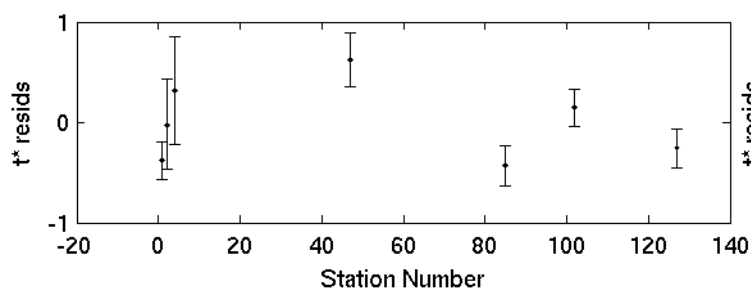


# Event\_2006\_033\_12\_48\_43

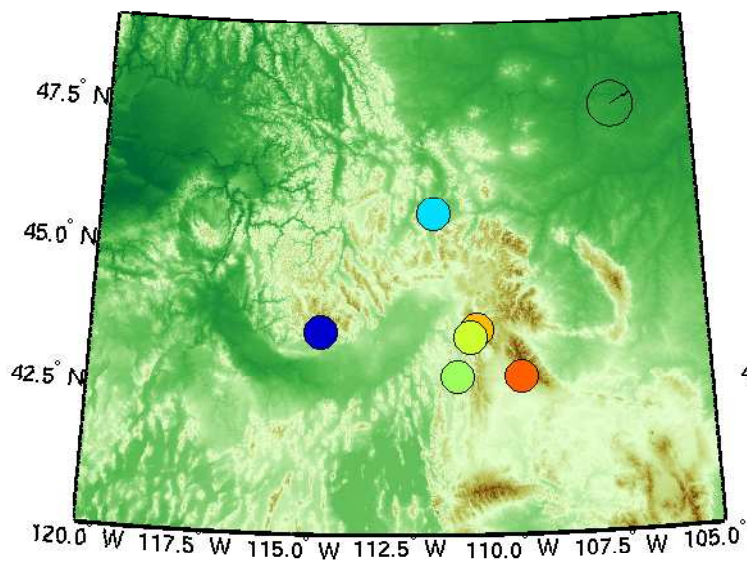
Stack



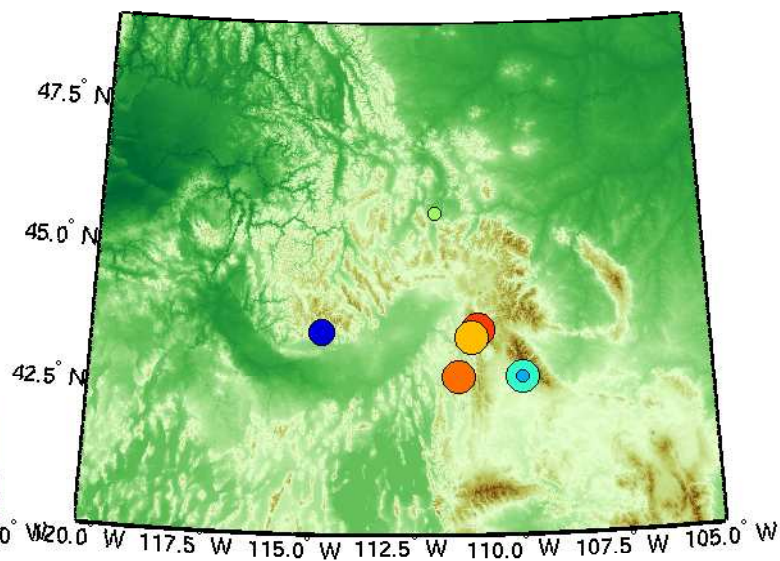
Baz = 241.444  
Mean xcor value = 0.67286  
Range of  $t^*$  values is 1.0629  
Median  $t^*$  err is 0.20509  
Slope = 0.41528 +/- 0.33036



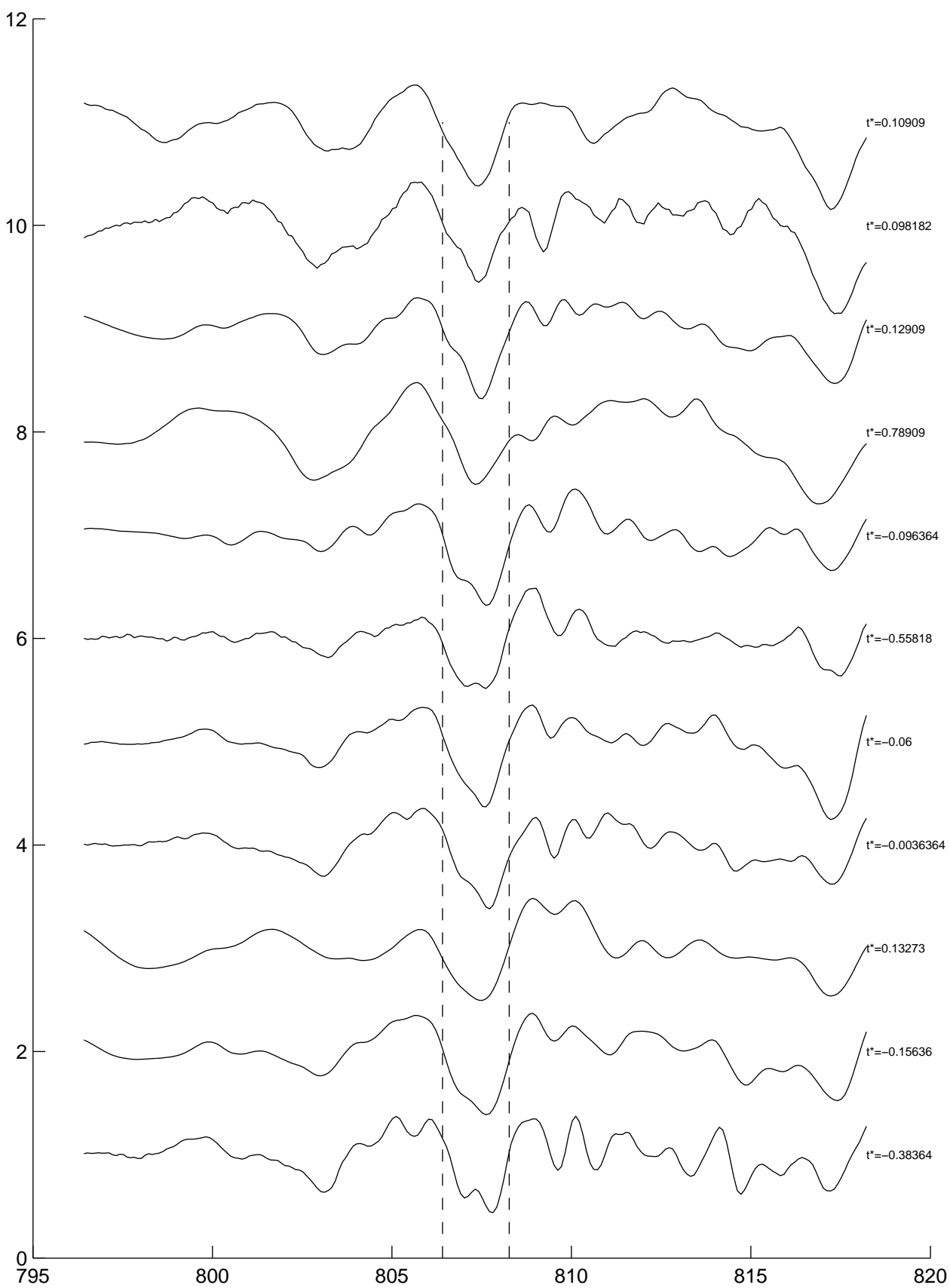
travel time residuals



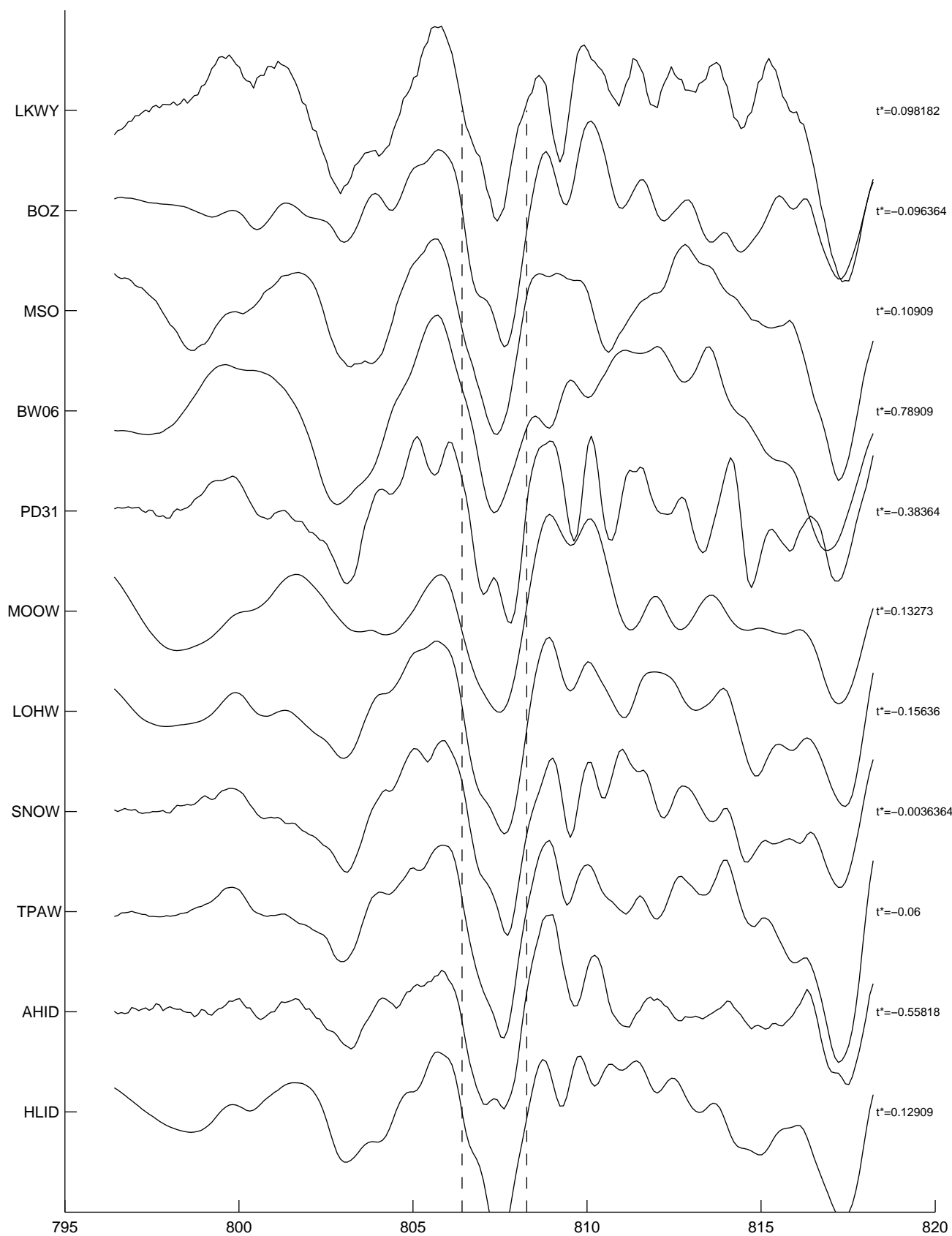
$t^*$  values



# Event\_2006\_090\_13\_21\_00

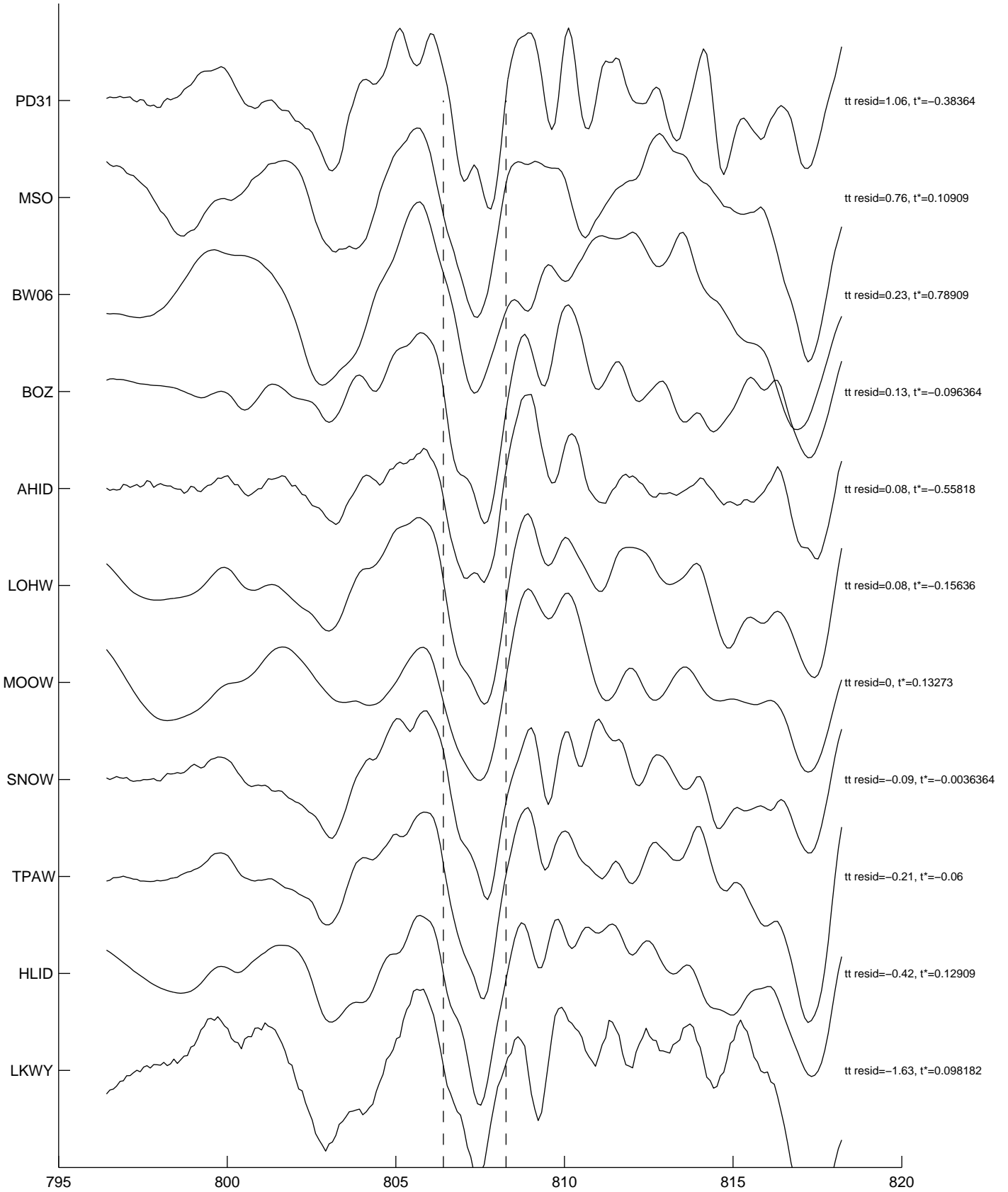


# Sorted by Delta:Event\_2006\_090\_13\_21\_00

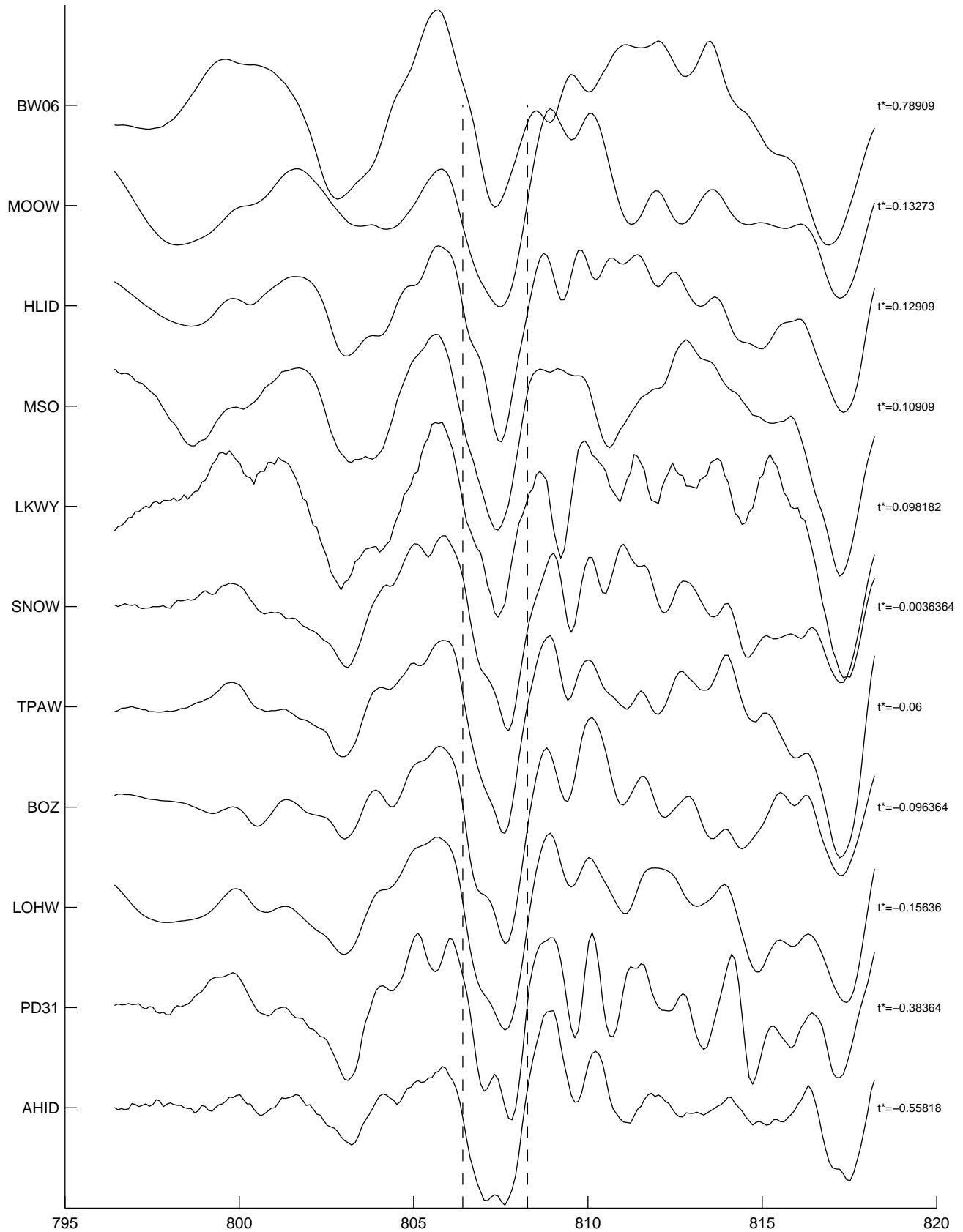




# Sorted by travel time:Event\_2006\_090\_13\_21\_00

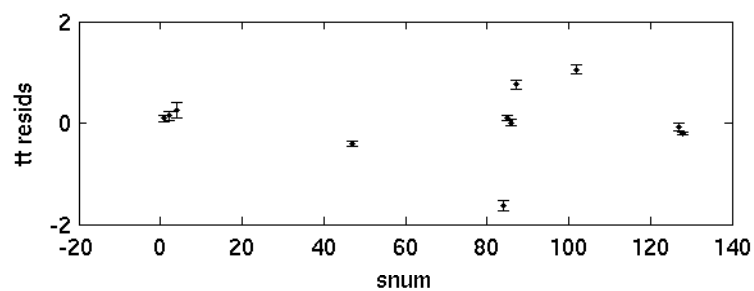
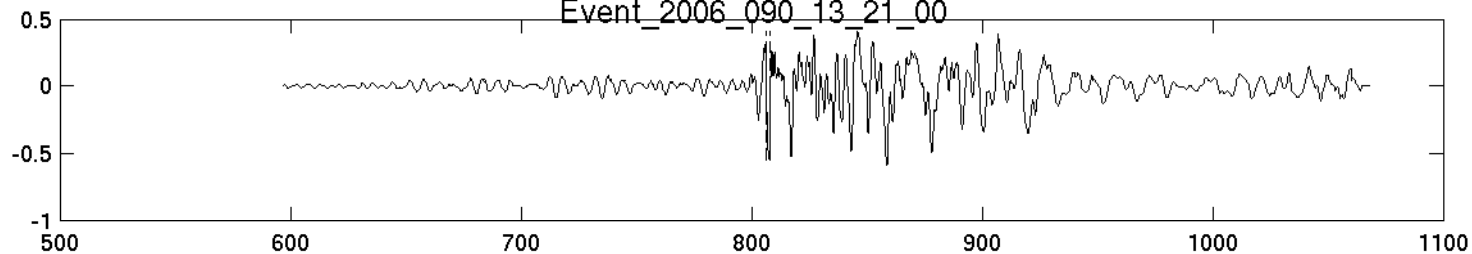


Sorted by  $t^*$ :Event\_2006\_090\_13\_21\_00

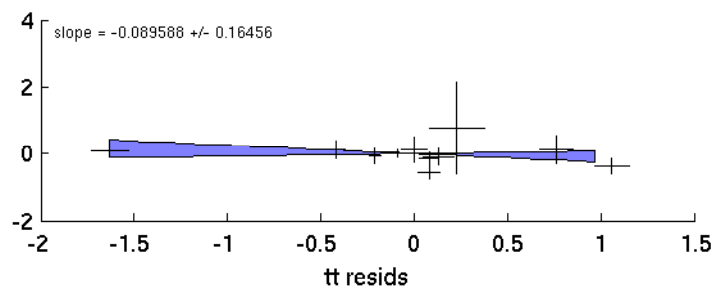
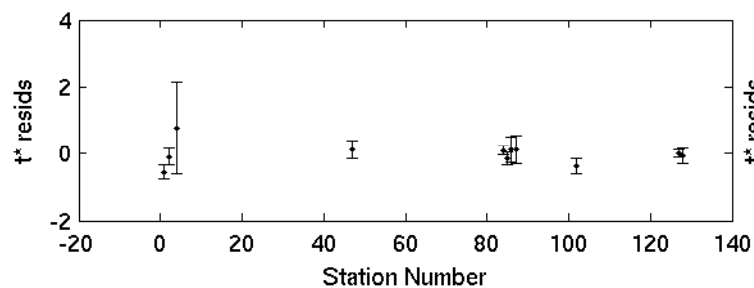


# Event\_2006\_090\_13\_21\_00

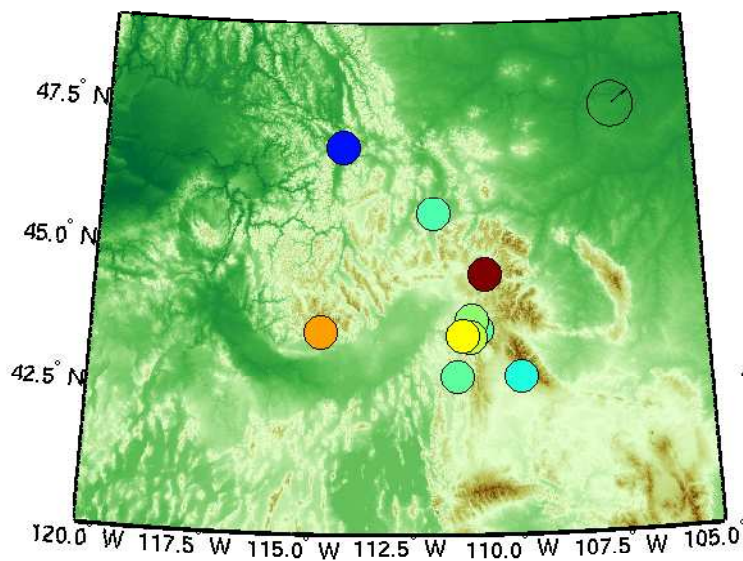
Stack



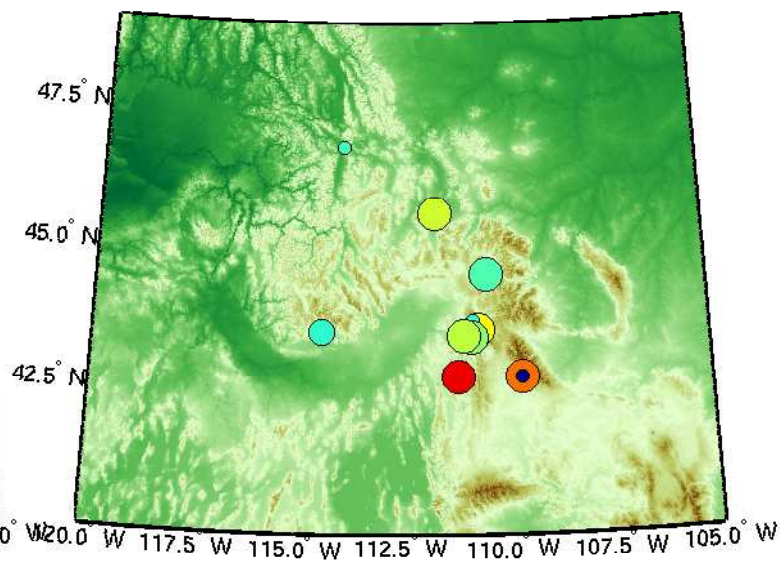
Baz = 232.598  
Mean xcor value = 0.72364  
Range of  $t^*$  values is 1.3473  
Median  $t^*$  err is 0.23776  
Slope =  $-0.089588 \pm 0.16456$



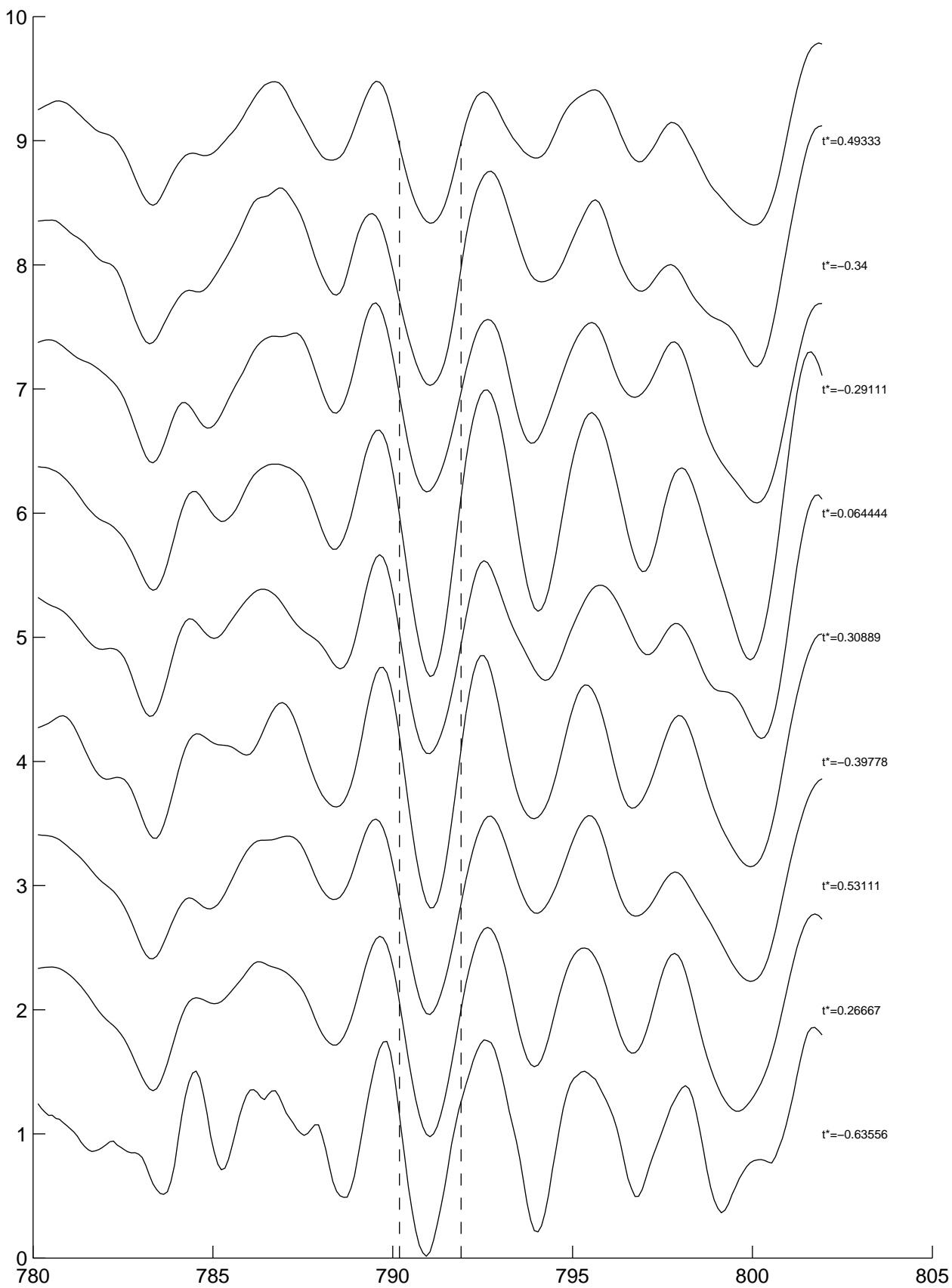
travel time residuals



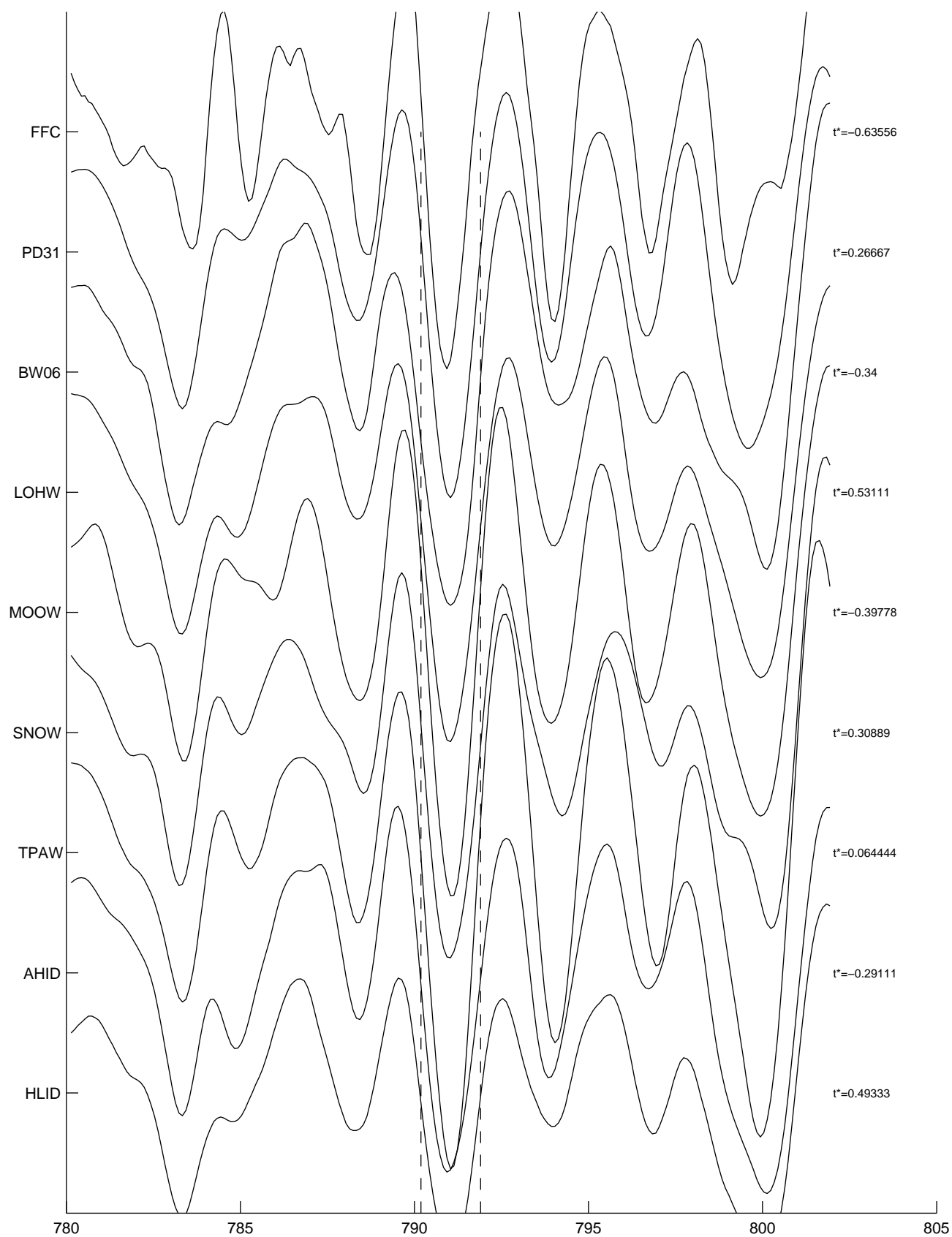
$t^*$  values



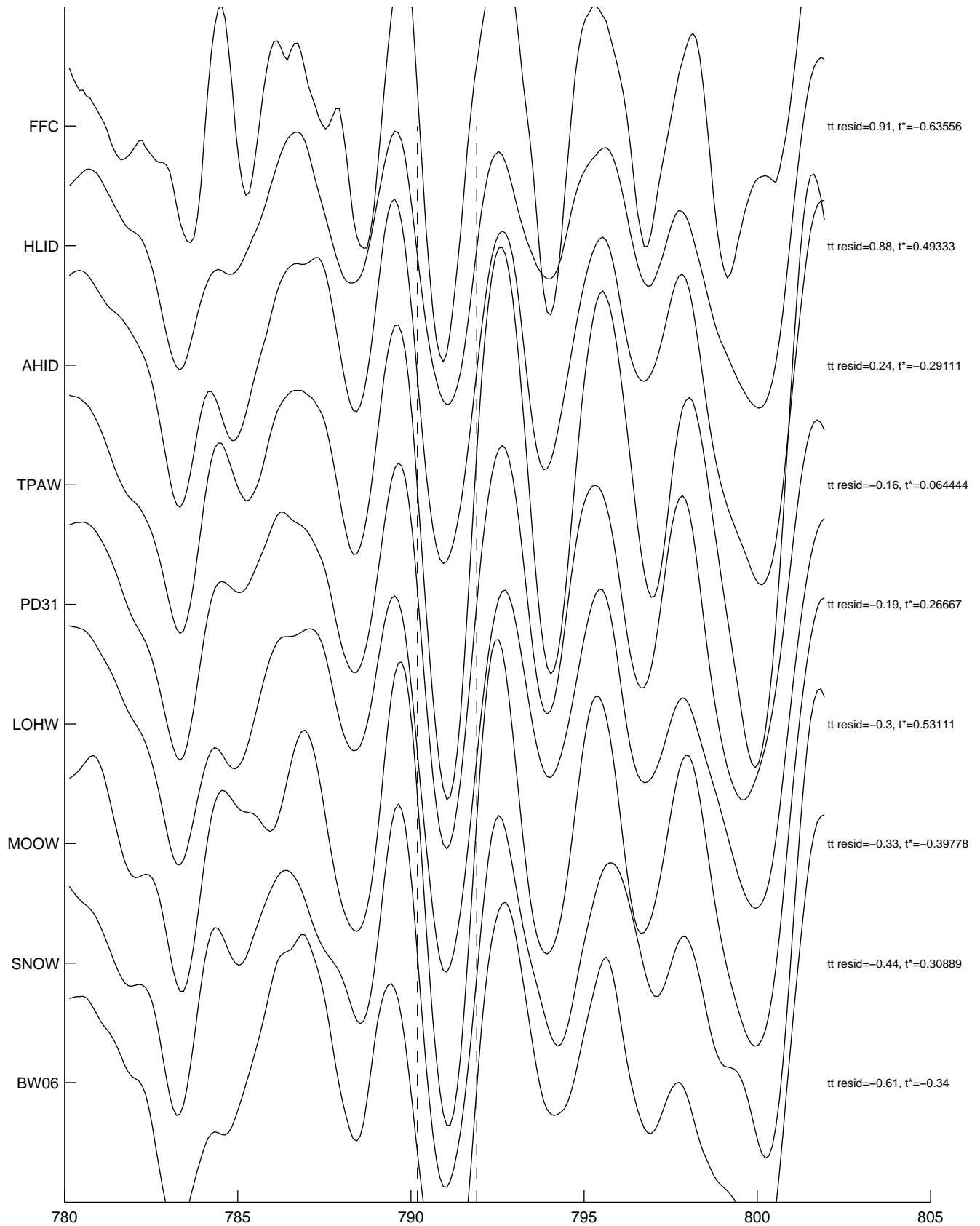
# Event\_2006\_097\_08\_30\_45



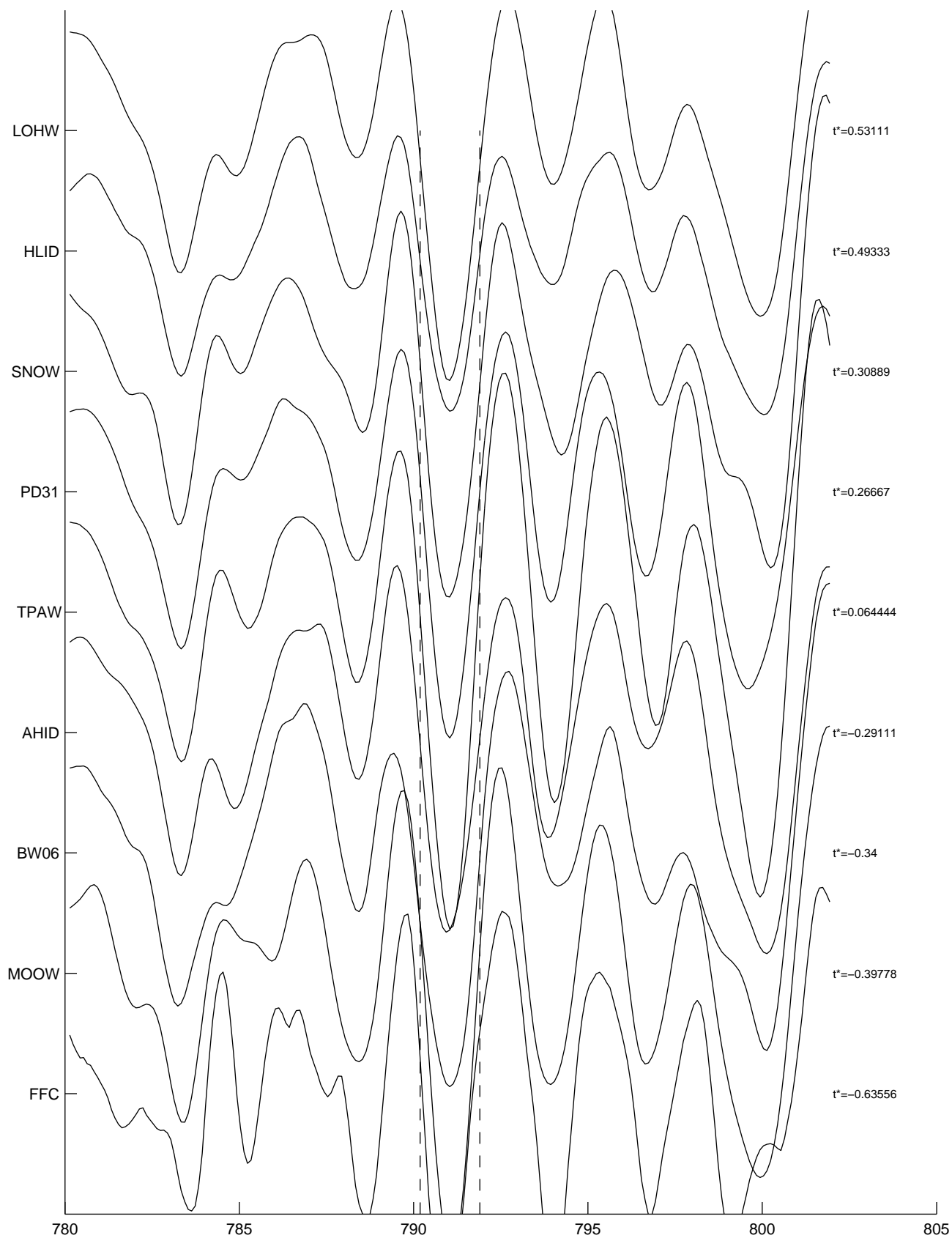
# Sorted by Delta:Event\_2006\_097\_08\_30\_45



# Sorted by travel time:Event\_2006\_097\_08\_30\_45

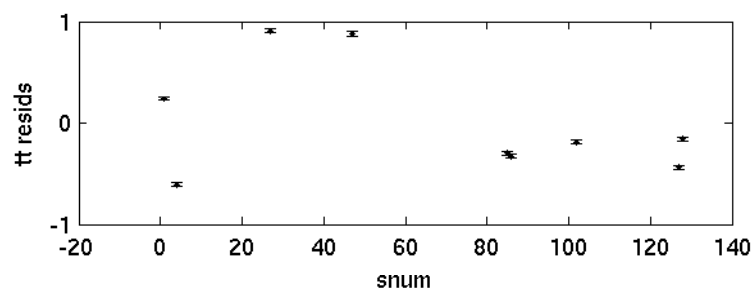
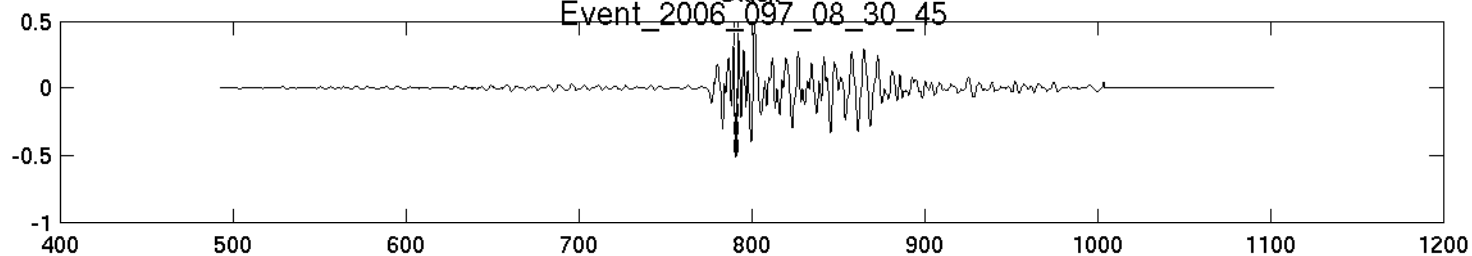


Sorted by  $t^*$ :Event\_2006\_097\_08\_30\_45

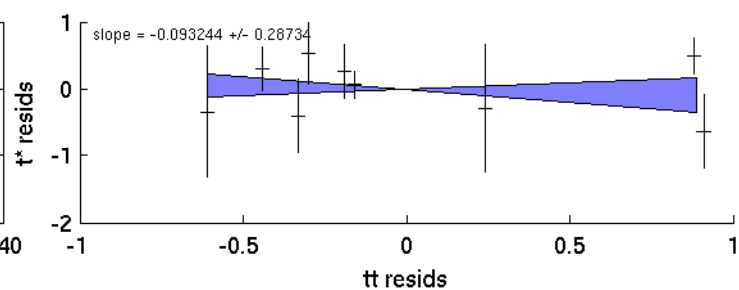
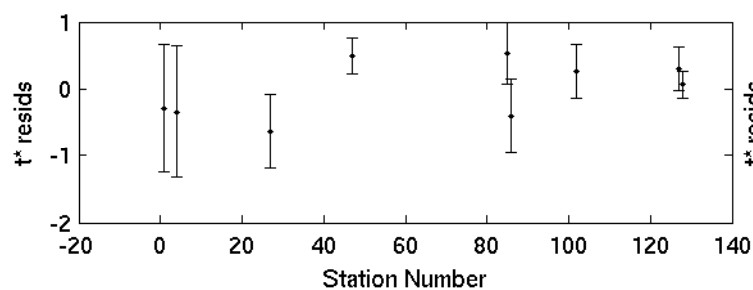


Event\_2006\_097\_08\_30\_45

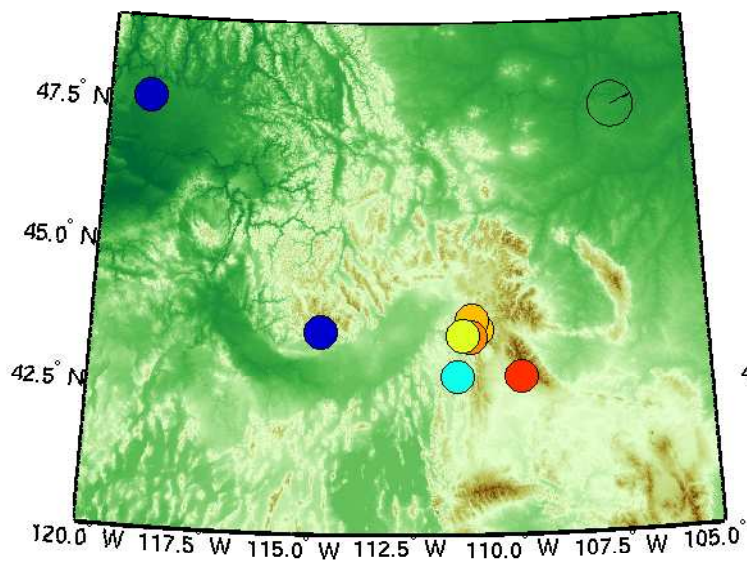
Stack



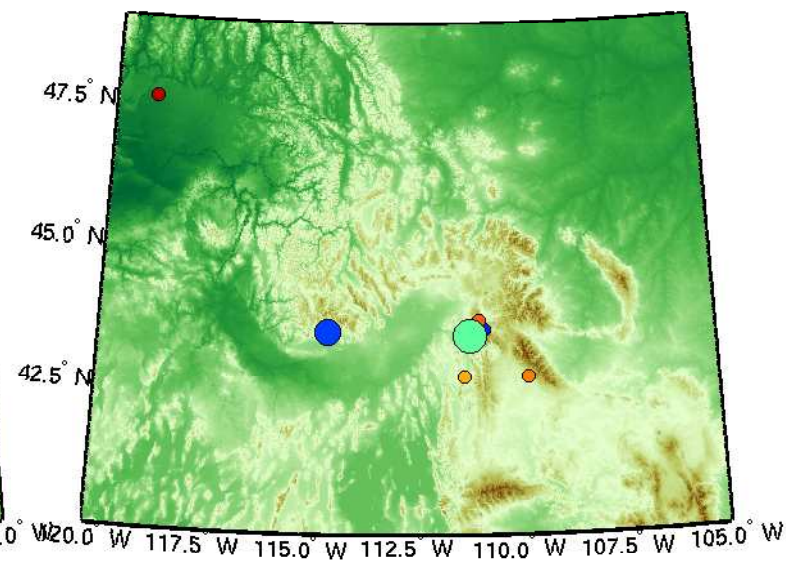
Baz = 246.3103  
Mean xcor value = 0.82556  
Range of  $t^*$  values is 1.1667  
Median  $t^*$  err is 0.46108  
Slope =  $-0.093244 \pm 0.28734$



travel time residuals

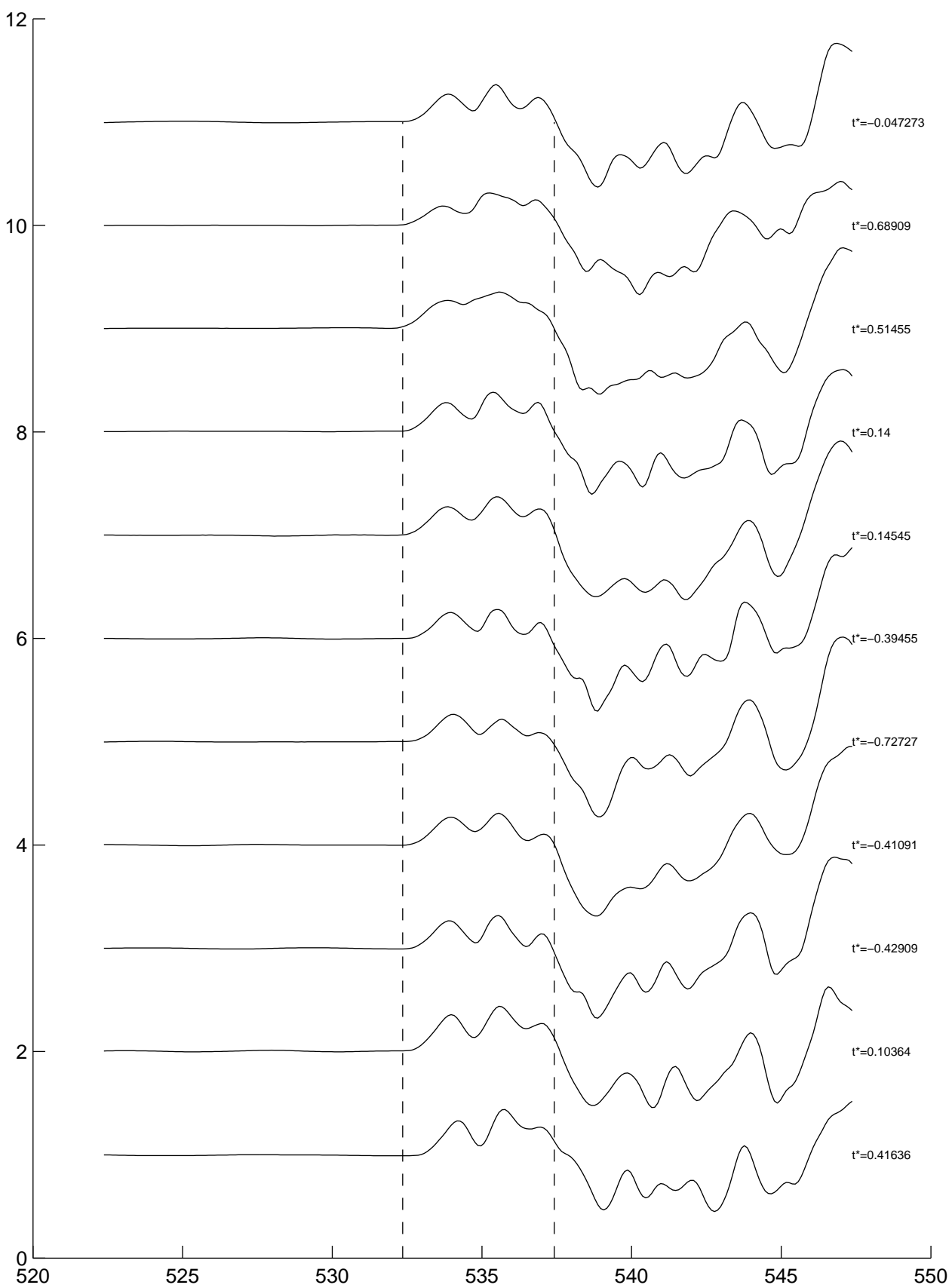


$t^*$  values

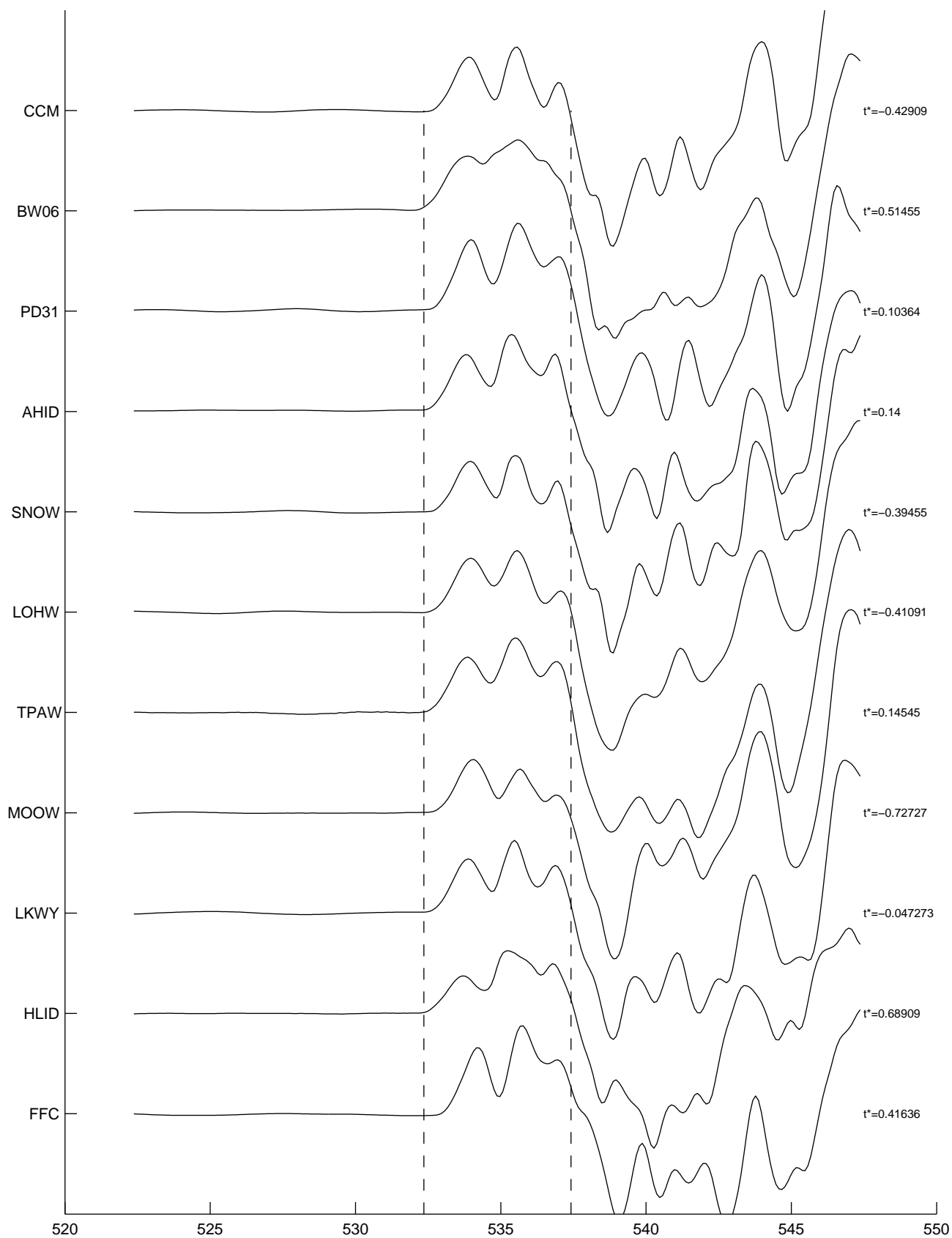




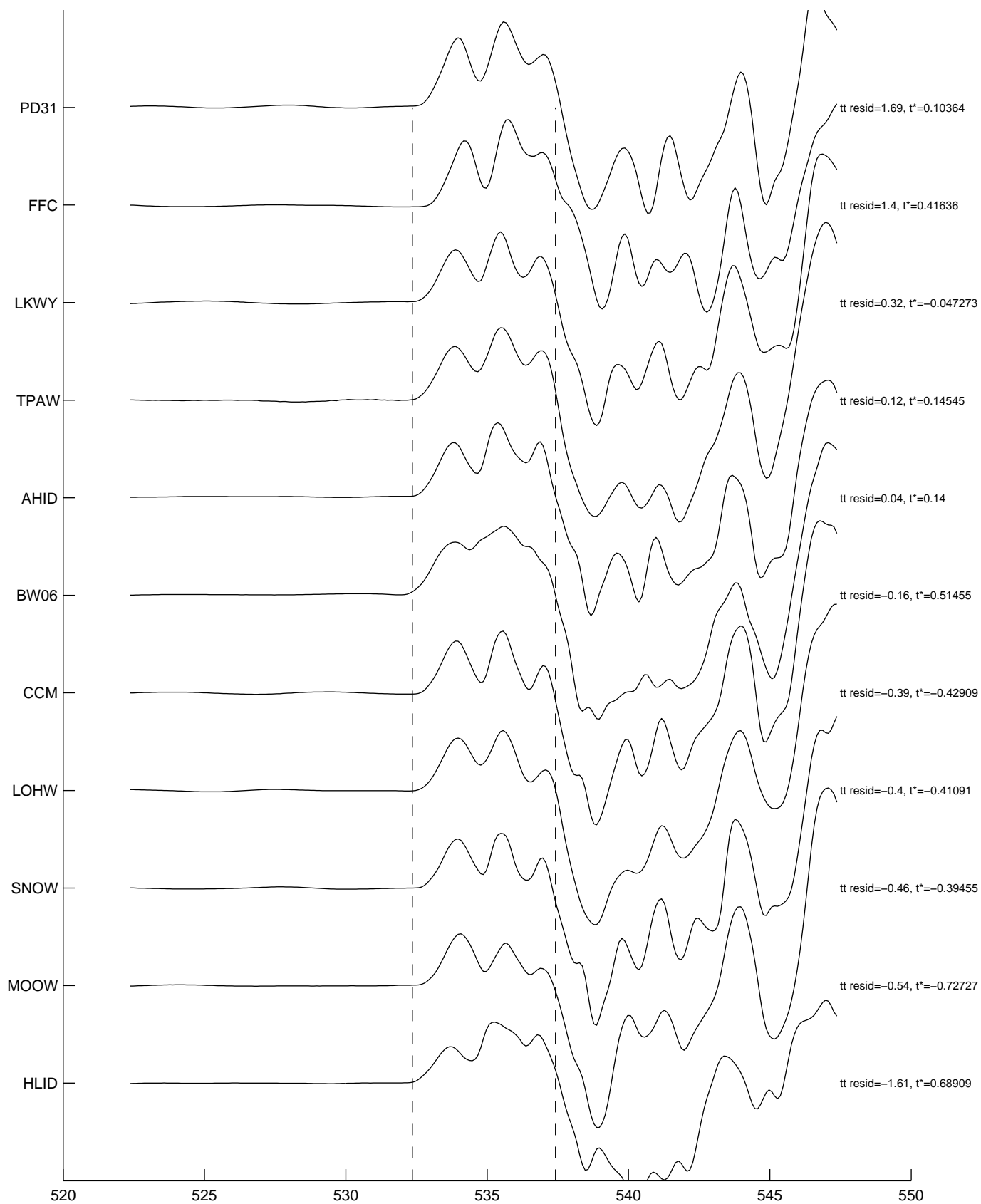
# Event\_2006\_110\_23\_25\_02



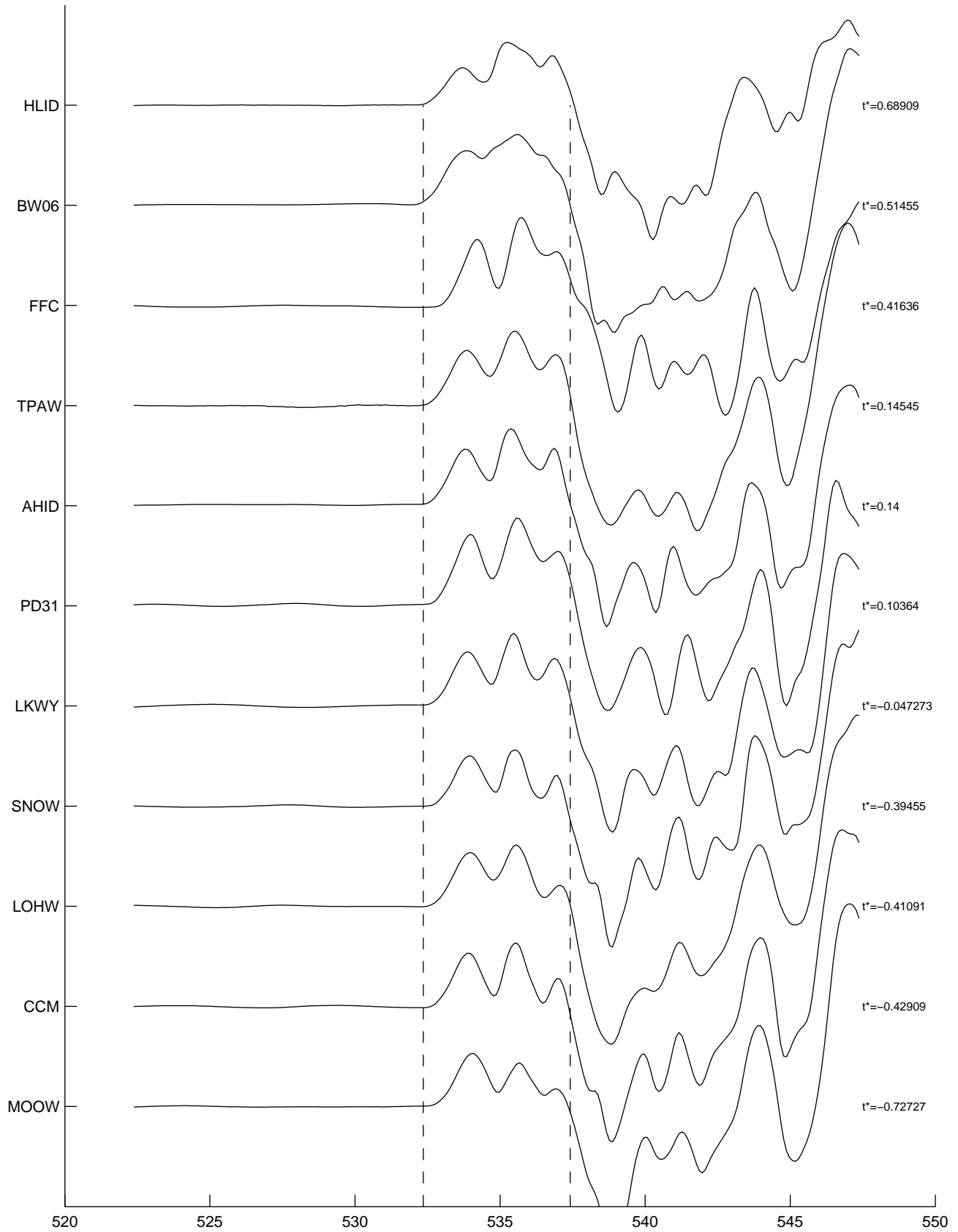
# Sorted by Delta:Event\_2006\_110\_23\_25\_02



# Sorted by travel time:Event\_2006\_110\_23\_25\_02

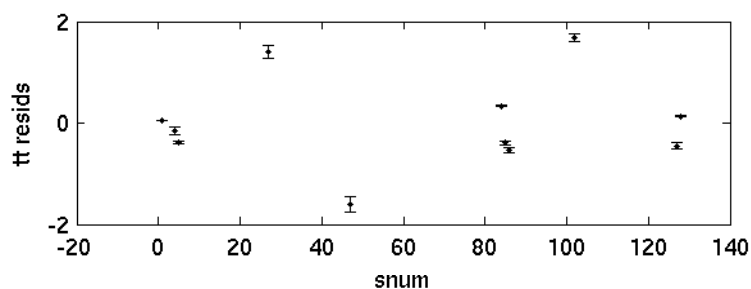
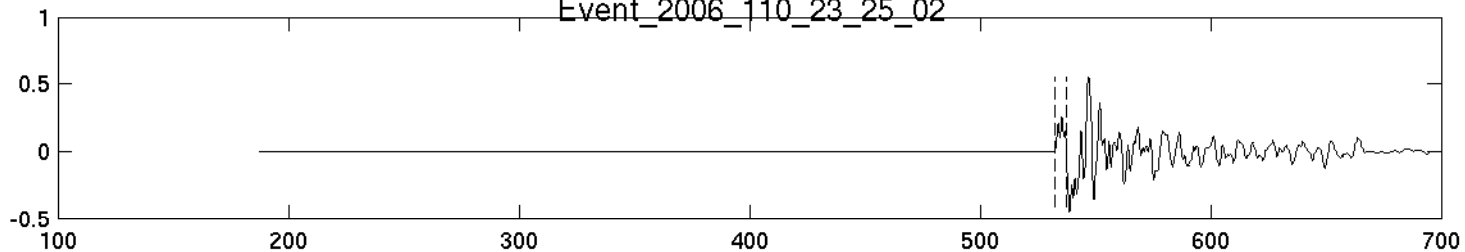


Sorted by  $t^*$ :Event\_2006\_110\_23\_25\_02

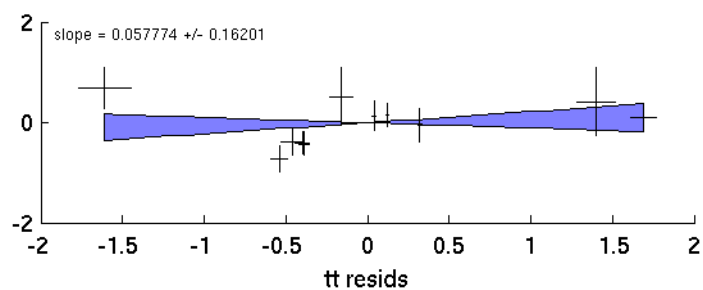
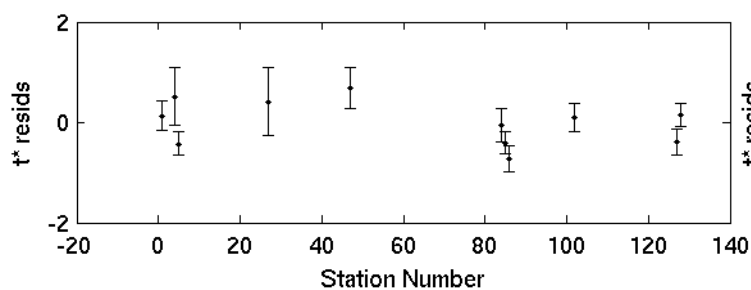


# Event\_2006\_10\_23\_25\_02

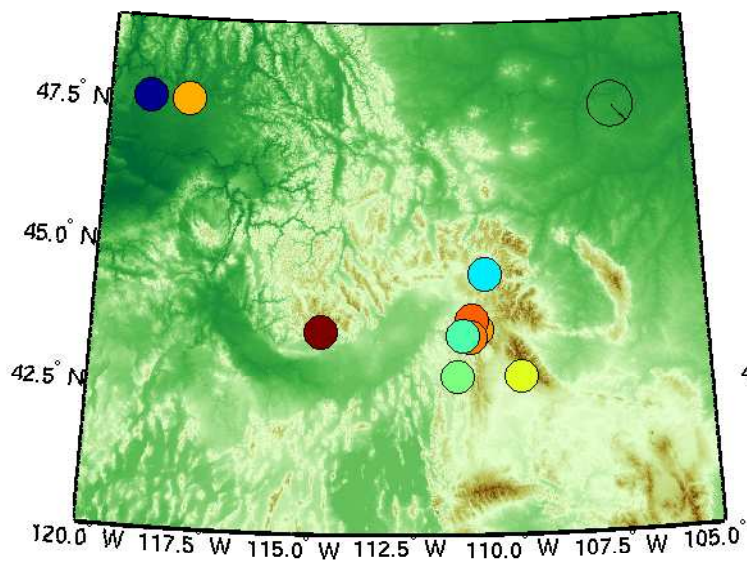
Stack



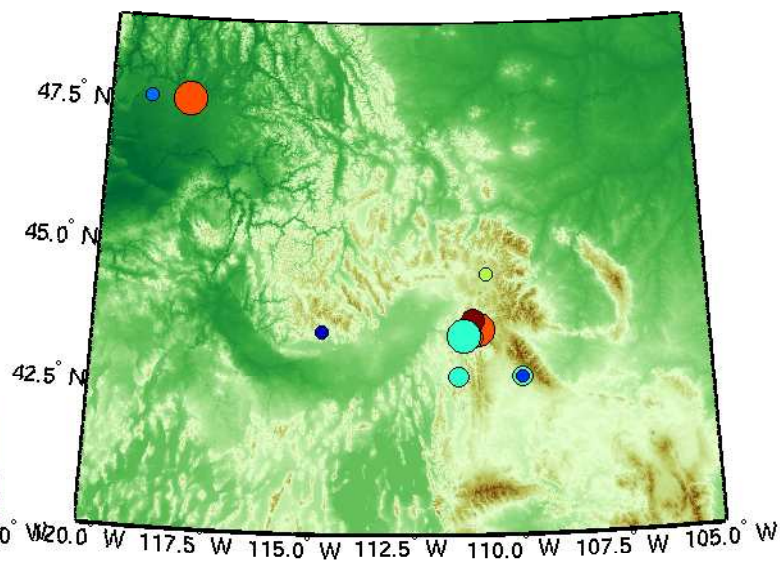
Baz = 320.7419  
Mean xcor value = 0.81636  
Range of  $t^*$  values is 1.4164  
Median  $t^*$  err is 0.29069  
Slope = 0.057774 +/- 0.16201



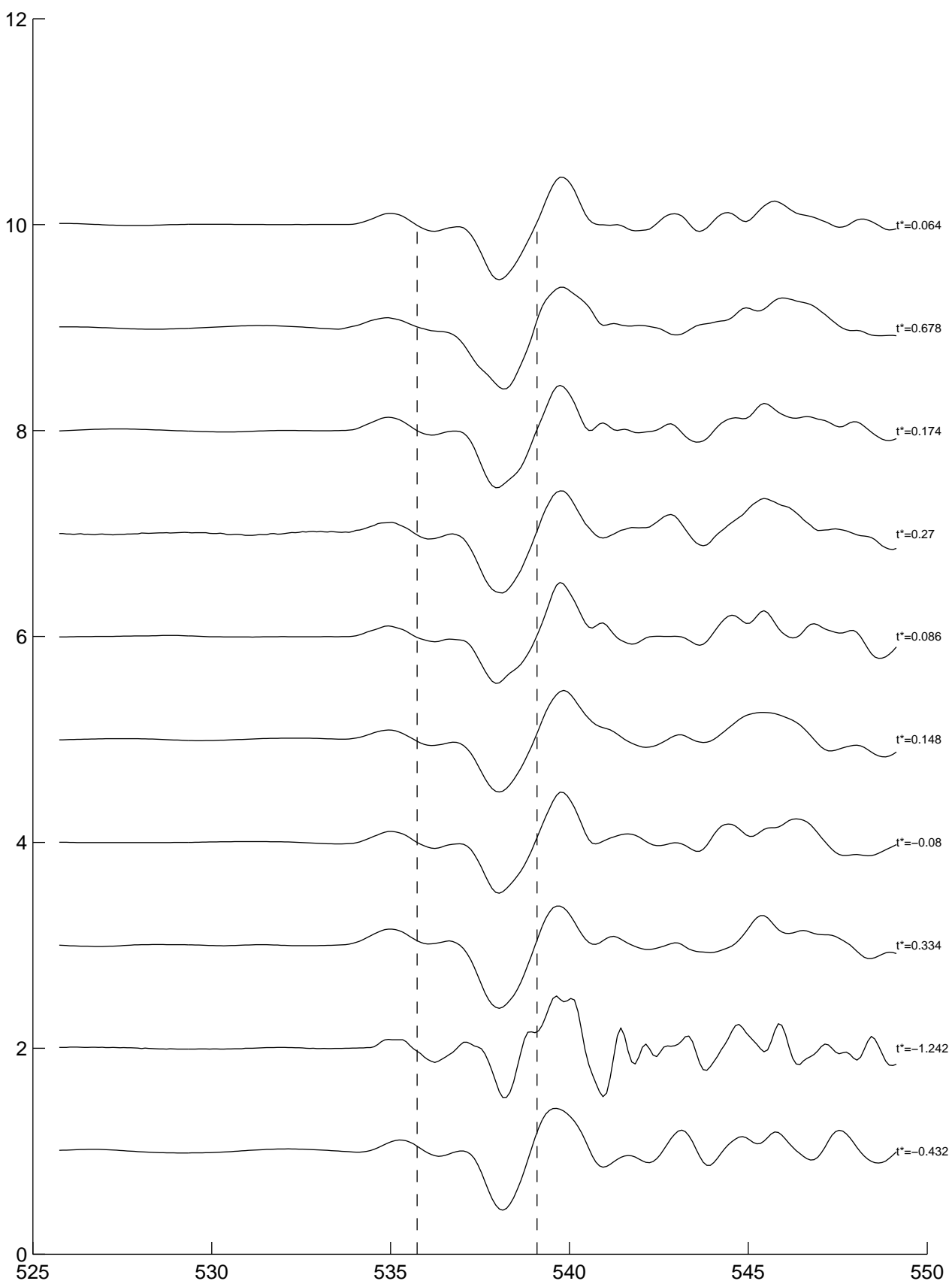
travel time residuals



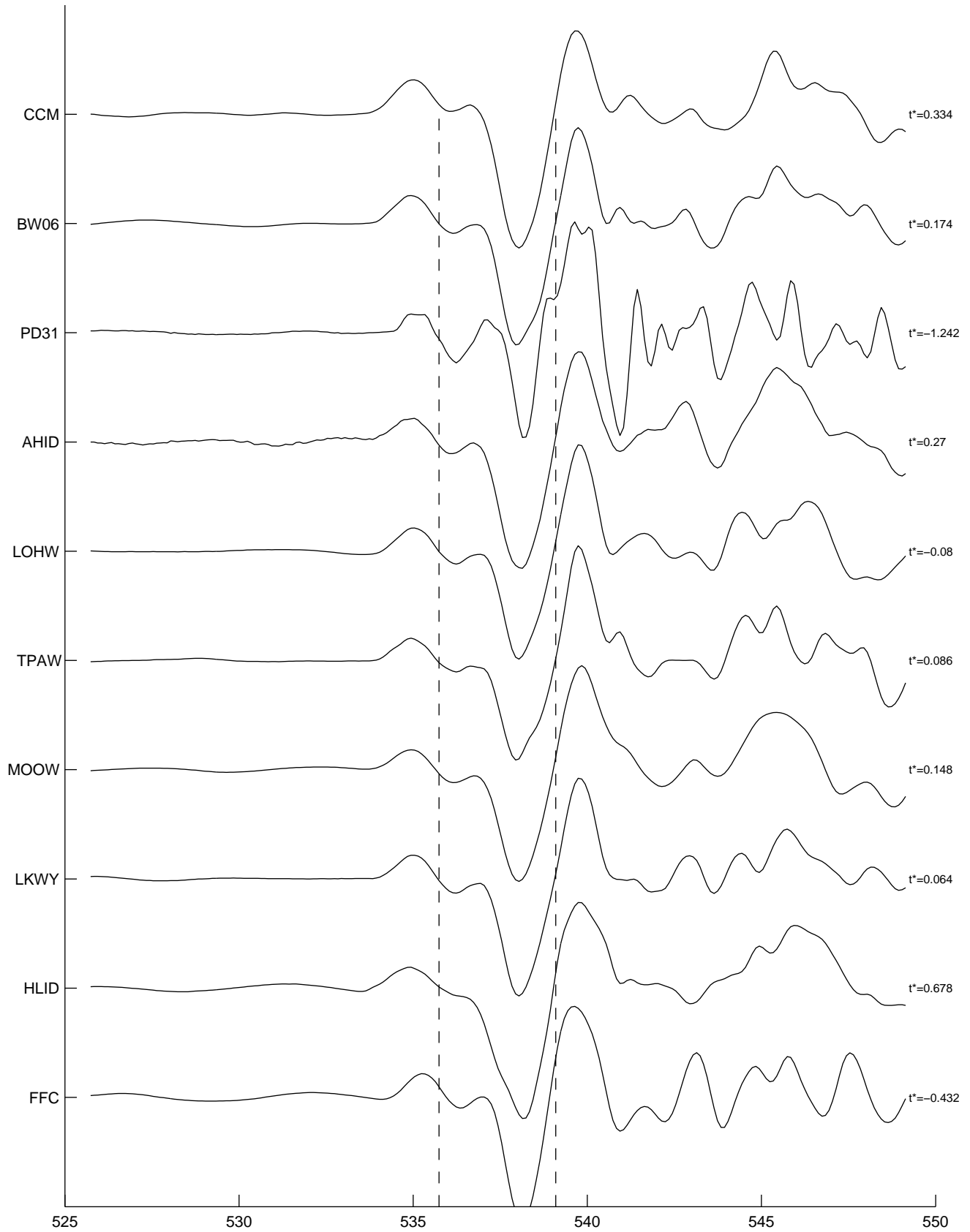
$t^*$  values



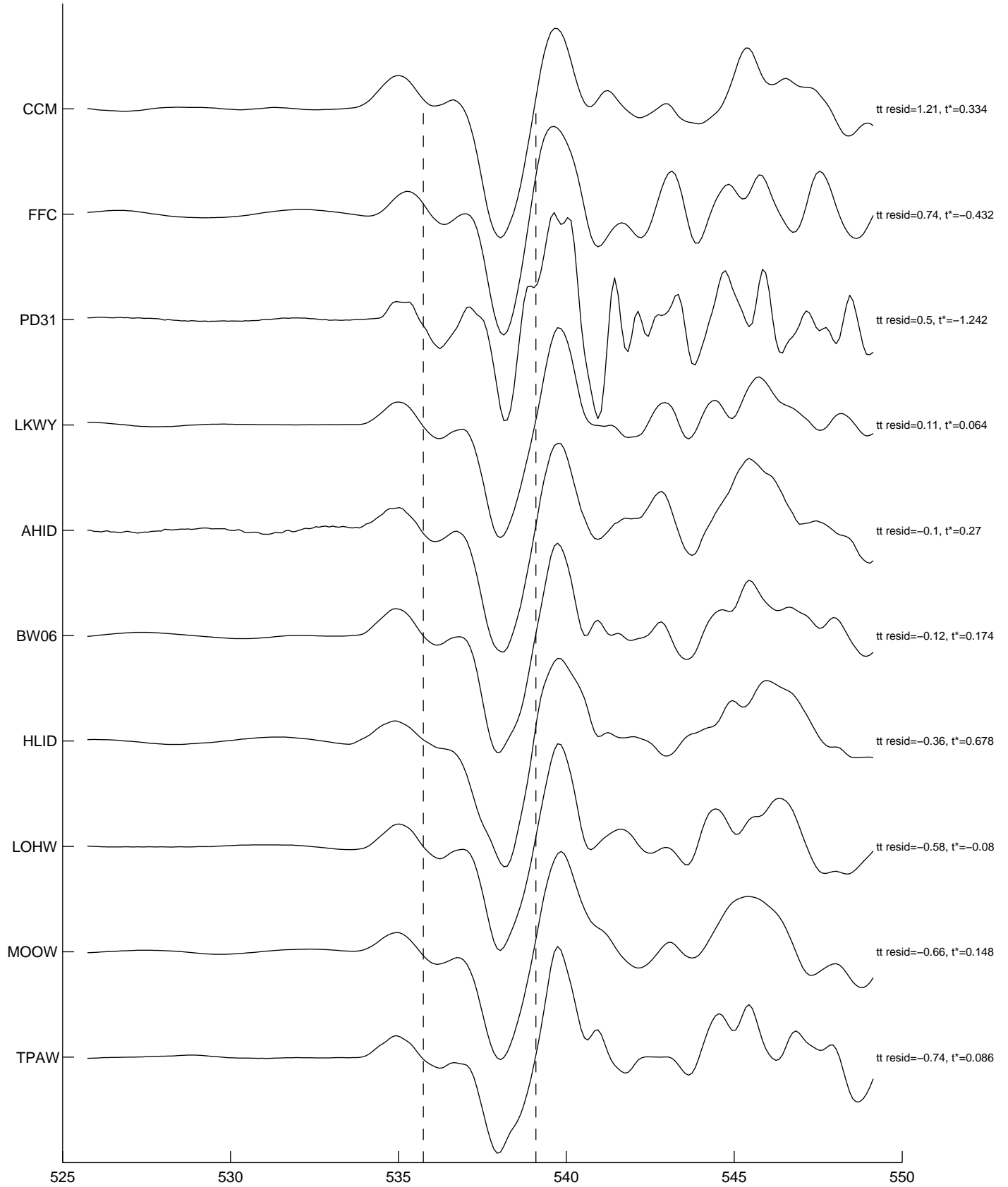
# Event\_2006\_119\_16\_58\_06



# Sorted by Delta:Event\_2006\_119\_16\_58\_06

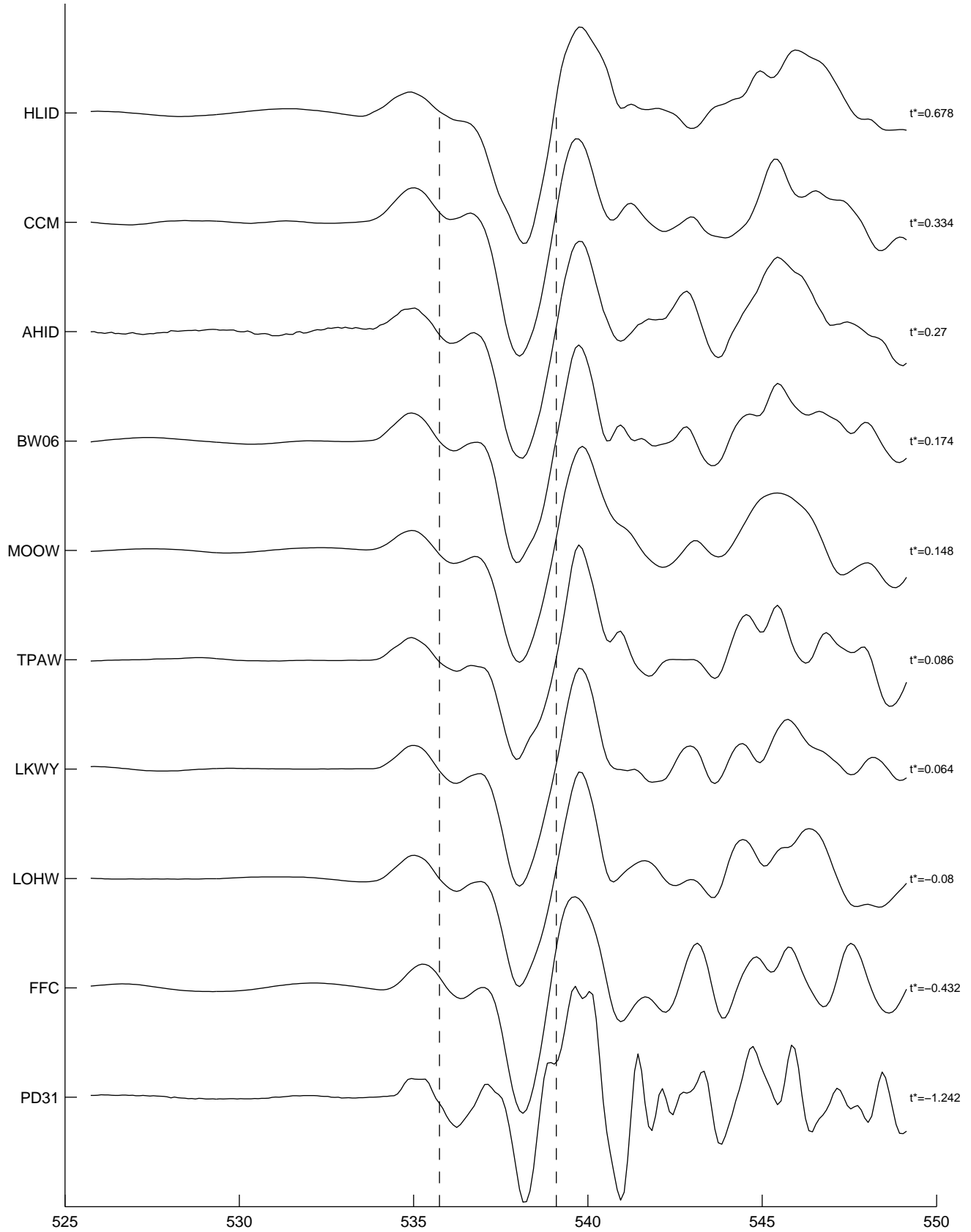


# Sorted by travel time:Event\_2006\_119\_16\_58\_06



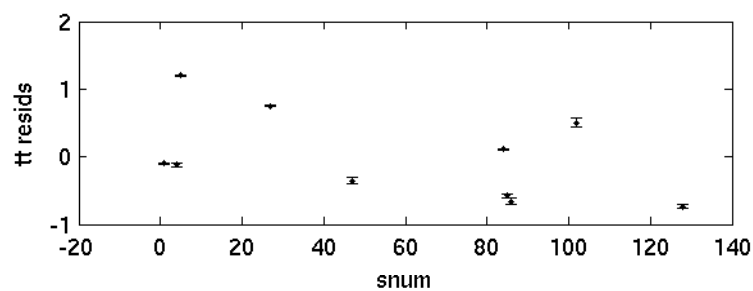
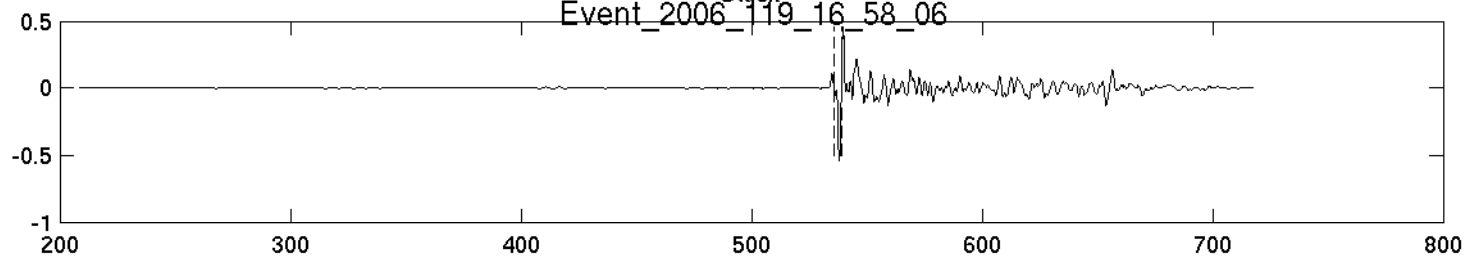


Sorted by  $t^*$ :Event\_2006\_119\_16\_58\_06

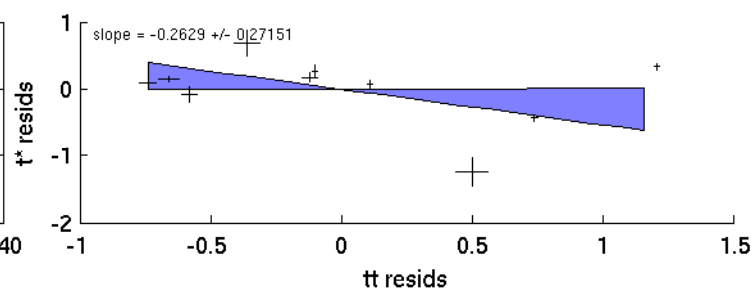
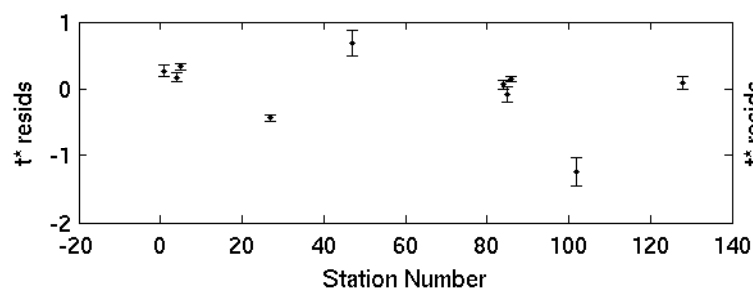


Event\_2006\_11\_19\_16\_58\_06

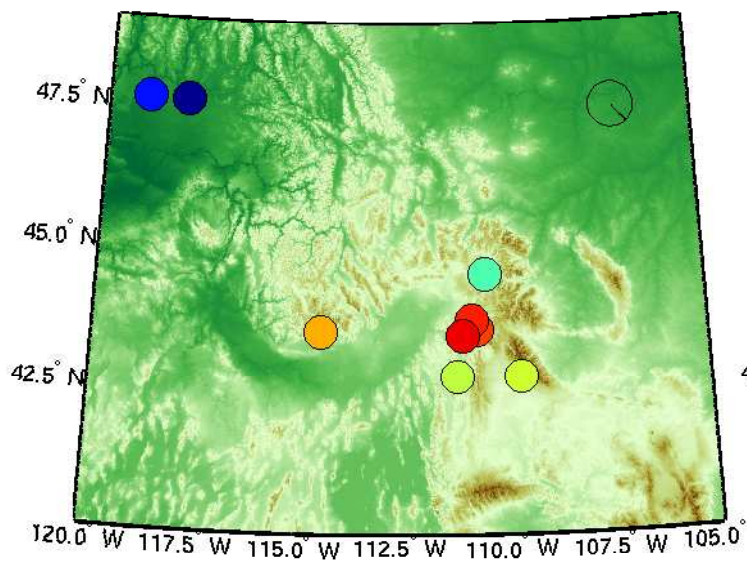
Stack



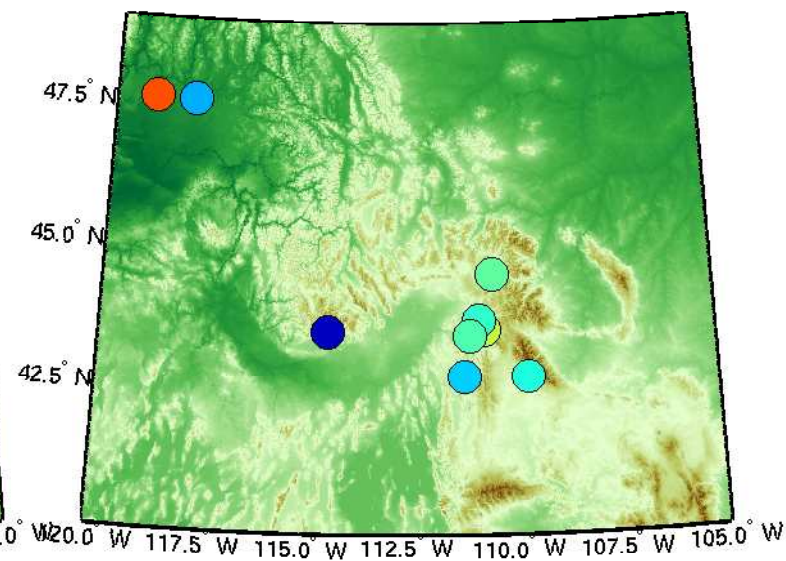
Baz = 320.0819  
Mean xcor value = 0.794  
Range of  $t^*$  values is 1.92  
Median  $t^*$  err is 0.075423  
Slope =  $-0.2629 \pm 0.27151$



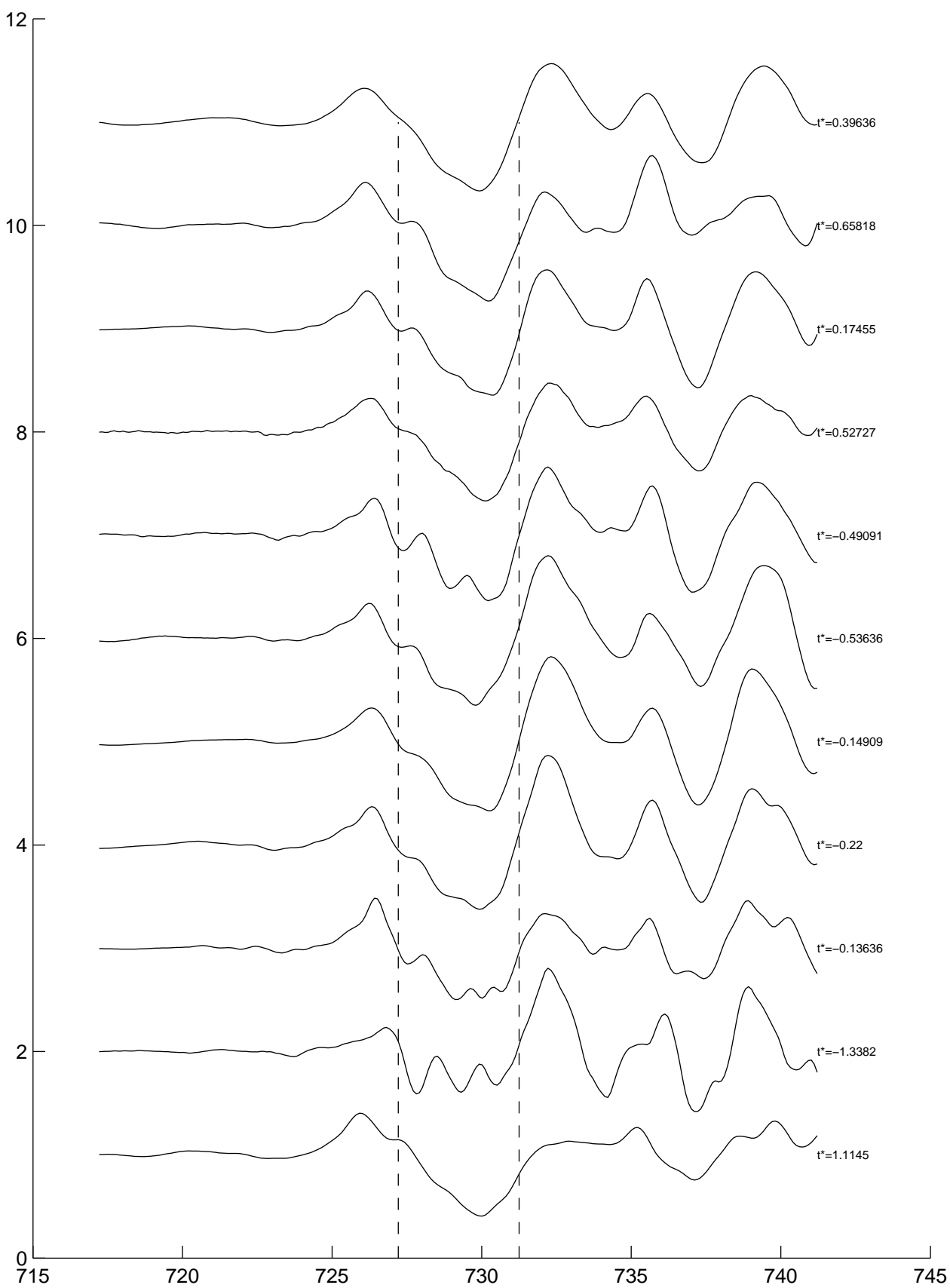
travel time residuals



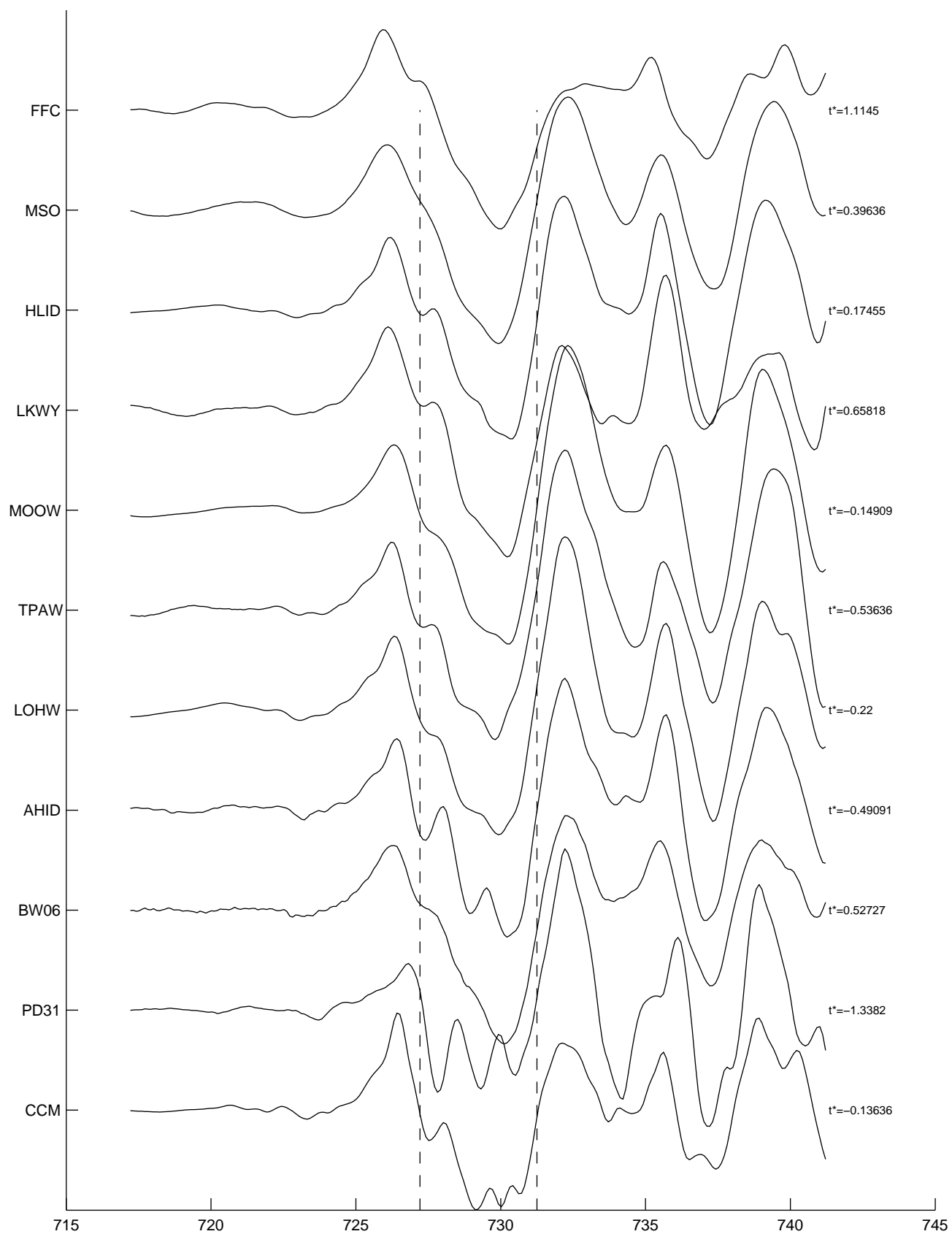
$t^*$  values



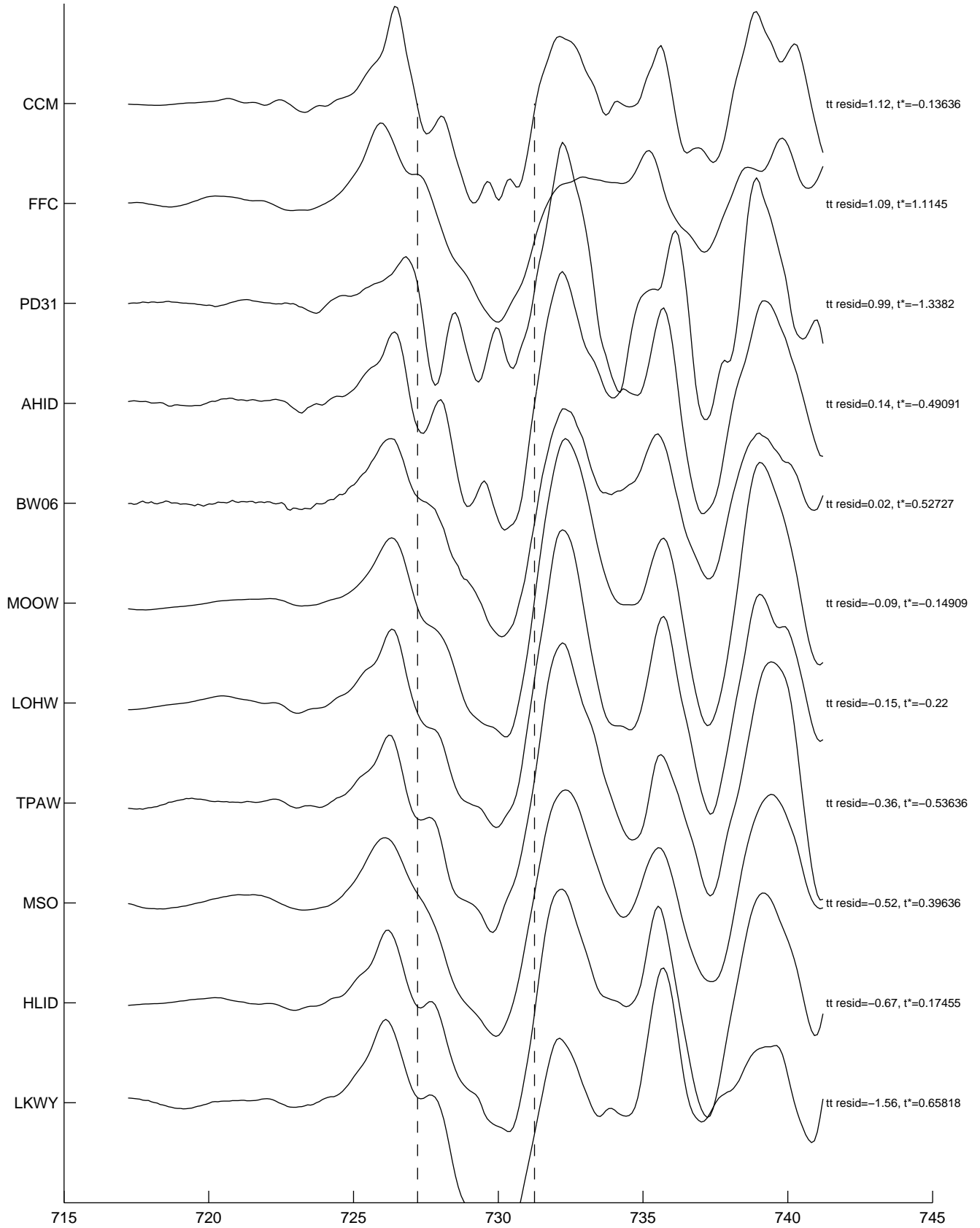
# Event\_2006\_120\_19\_17\_17



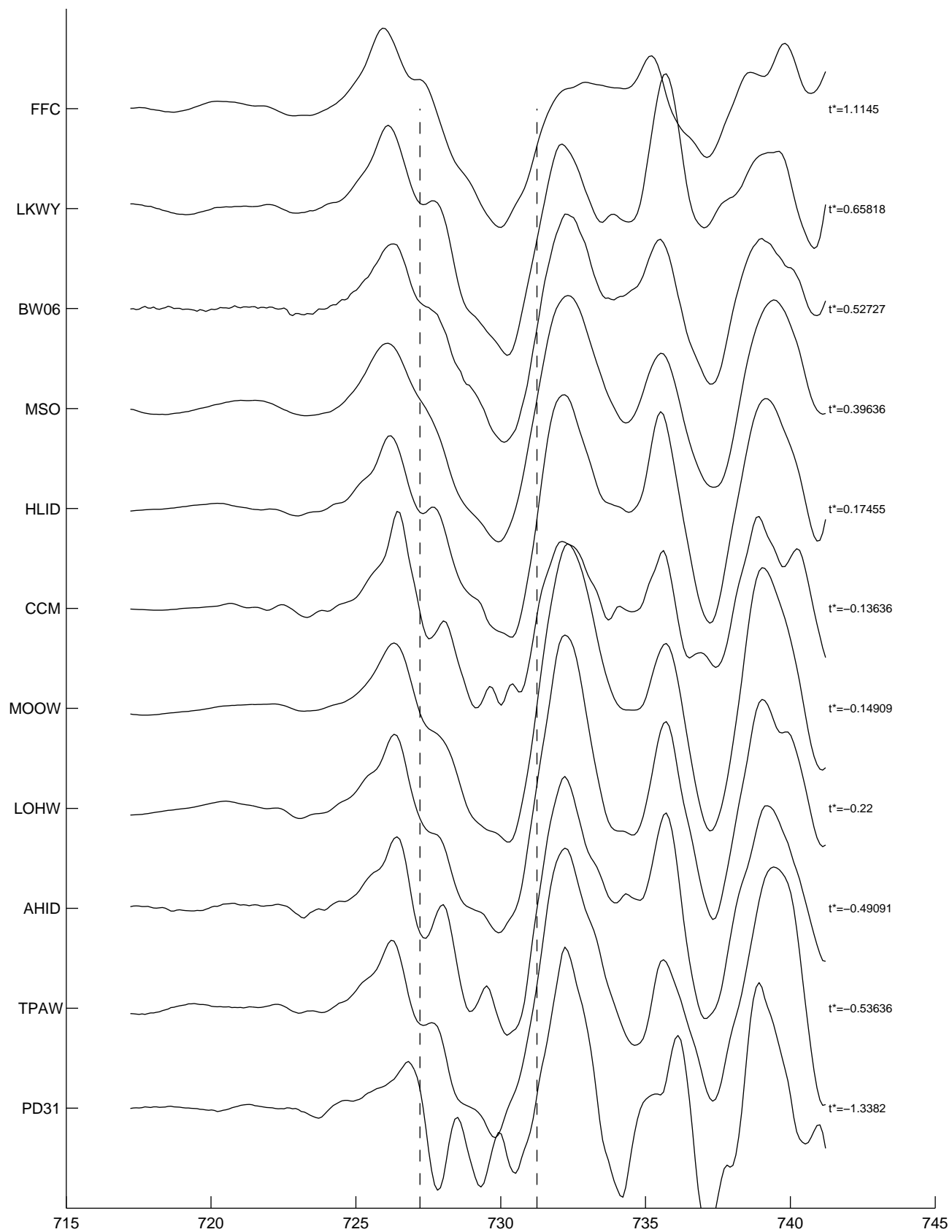
# Sorted by Delta:Event\_2006\_120\_19\_17\_17



# Sorted by travel time:Event\_2006\_120\_19\_17\_17

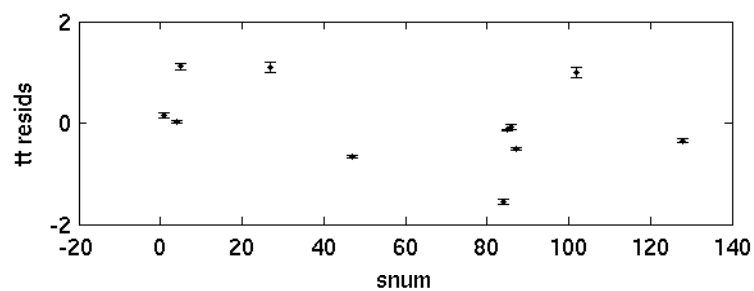
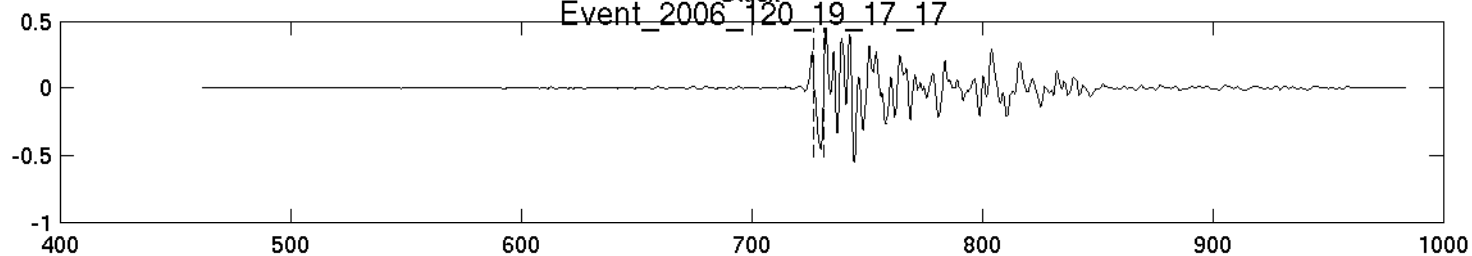


Sorted by  $t^*$ :Event\_2006\_120\_19\_17\_17

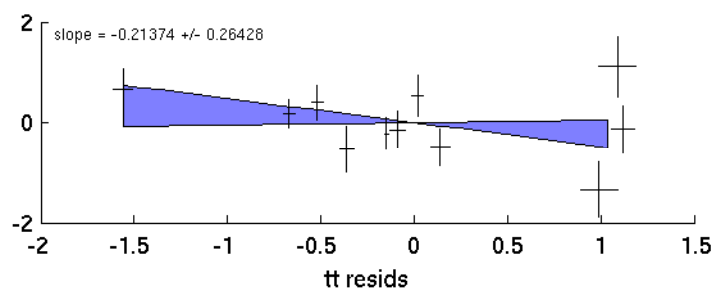
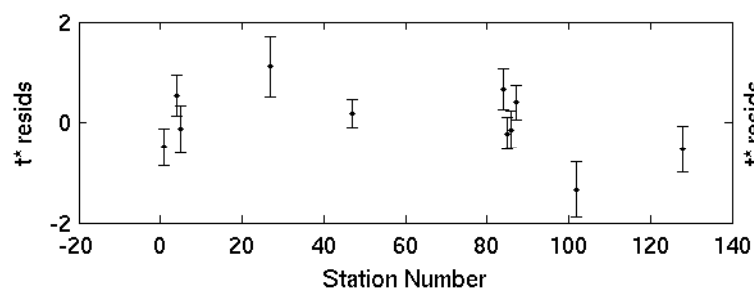


Event\_2006\_120\_19\_17\_17

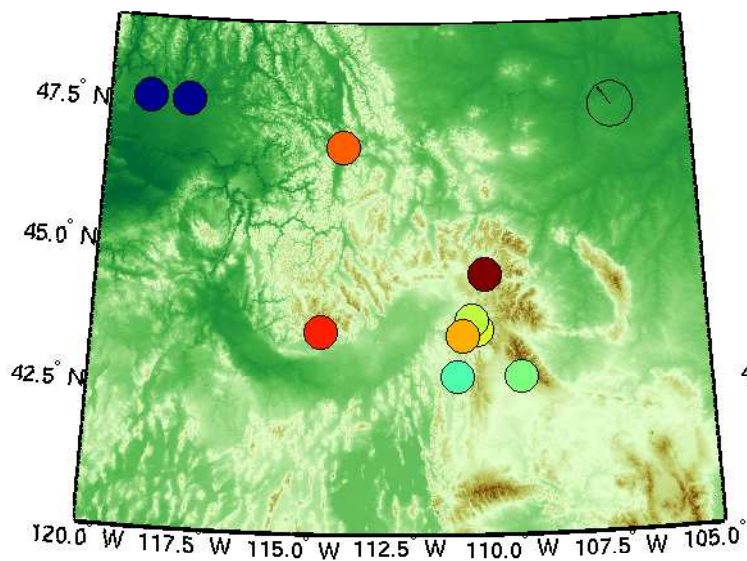
Stack



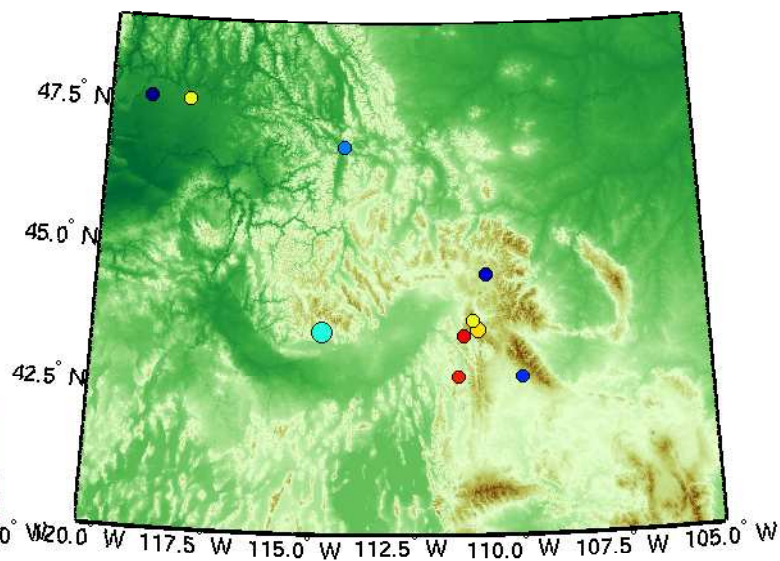
Baz = 146.4242  
Mean xcor value = 0.85364  
Range of  $t^*$  values is 2.4527  
Median  $t^*$  err is 0.4061  
Slope = -0.21374 +/- 0.26428



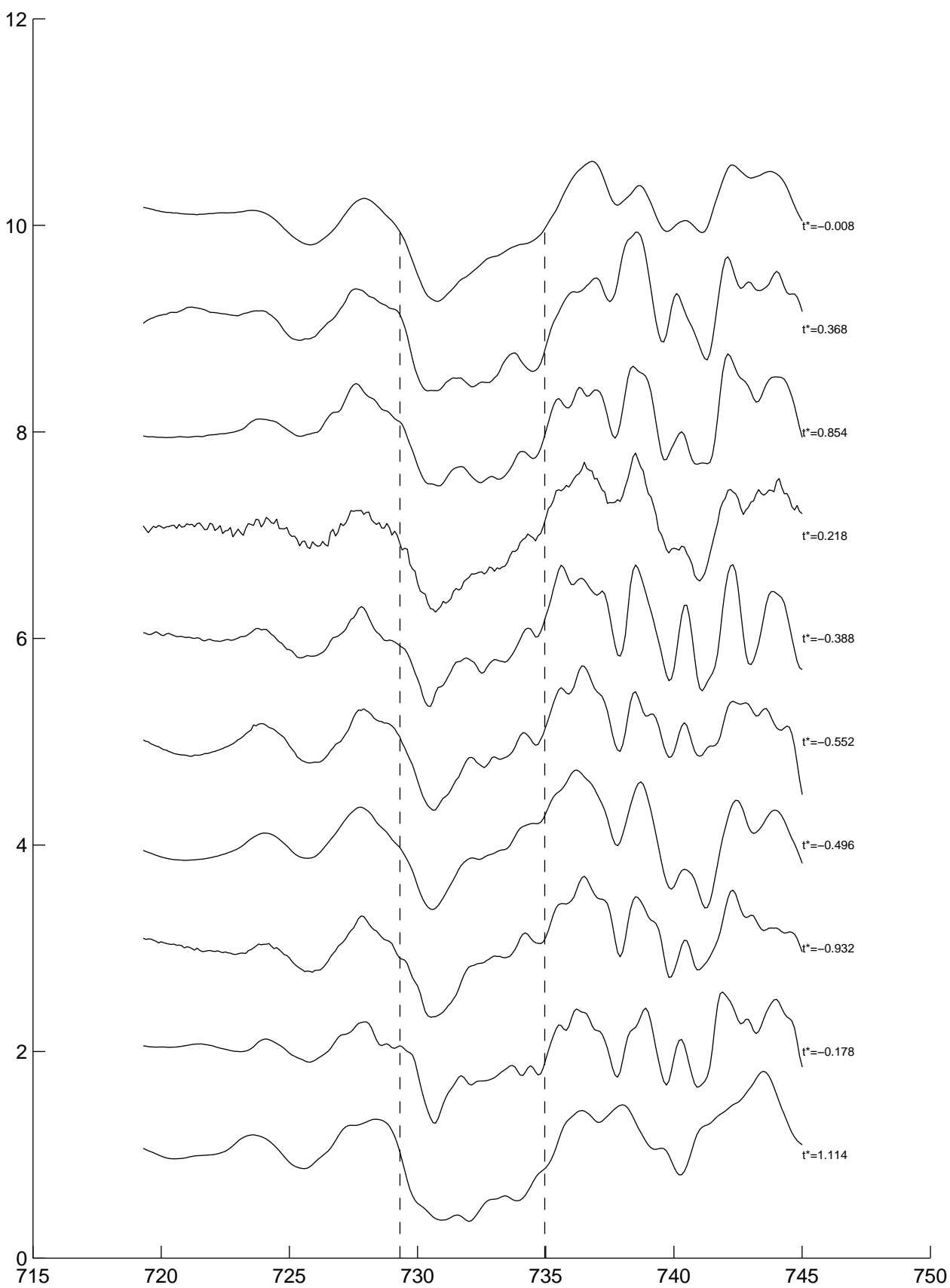
travel time residuals



$t^*$  values

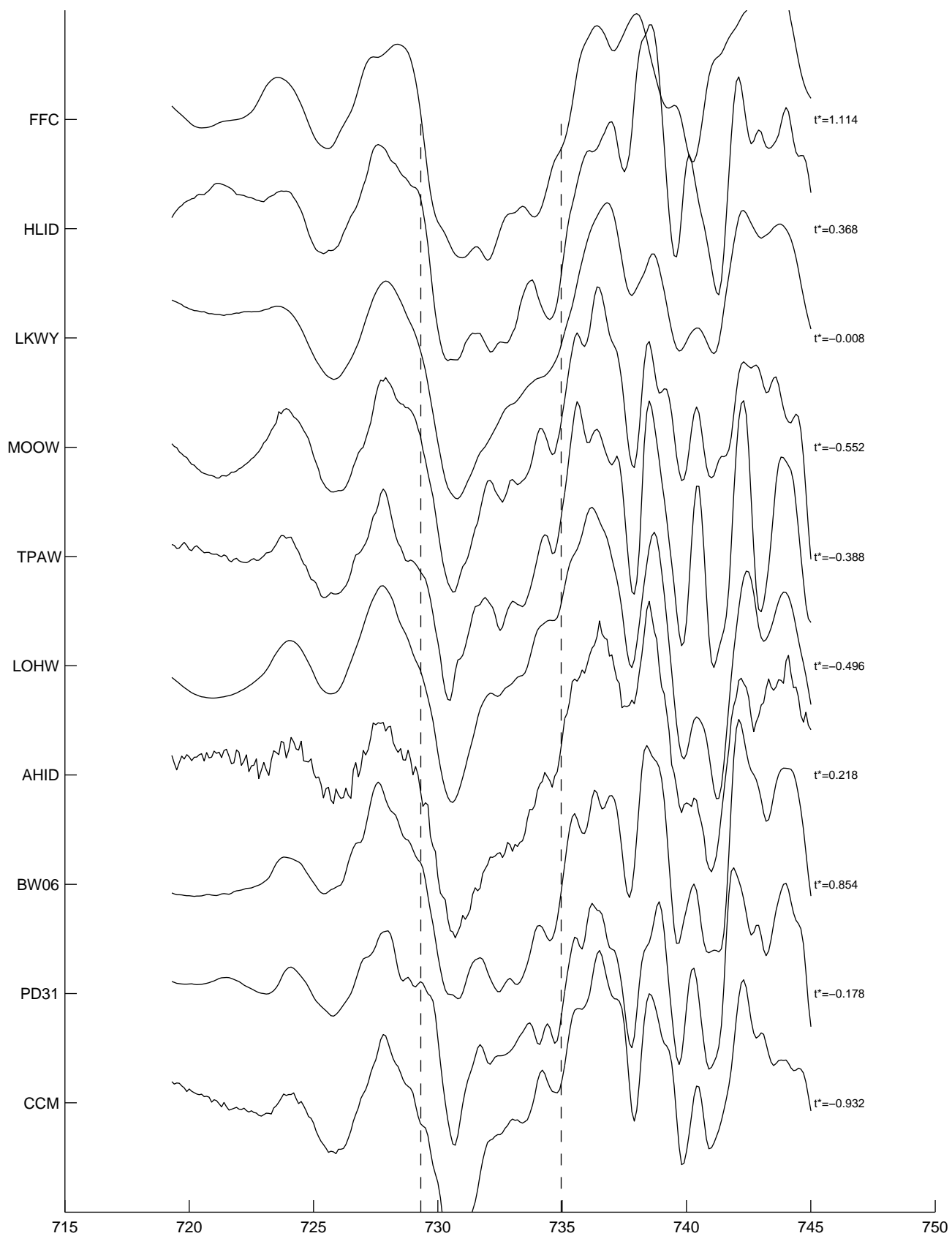


# Event\_2006\_120\_21\_40\_58

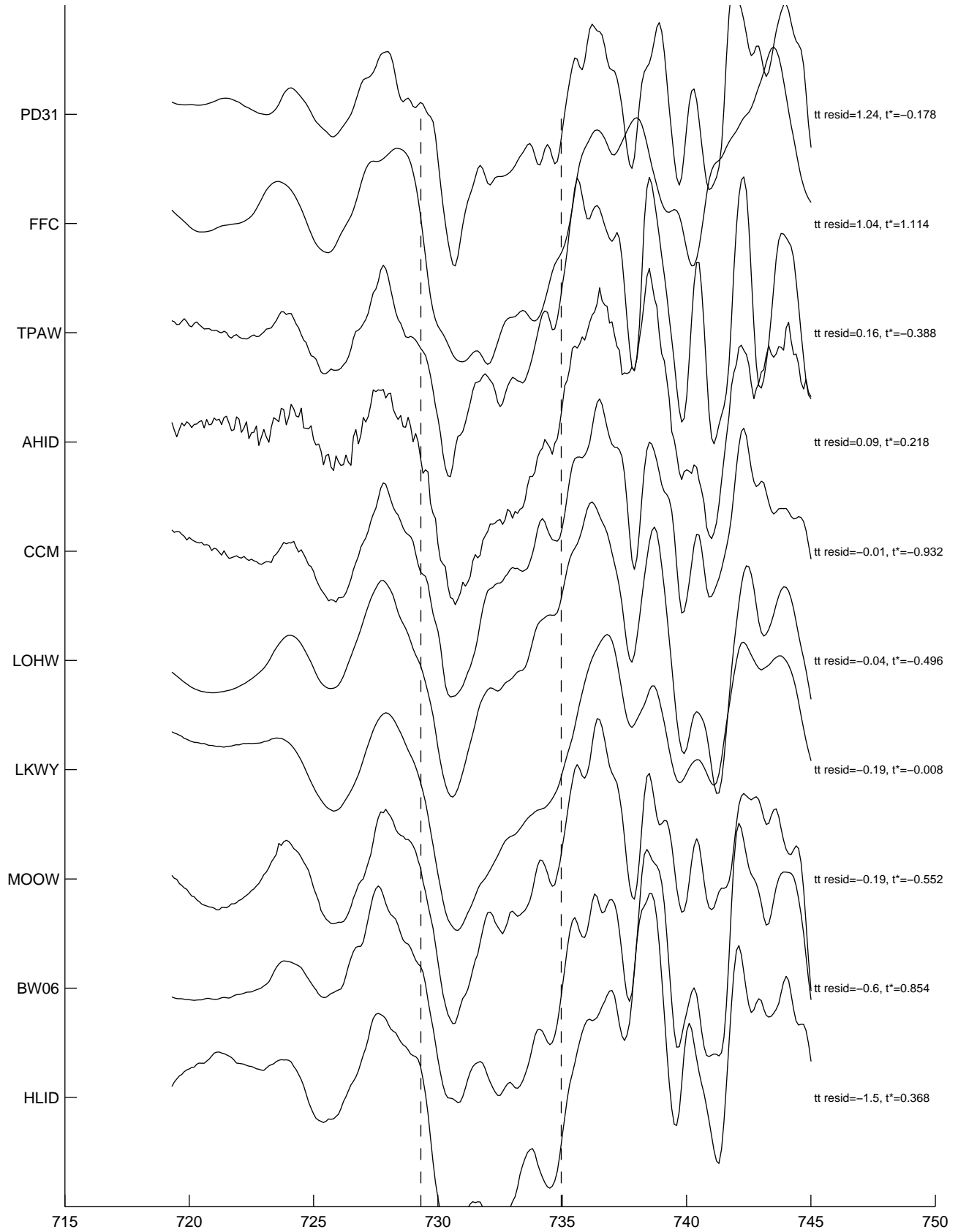




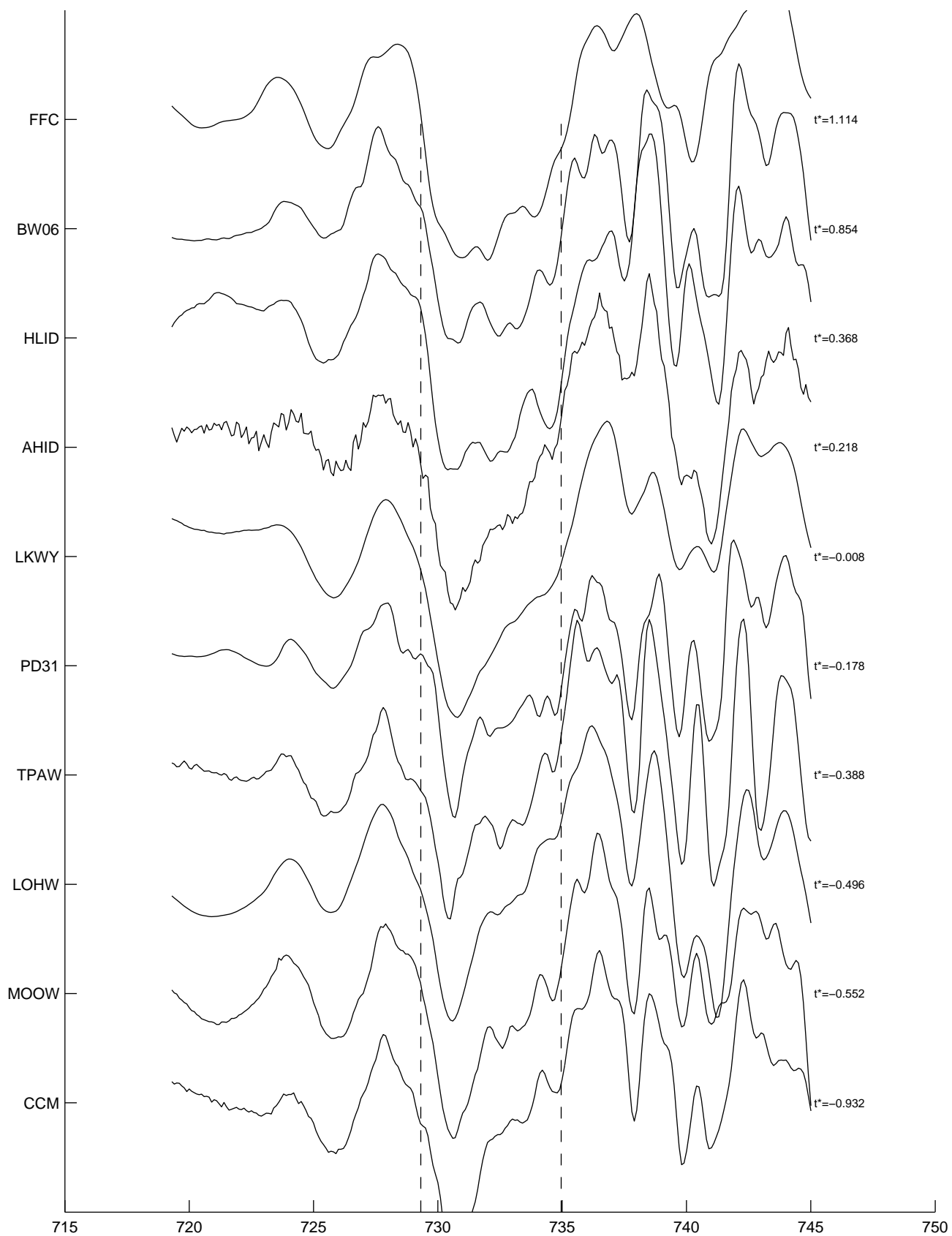
# Sorted by Delta:Event\_2006\_120\_21\_40\_58



# Sorted by travel time:Event\_2006\_120\_21\_40\_58

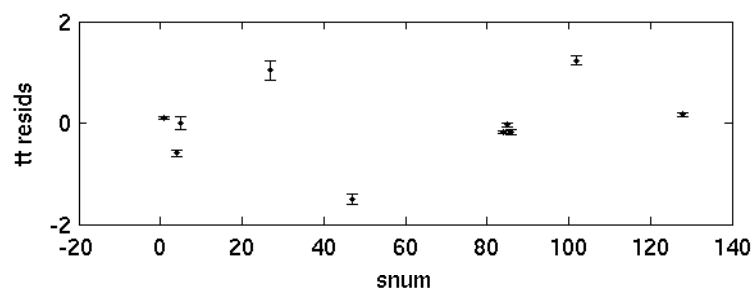
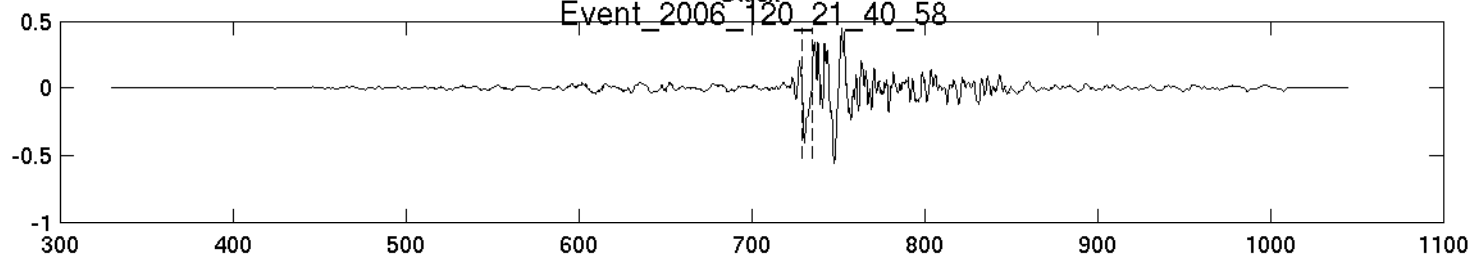


Sorted by  $t^*$ :Event\_2006\_120\_21\_40\_58

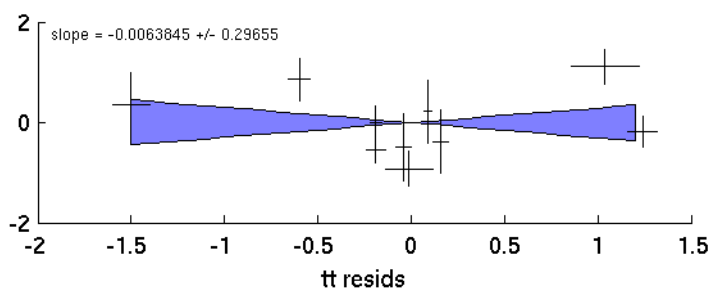
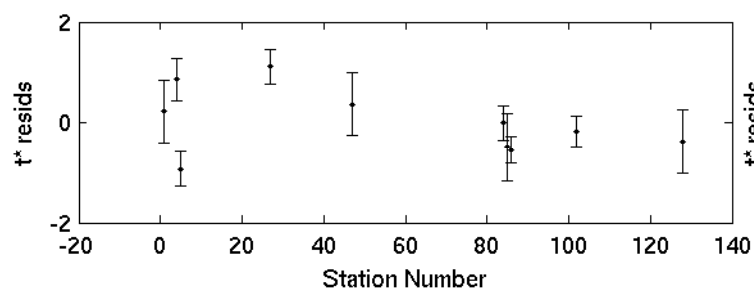


Event\_2006\_120\_21\_40\_58

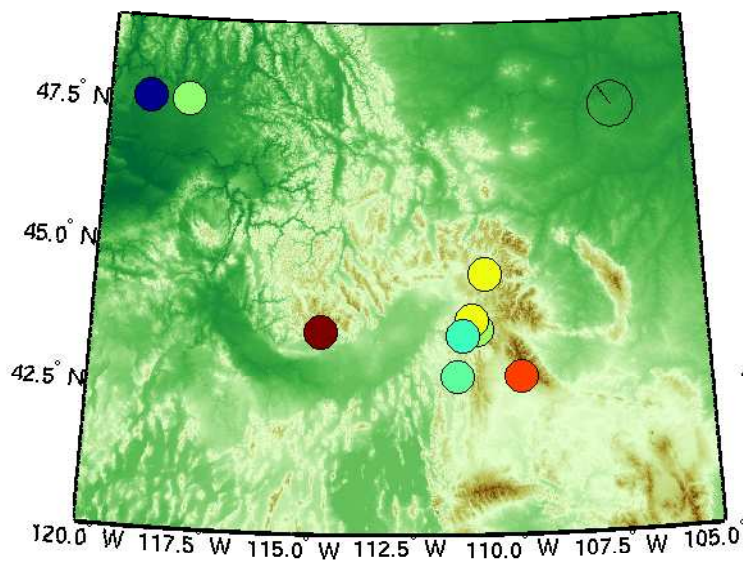
Stack



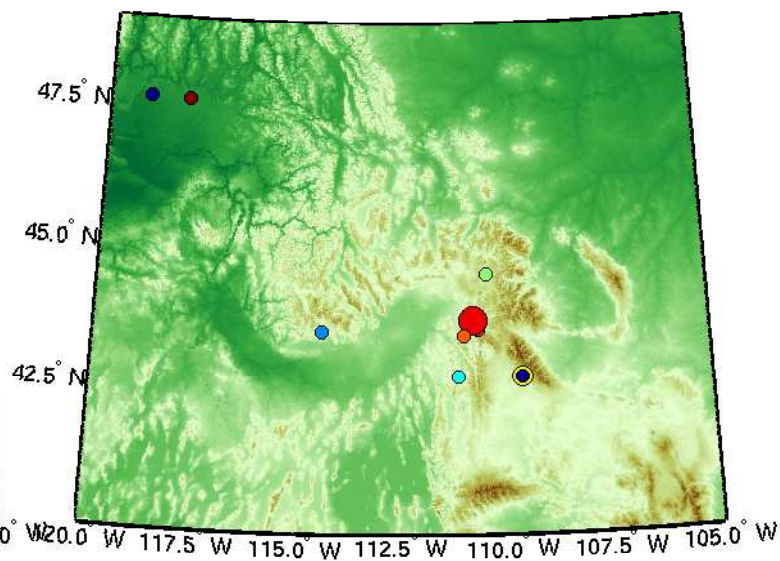
Baz = 146.592  
Mean xcor value = 0.769  
Range of t\* values is 2.046  
Median t\* err is 0.38085  
Slope = -0.0063845 +/- 0.29655



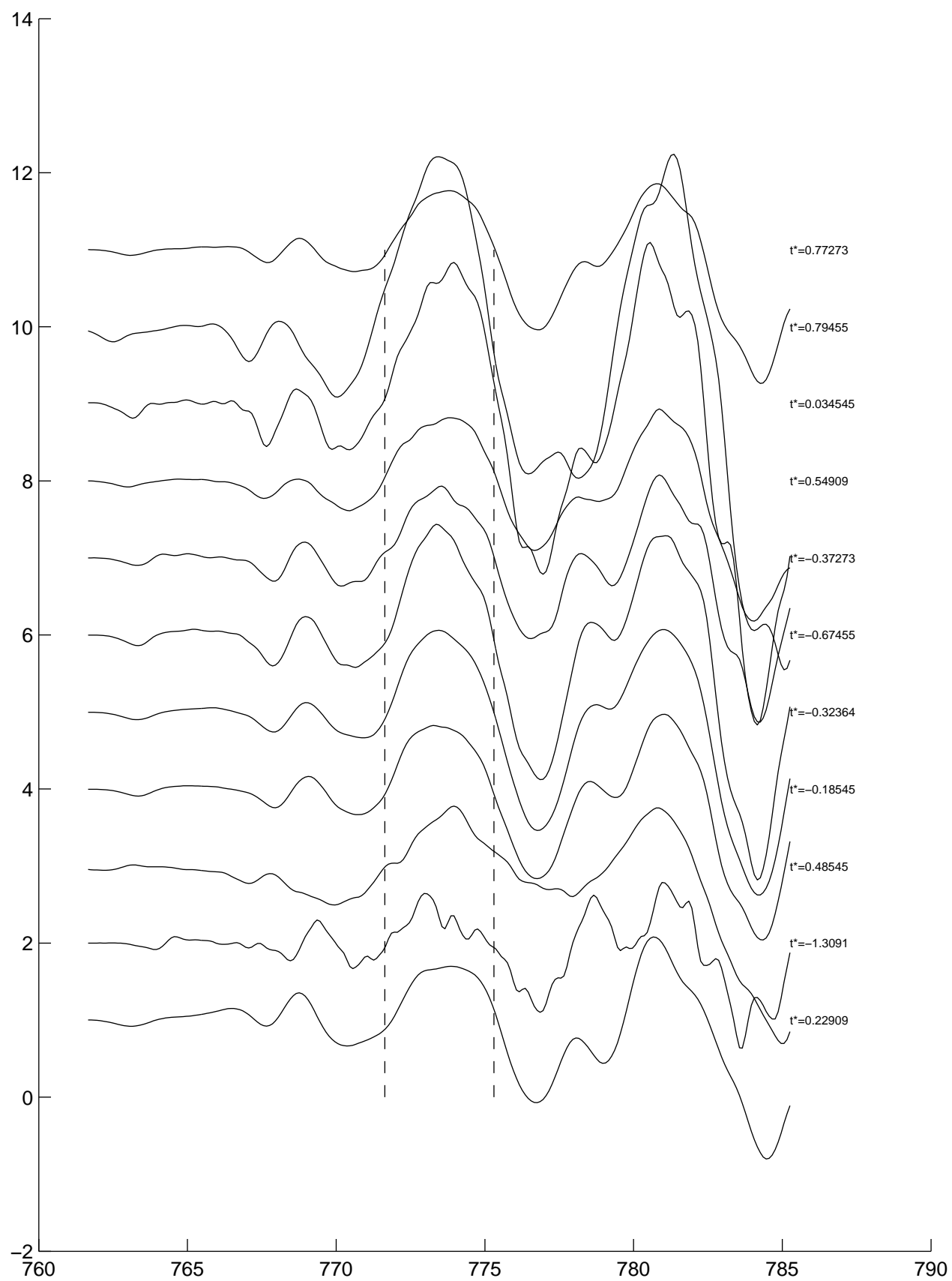
travel time residuals



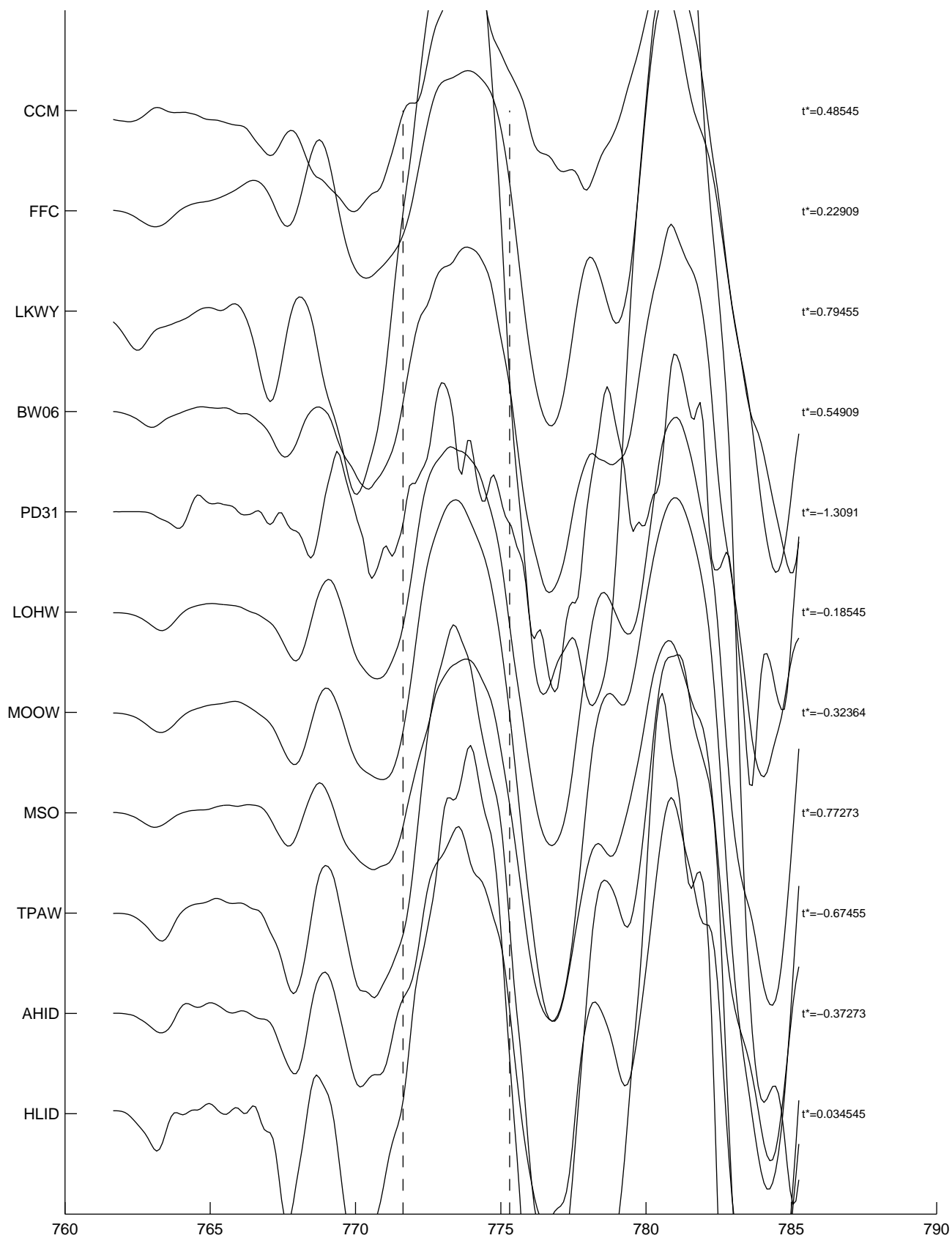
t\* values



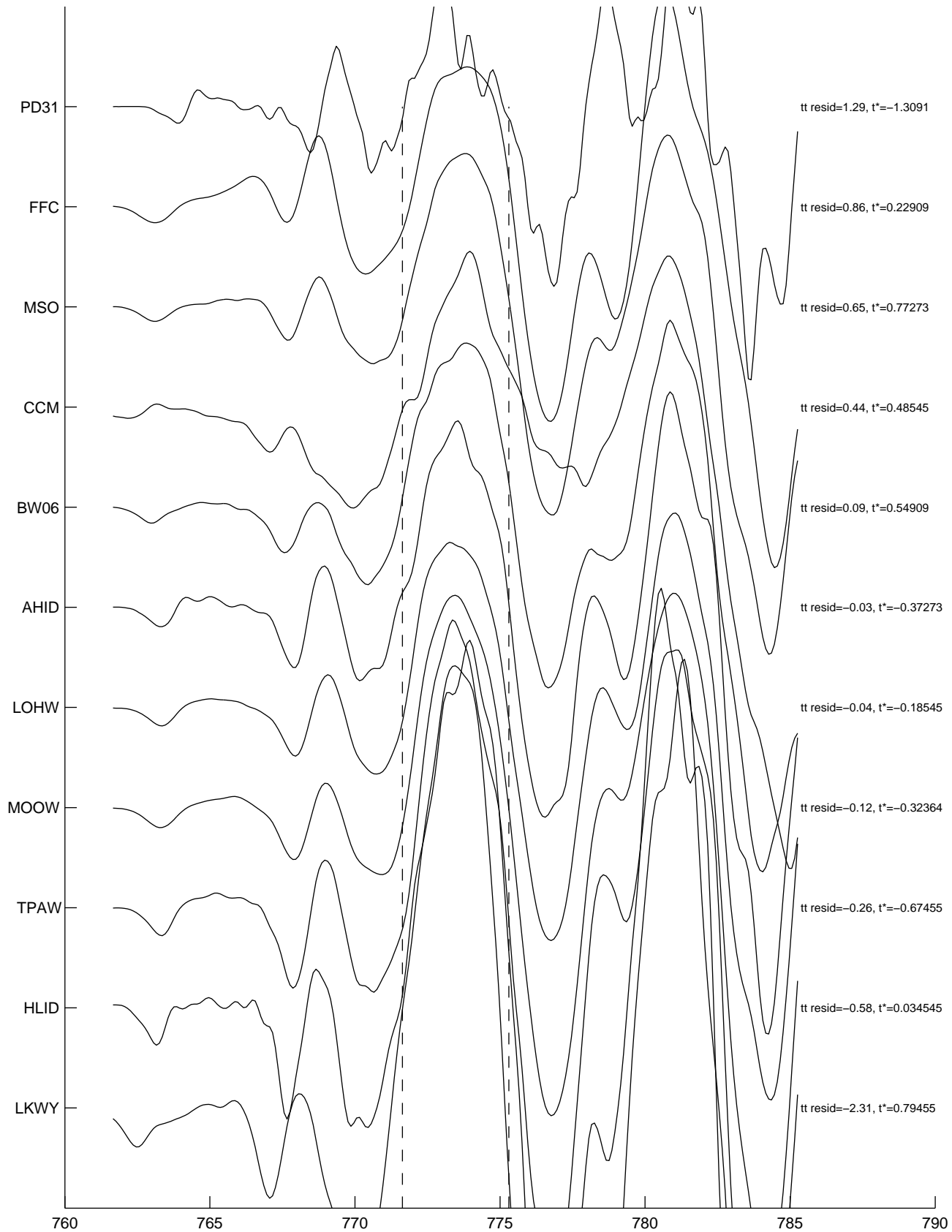
# Event\_2006\_123\_15\_26\_40



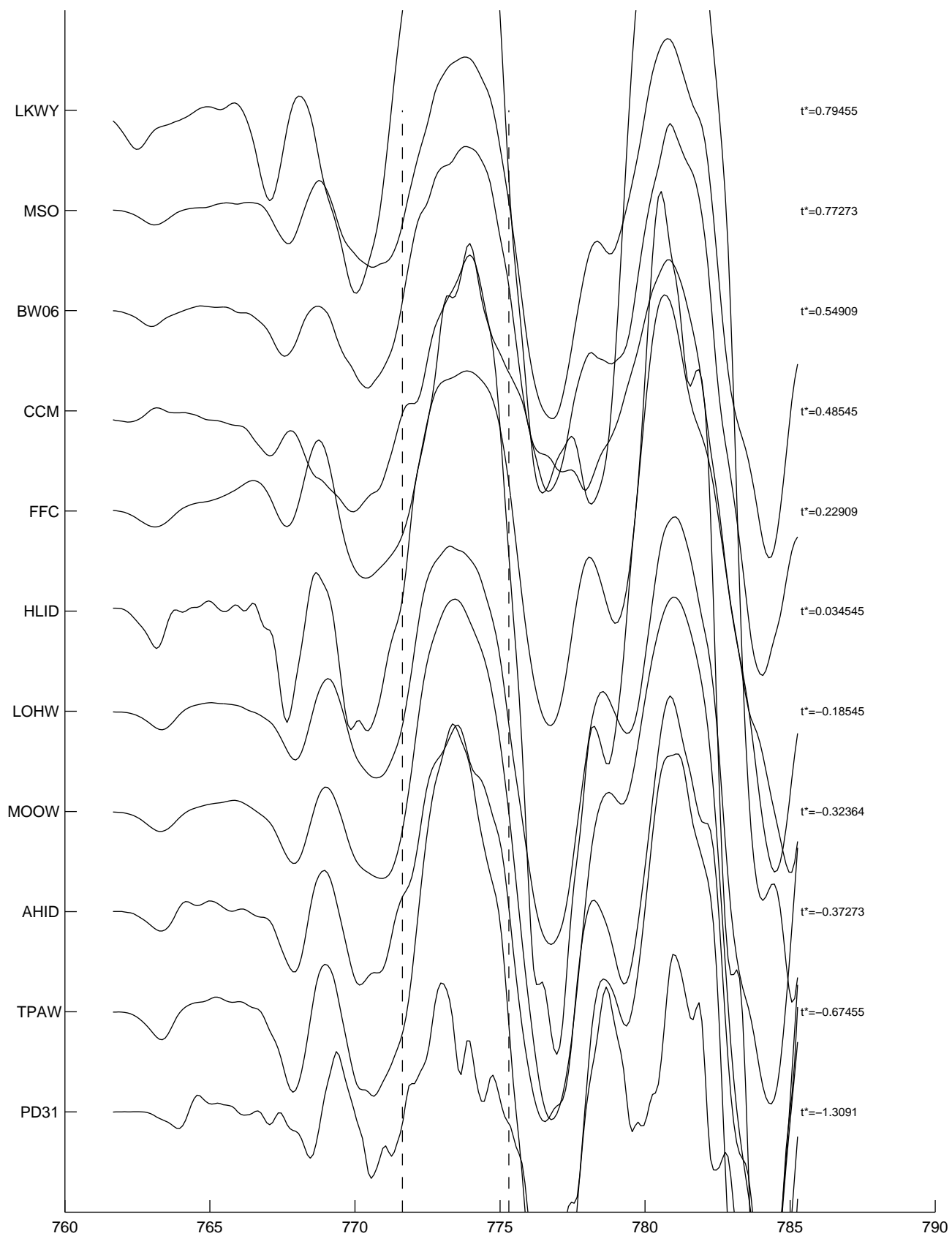
# Sorted by Delta:Event\_2006\_123\_15\_26\_40



# Sorted by travel time:Event\_2006\_123\_15\_26\_40



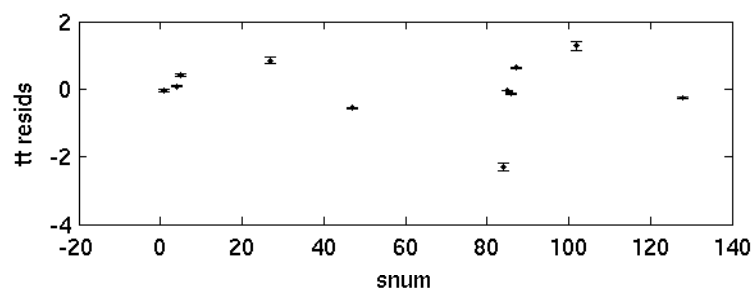
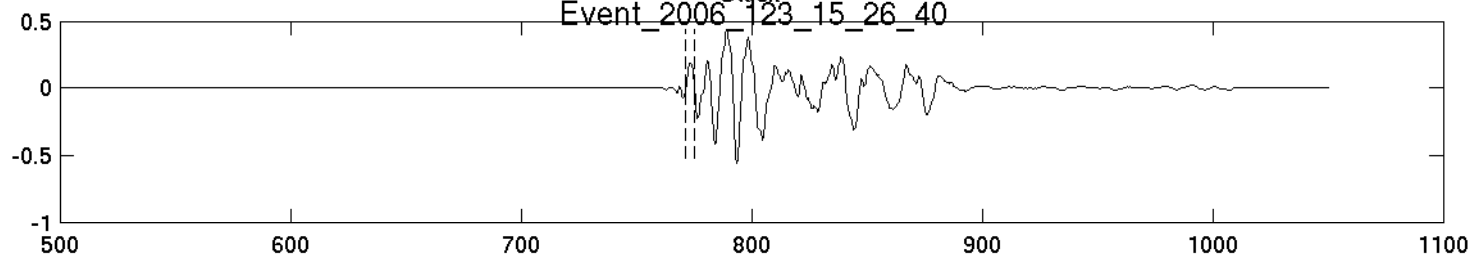
Sorted by  $t^*$ :Event\_2006\_123\_15\_26\_40



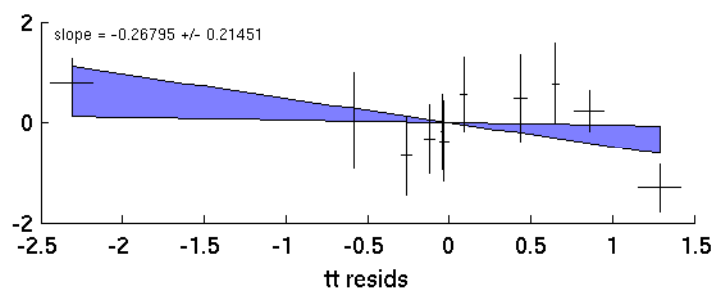
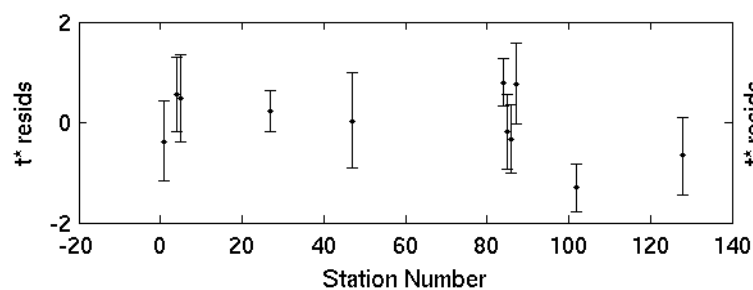


Event\_2006\_123\_15\_26\_40

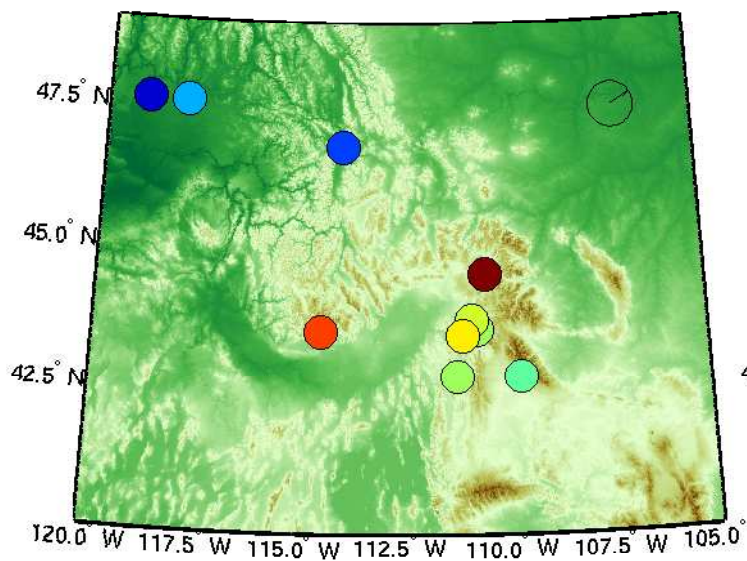
Stack



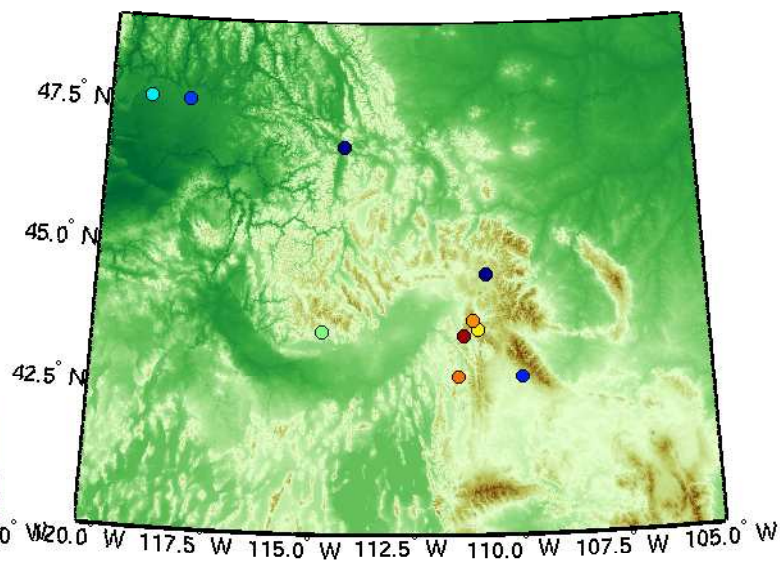
Baz = 238.6833  
Mean xcor value = 0.83273  
Range of t\* values is 2.1036  
Median t\* err is 0.74861  
Slope = -0.26795 +/- 0.21451



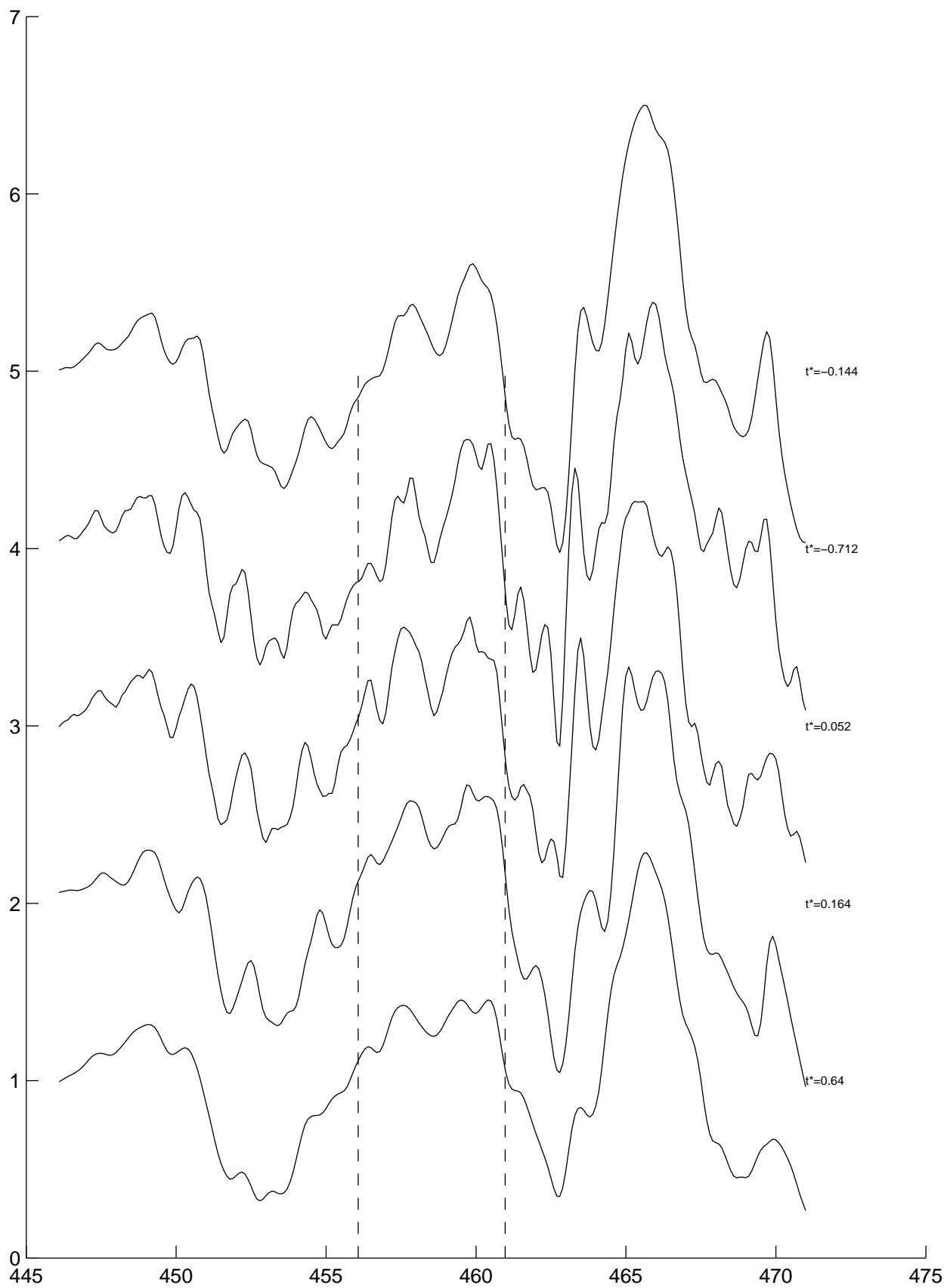
travel time residuals



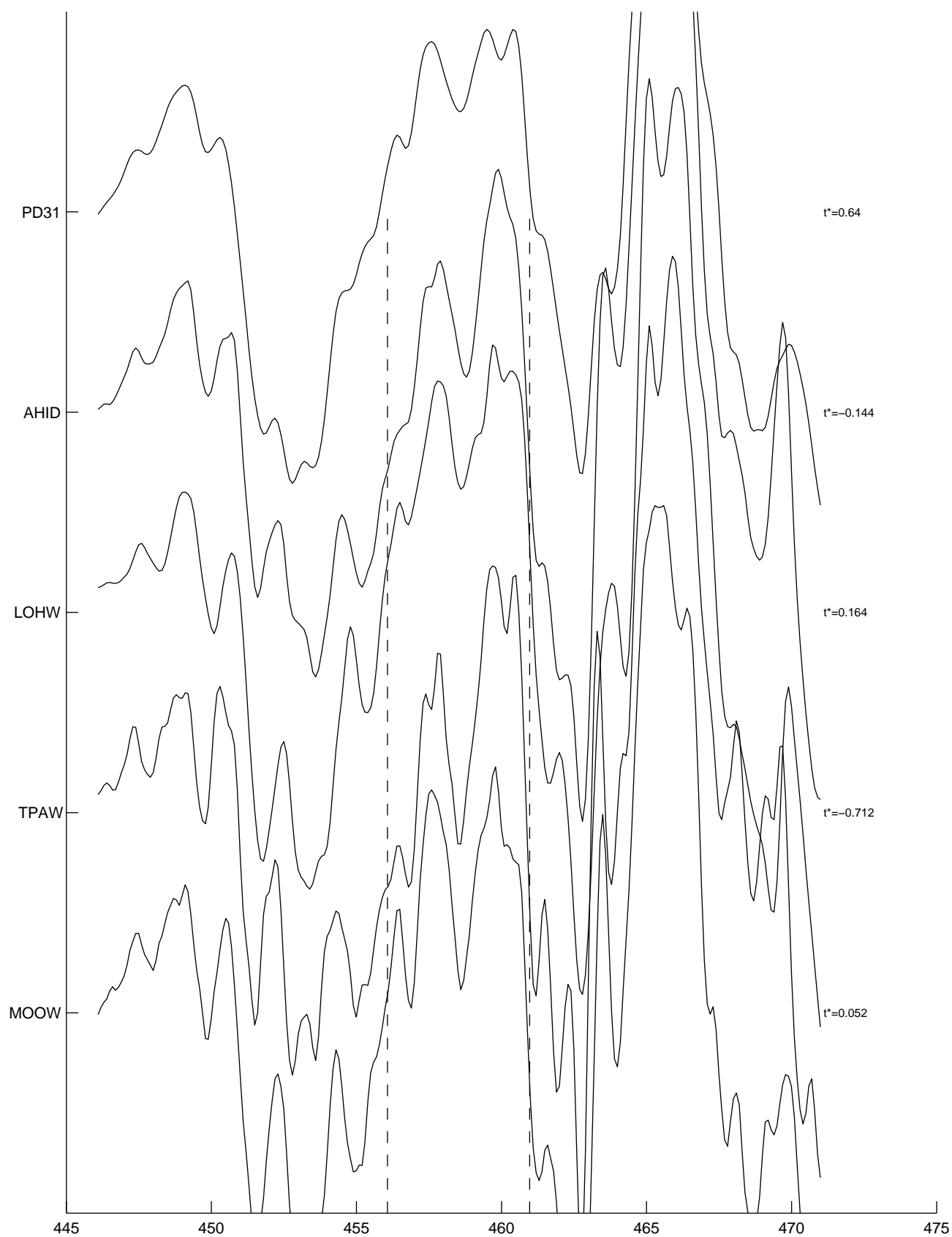
t\* values



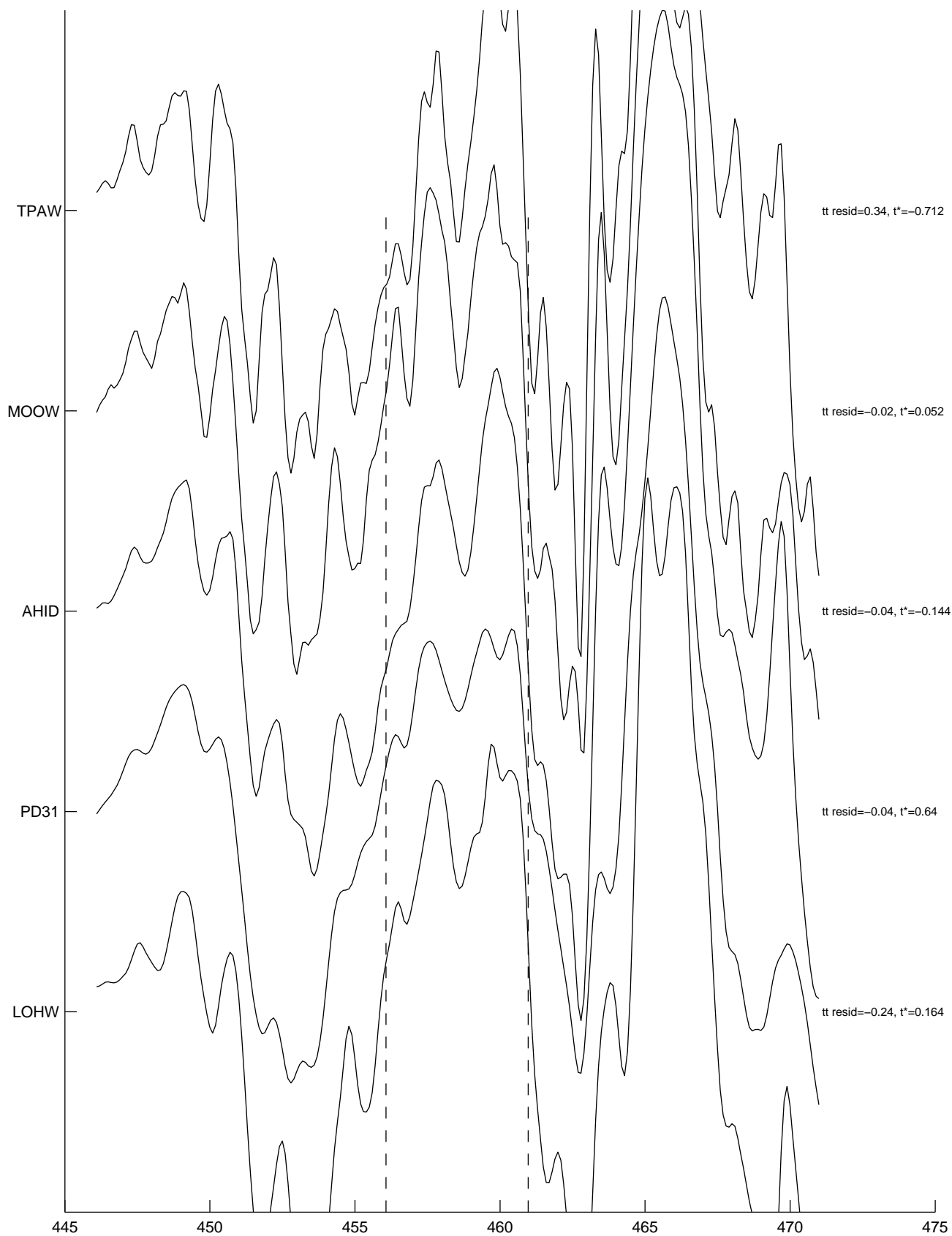
# Event\_2006\_130\_02\_42\_51



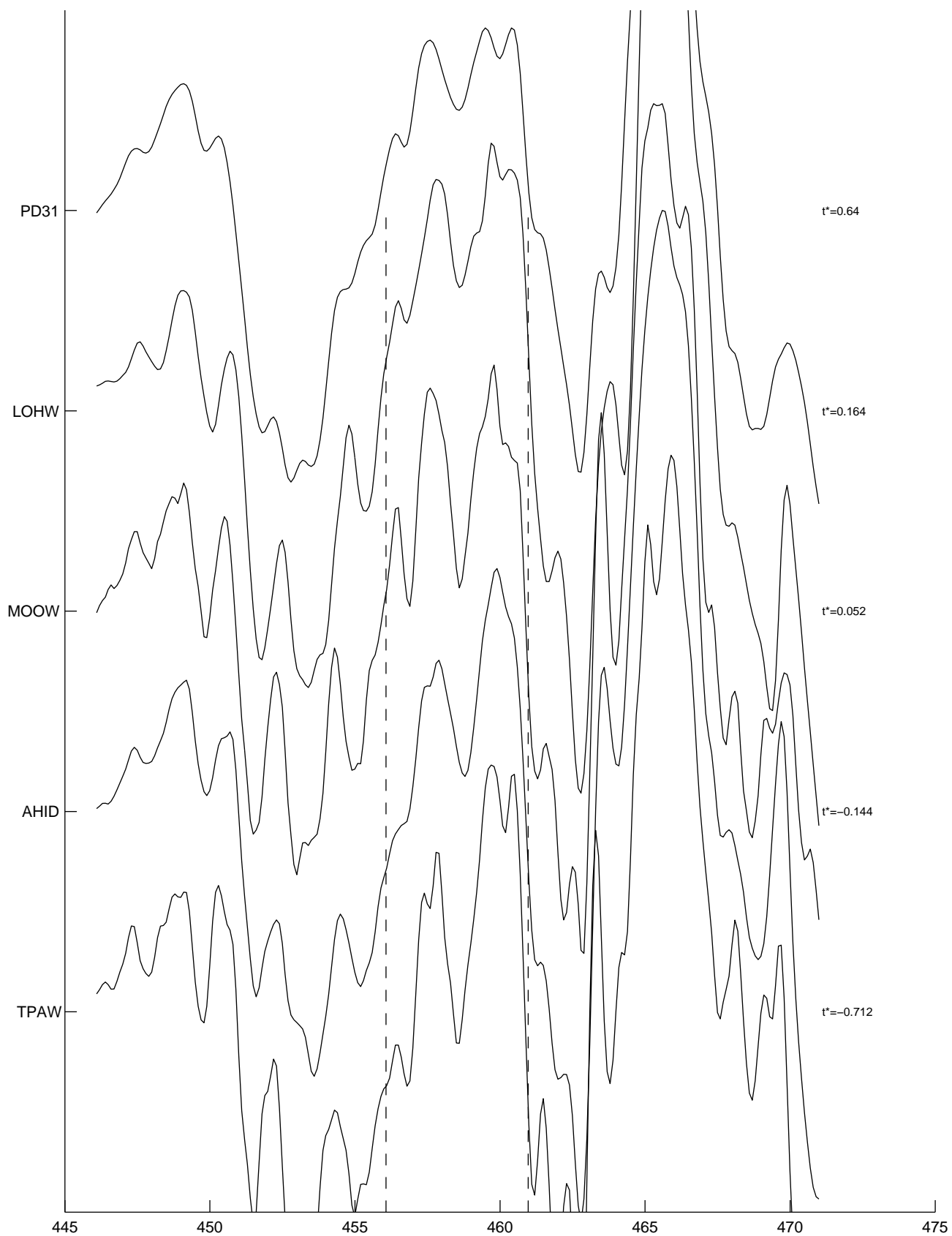
Sorted by Delta:Event\_2006\_130\_02\_42\_51

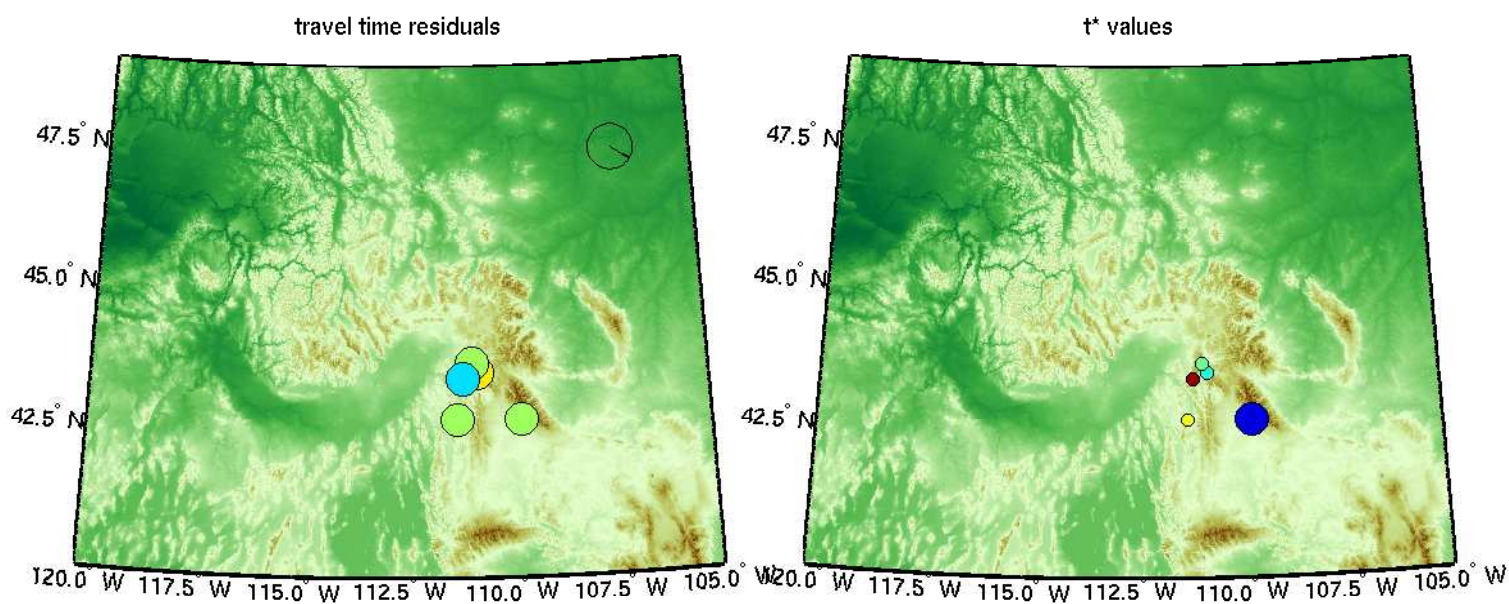
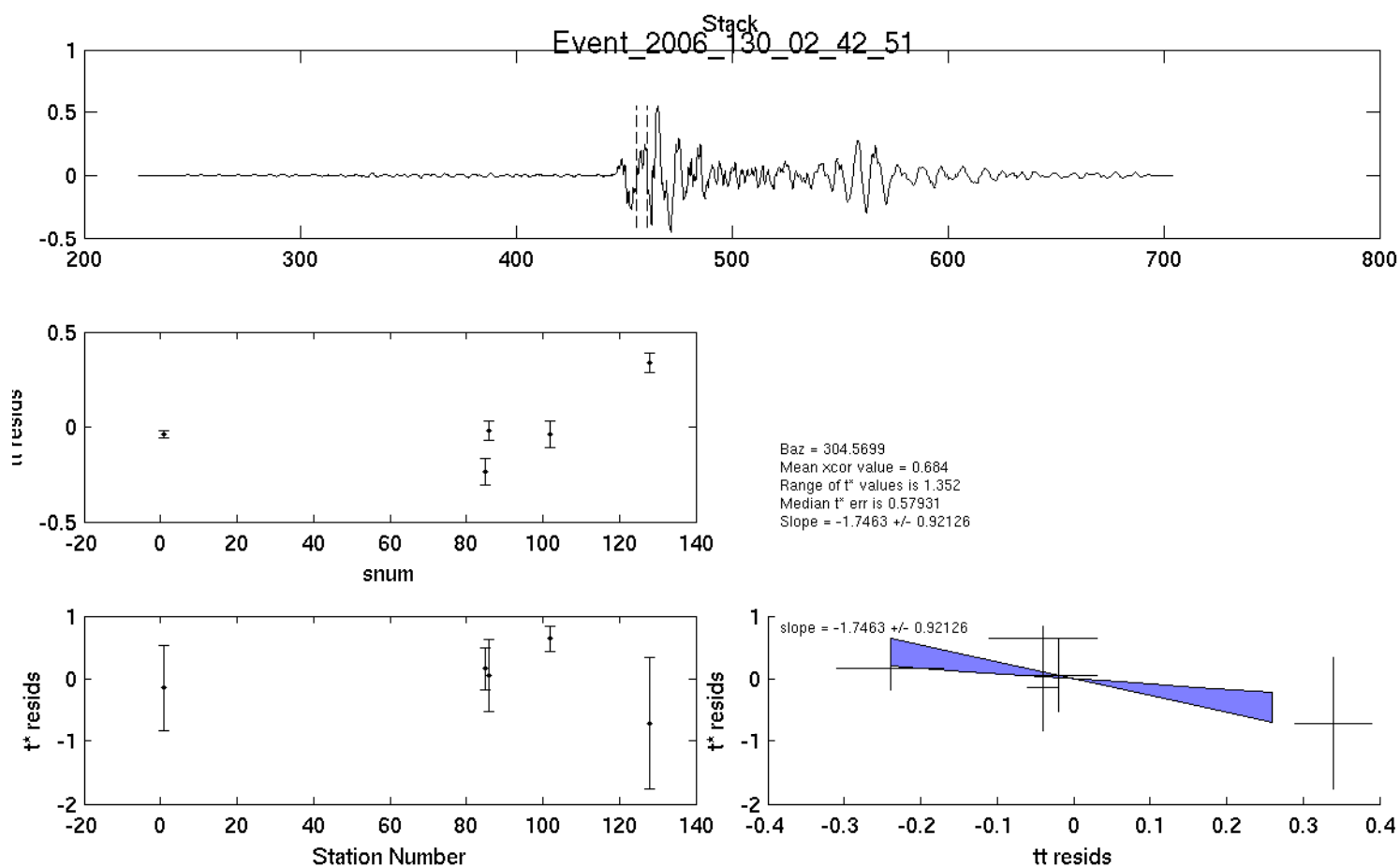


# Sorted by travel time:Event\_2006\_130\_02\_42\_51

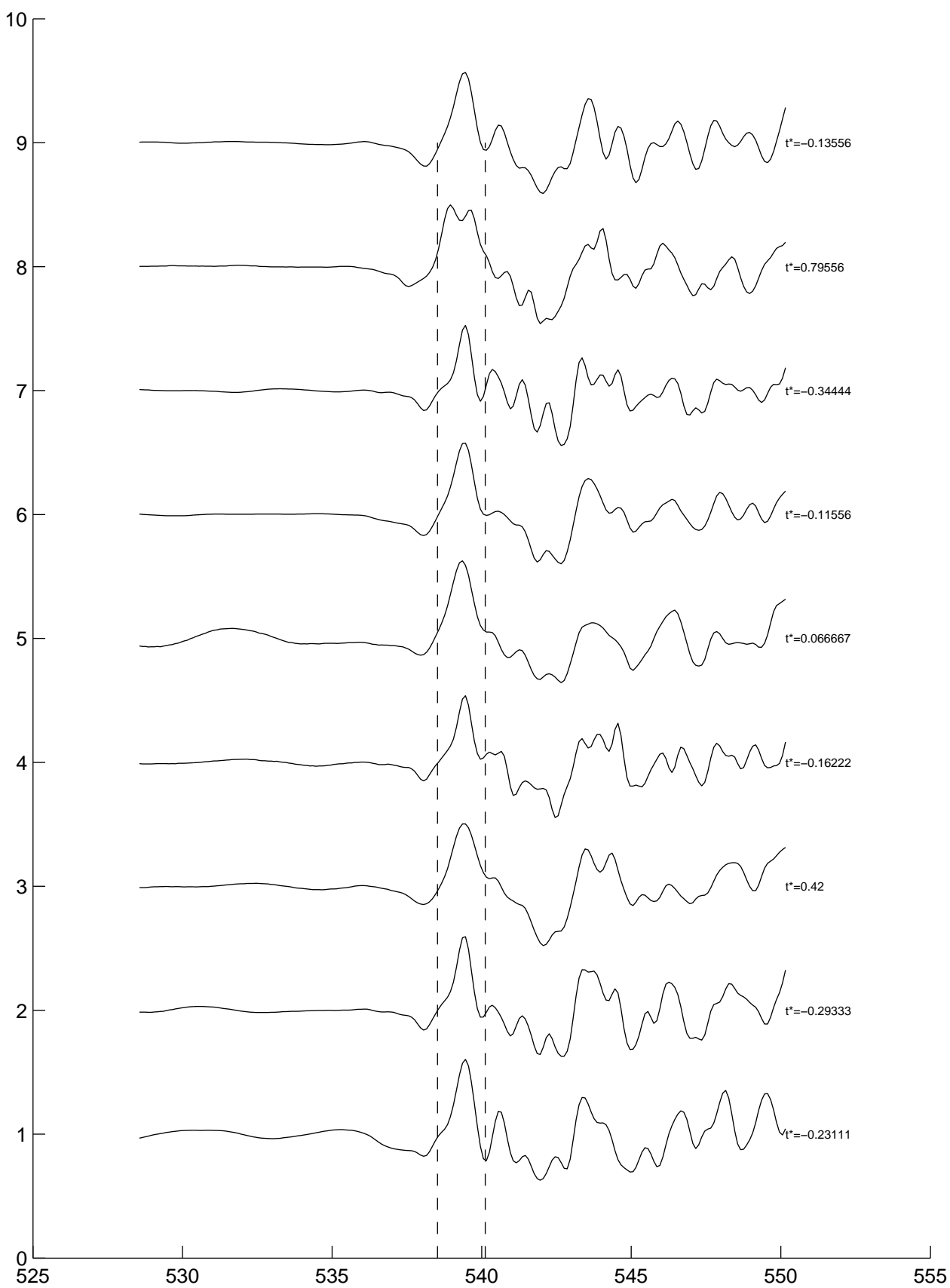


Sorted by t\*:Event\_2006\_130\_02\_42\_51

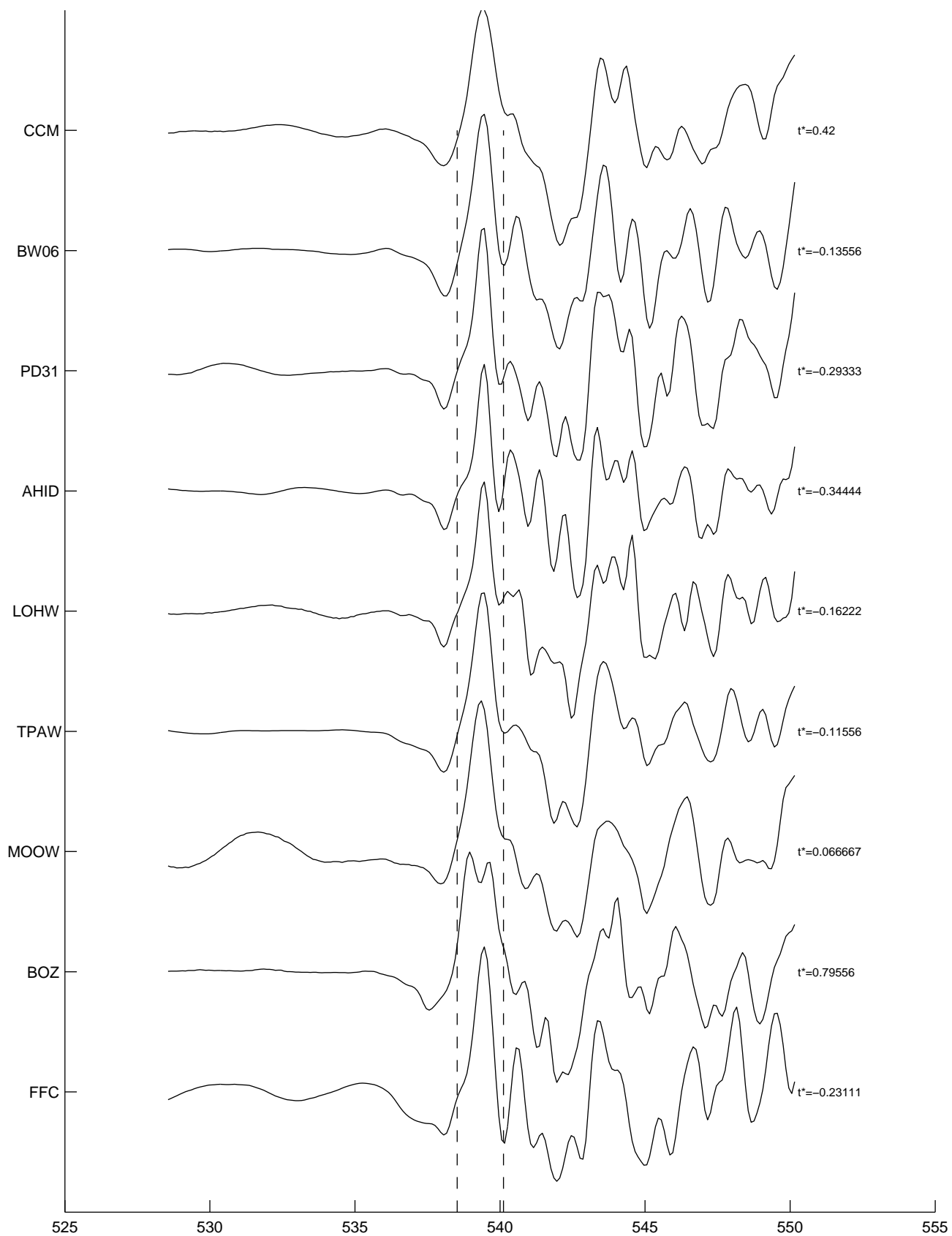




# Event\_2006\_142\_11\_12\_00

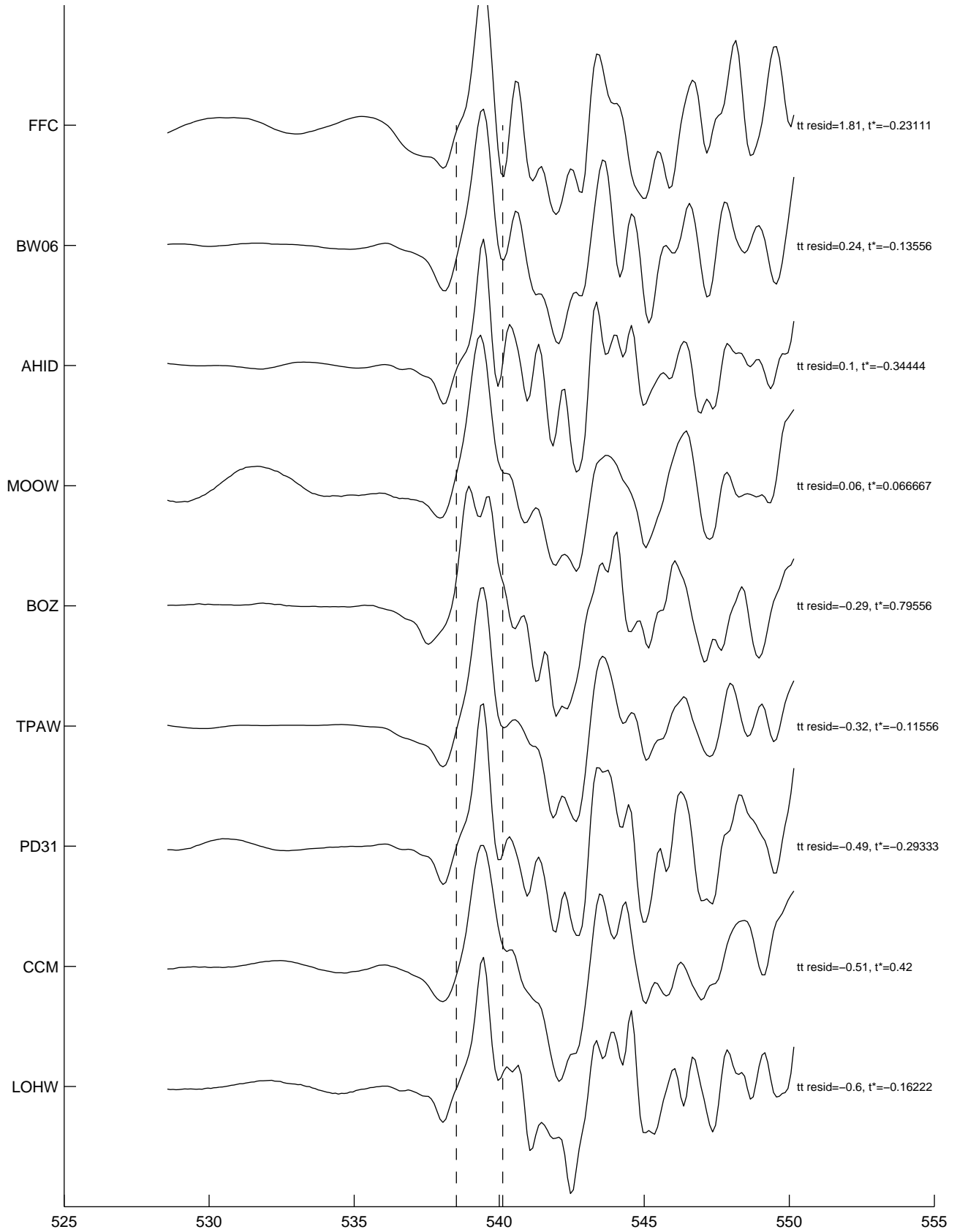


# Sorted by Delta:Event\_2006\_142\_11\_12\_00

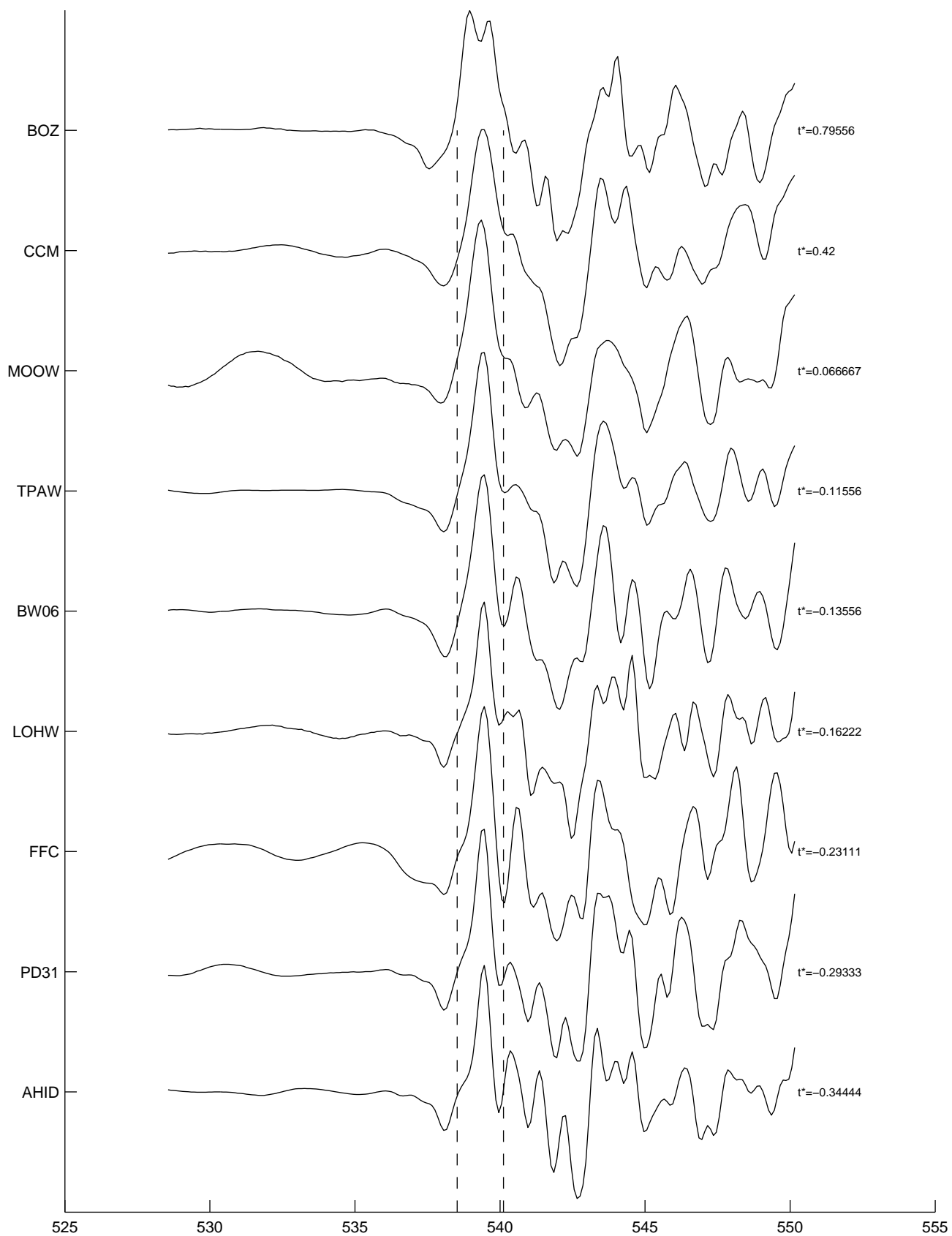




# Sorted by travel time:Event\_2006\_142\_11\_12\_00

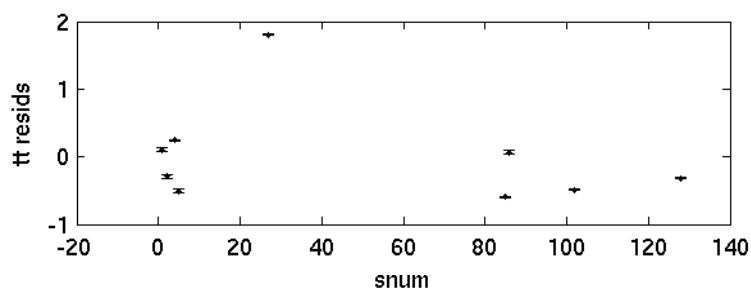
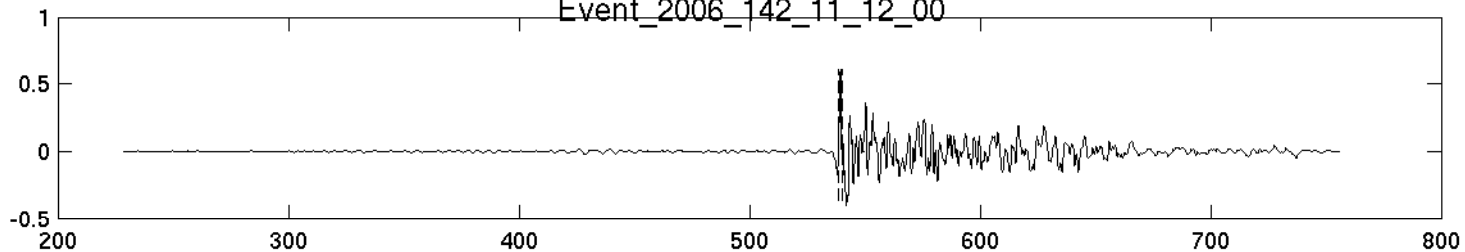


Sorted by  $t^*$ :Event\_2006\_142\_11\_12\_00

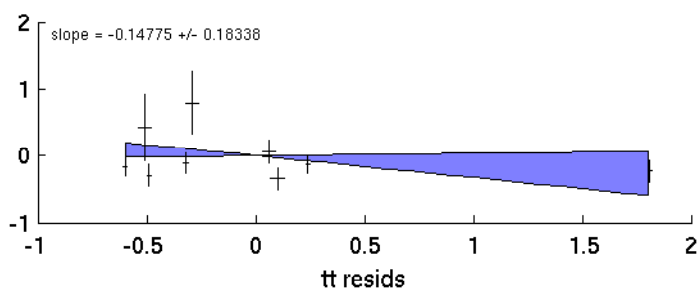
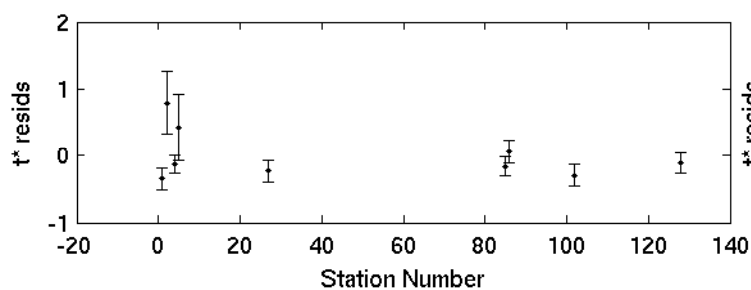


# Event\_2006\_142\_11\_12\_00

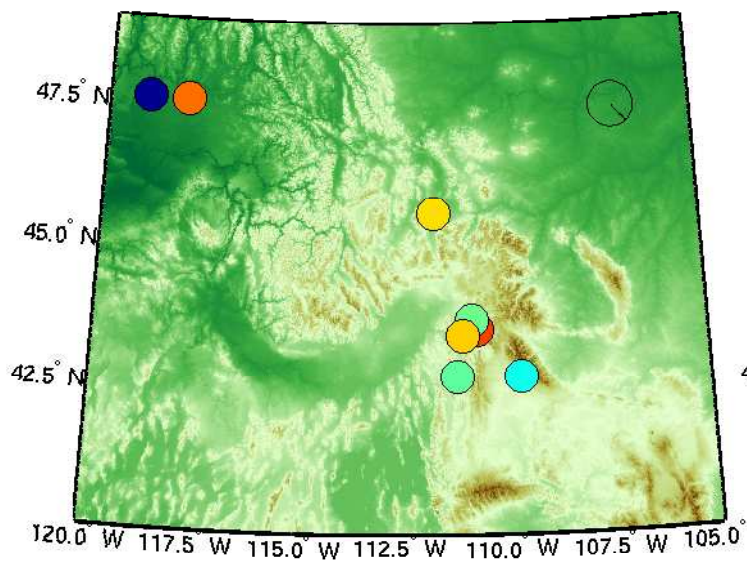
Stack



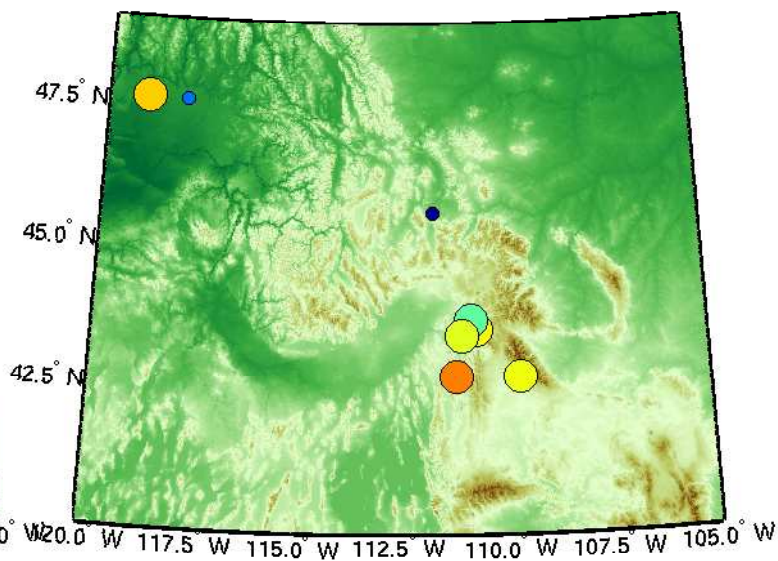
Baz = 320.725  
Mean xcor value = 0.70222  
Range of  $t^*$  values is 1.14  
Median  $t^*$  err is 0.16163  
Slope =  $-0.14775 \pm 0.18338$



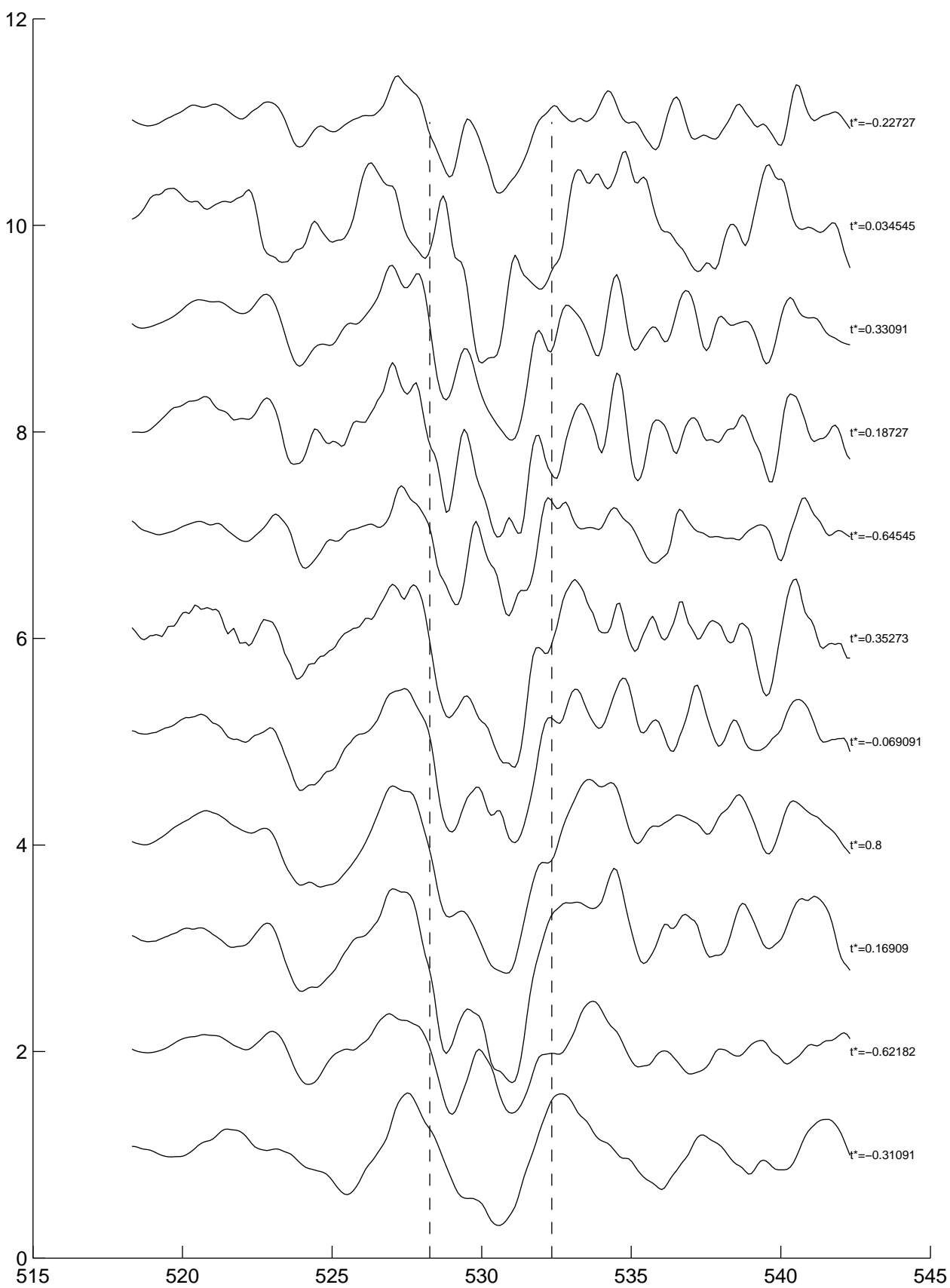
travel time residuals



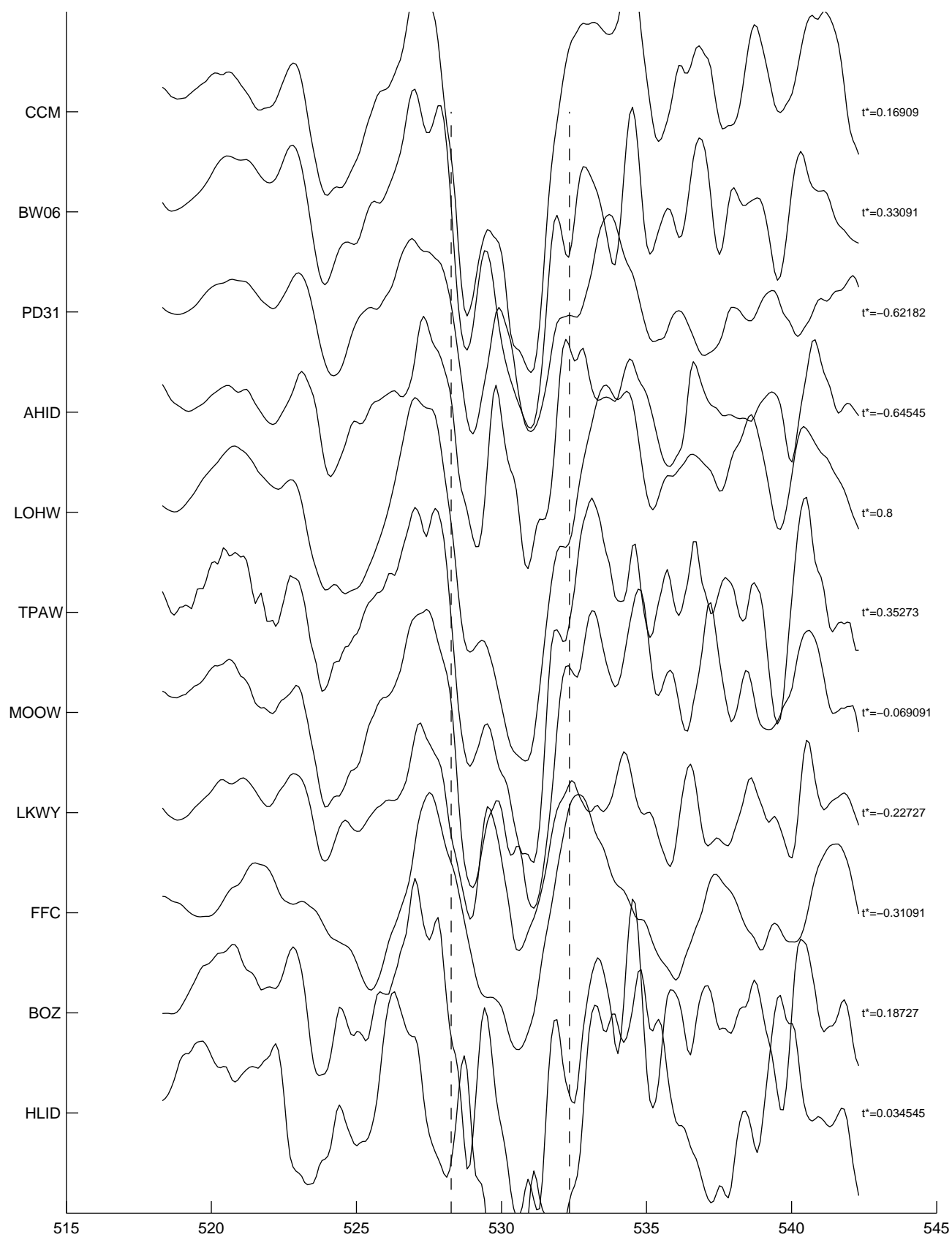
$t^*$  values



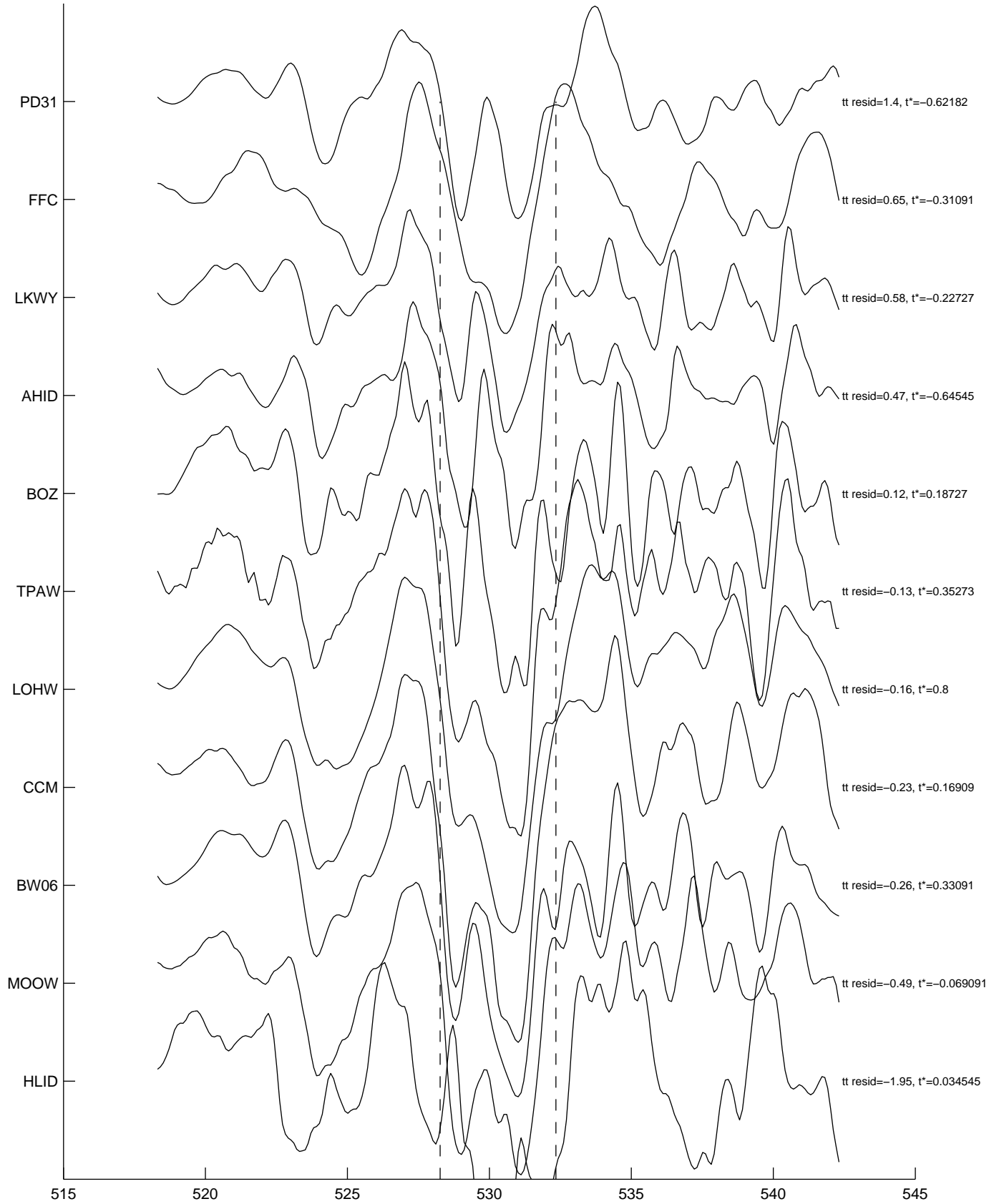
# Event\_2006\_165\_04\_18\_42



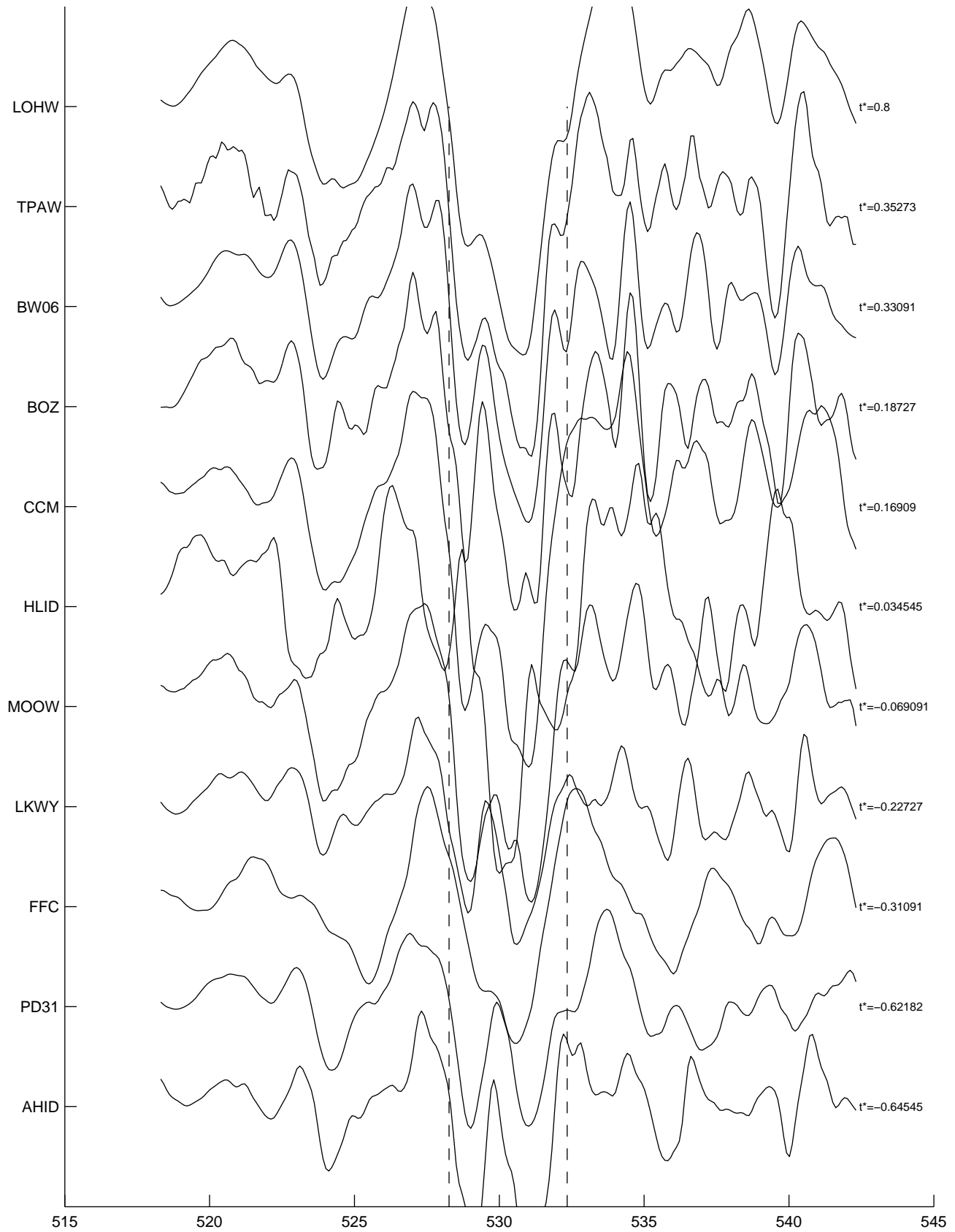
# Sorted by Delta:Event\_2006\_165\_04\_18\_42



# Sorted by travel time:Event\_2006\_165\_04\_18\_42

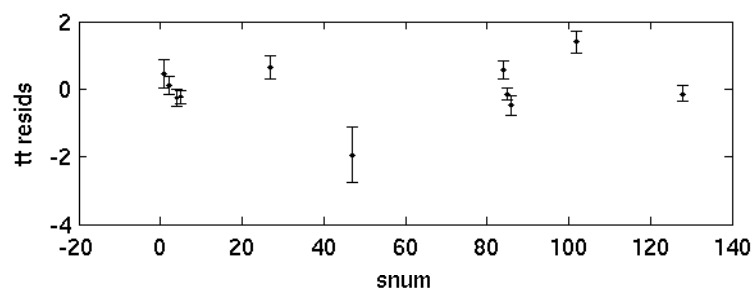
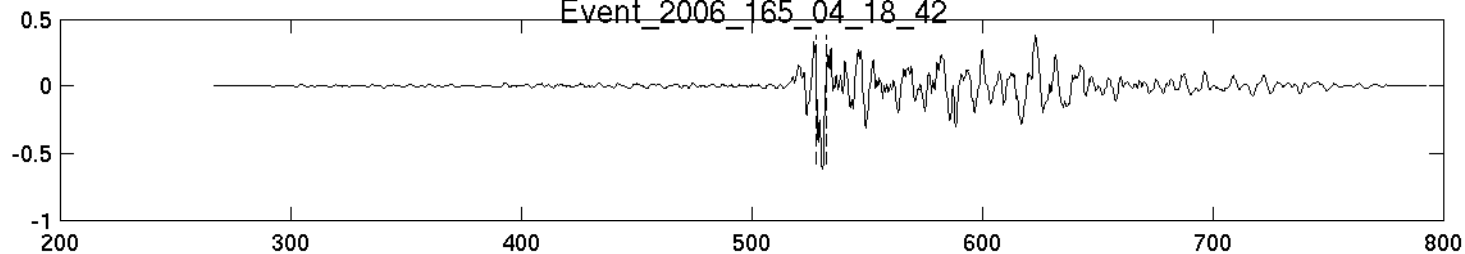


Sorted by  $t^*$ :Event\_2006\_165\_04\_18\_42

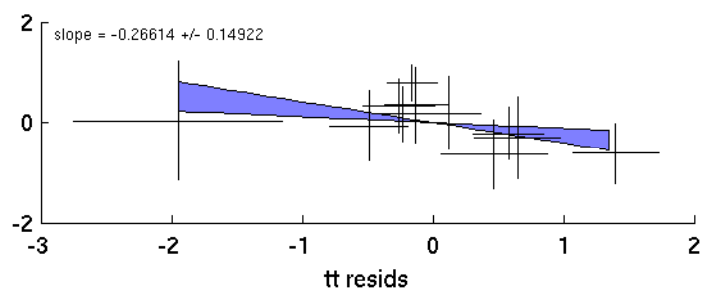
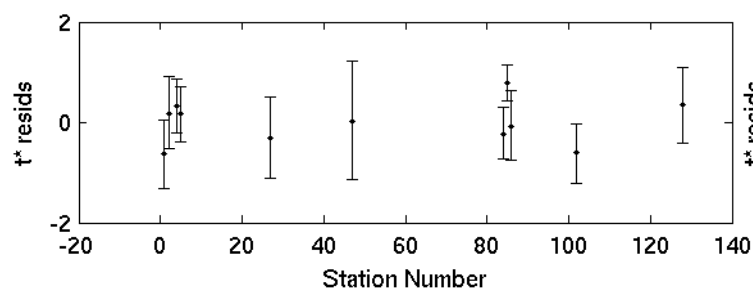


# Event\_2006\_165\_04\_18\_42

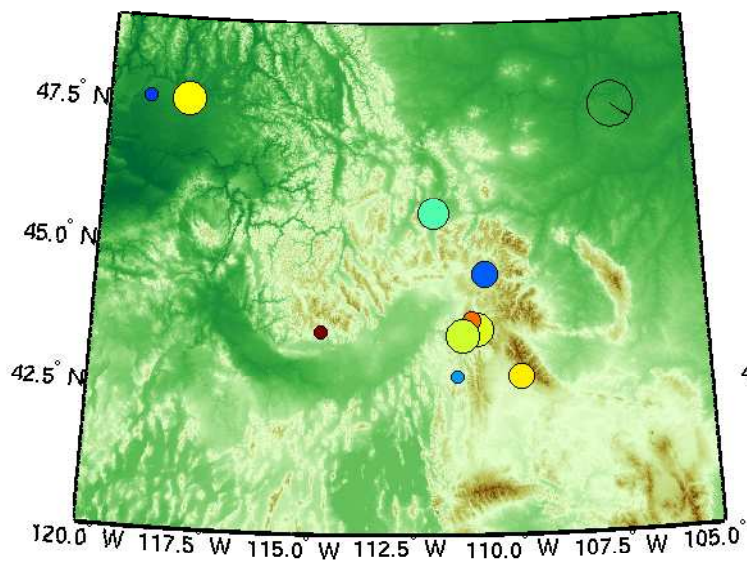
Stack



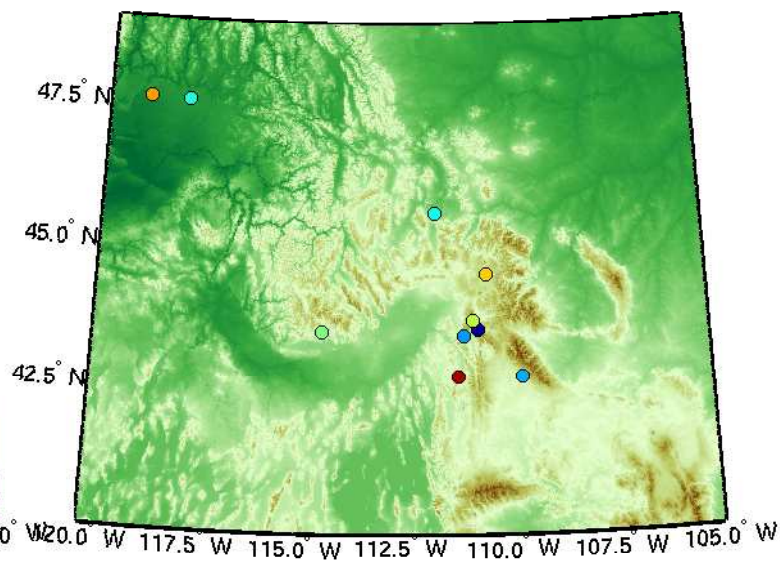
Baz = 306.534  
Mean xcor value = 0.74364  
Range of  $t^*$  values is 1.4455  
Median  $t^*$  err is 0.68496  
Slope =  $-0.26614 \pm 0.14922$



travel time residuals

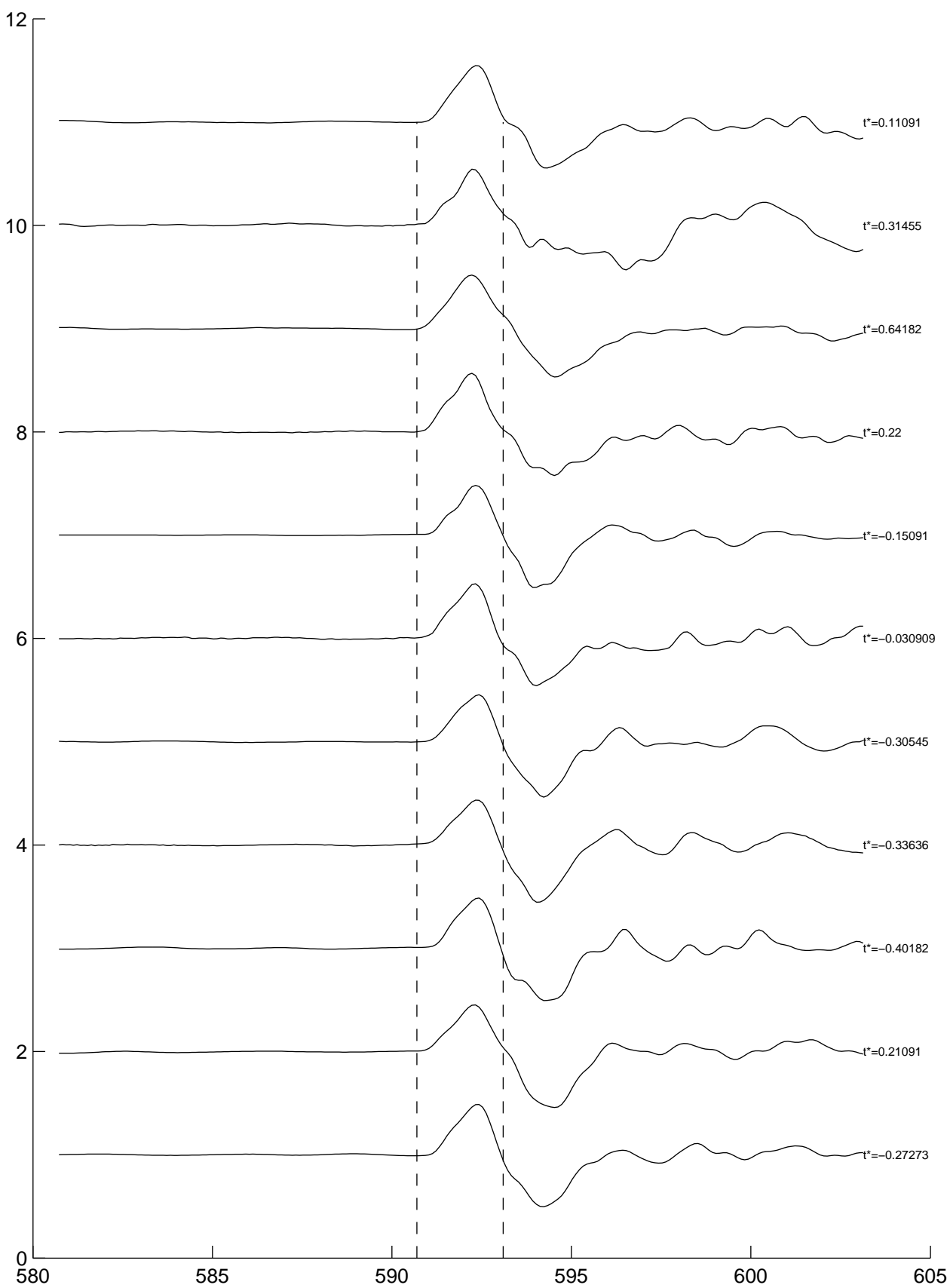


$t^*$  values

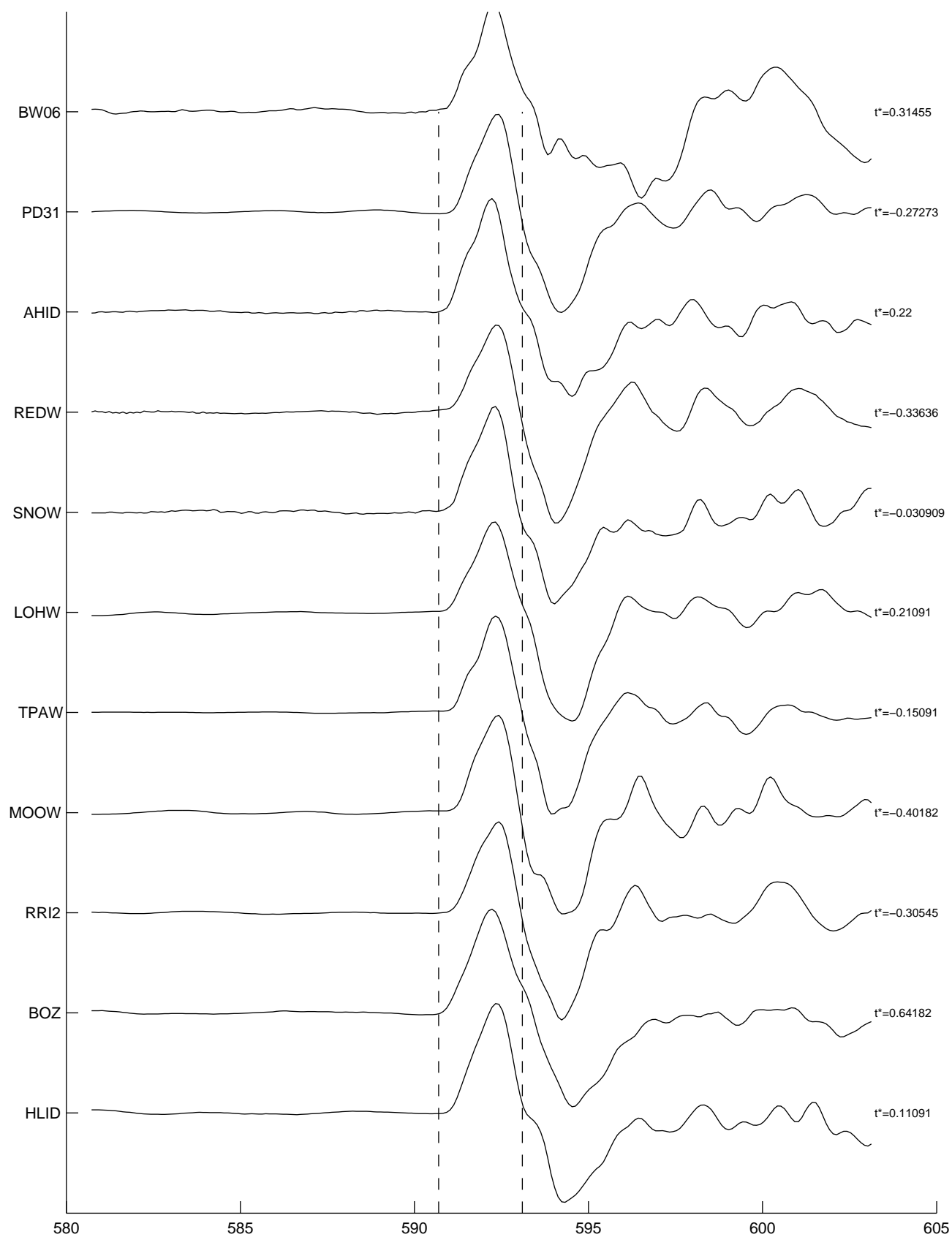




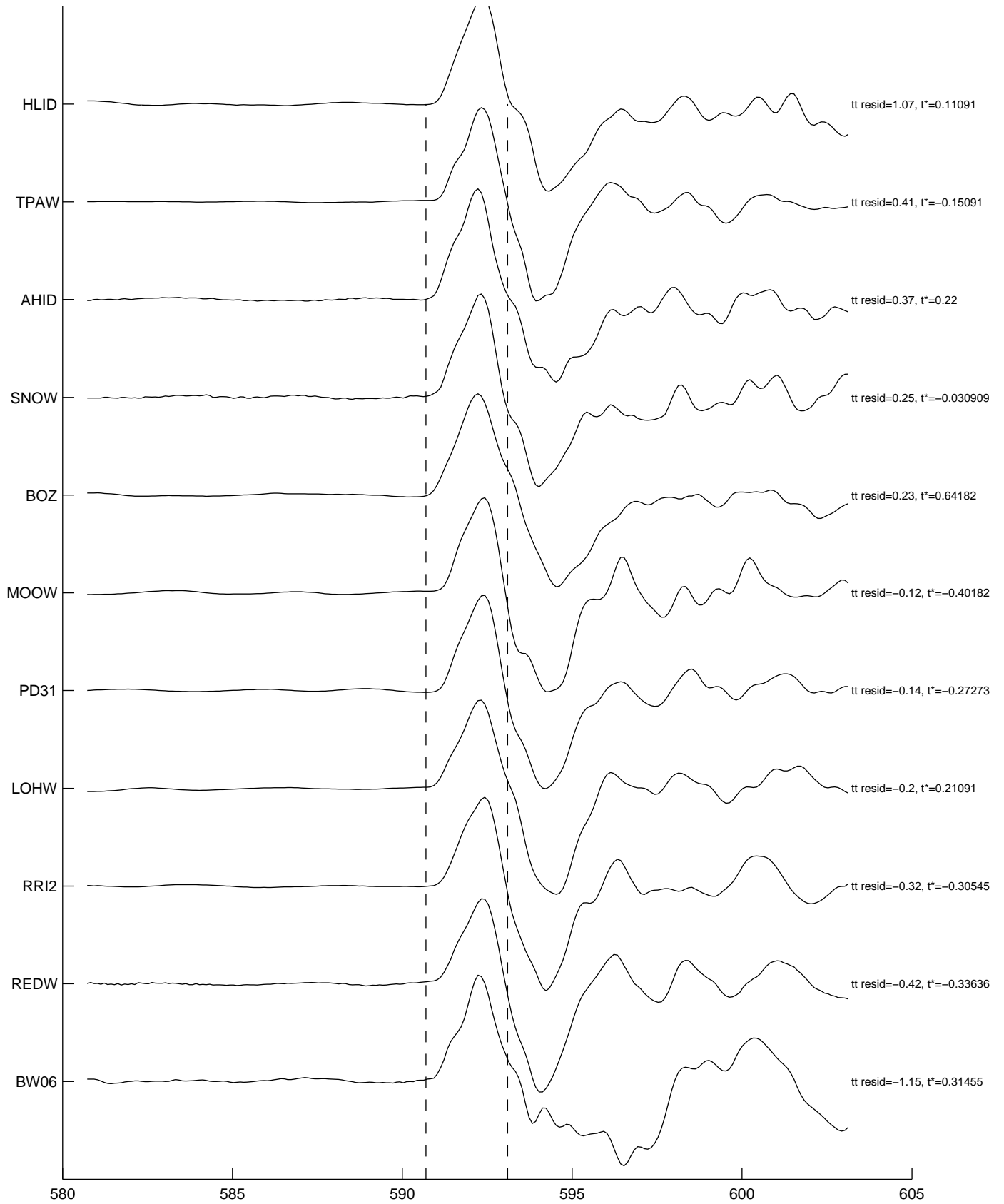
# Event\_2006\_236\_21\_50\_36



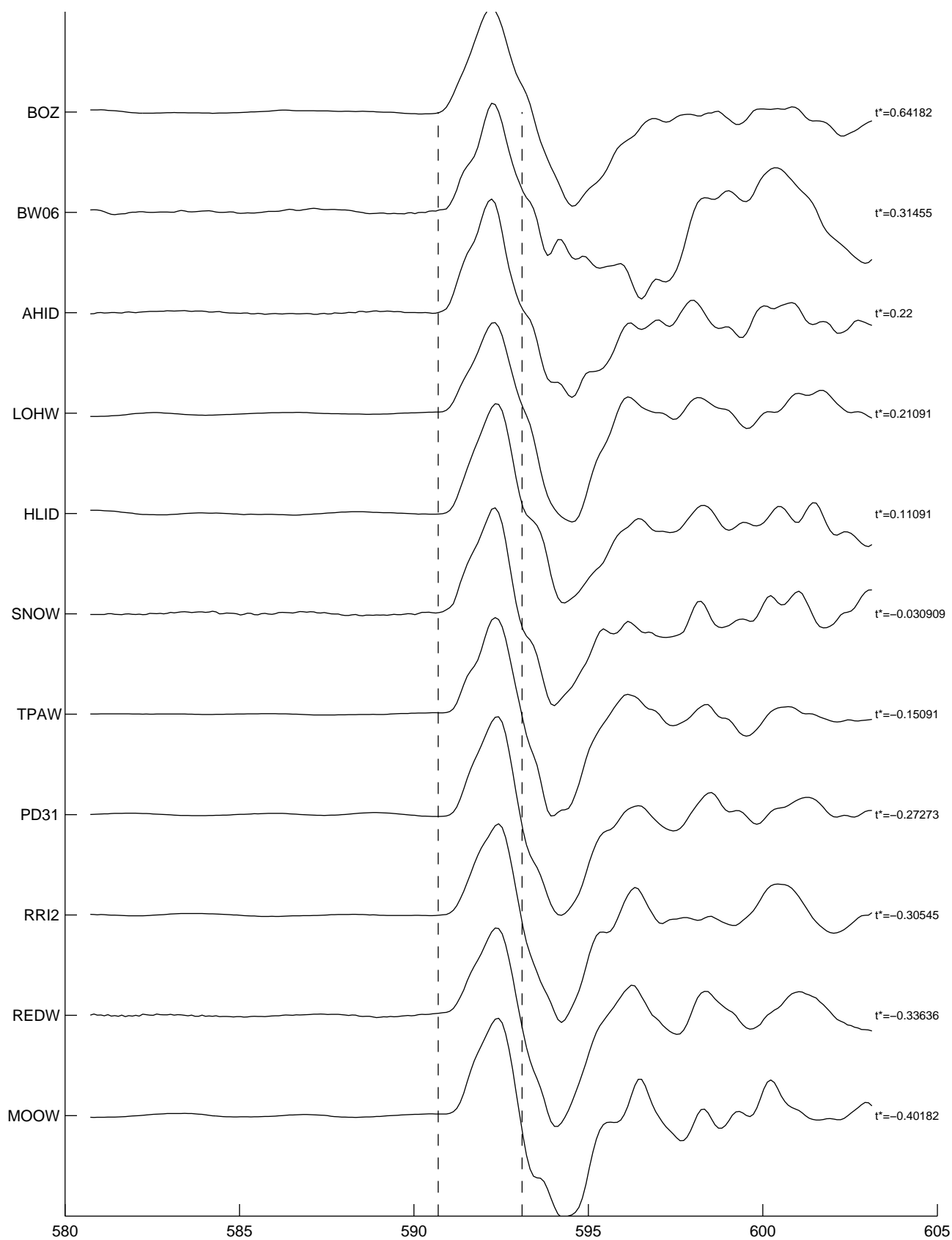
# Sorted by Delta:Event\_2006\_236\_21\_50\_36



# Sorted by travel time: Event\_2006\_236\_21\_50\_36

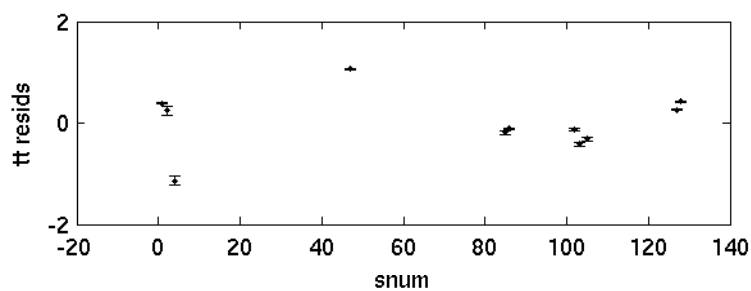
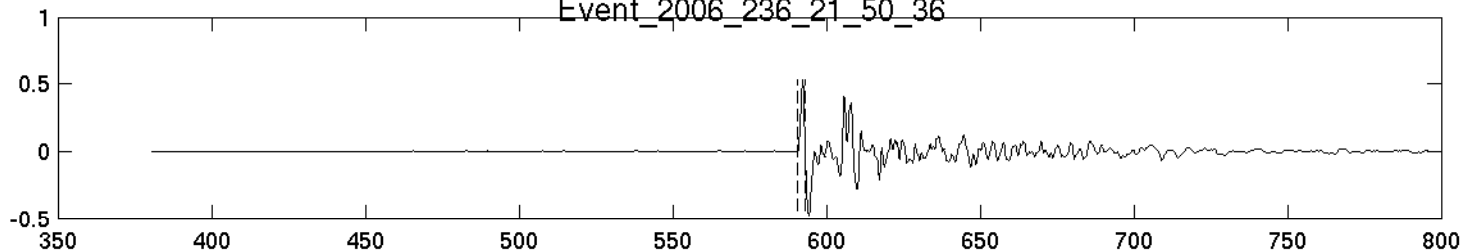


Sorted by  $t^*$ :Event\_2006\_236\_21\_50\_36

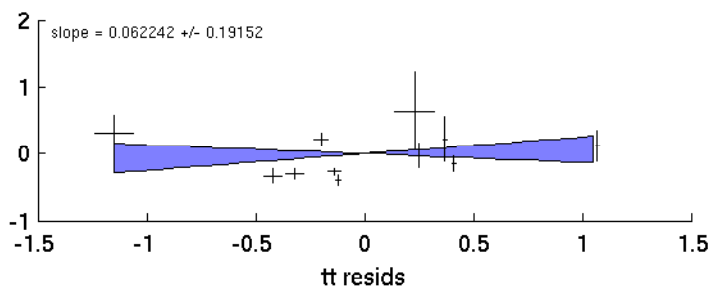
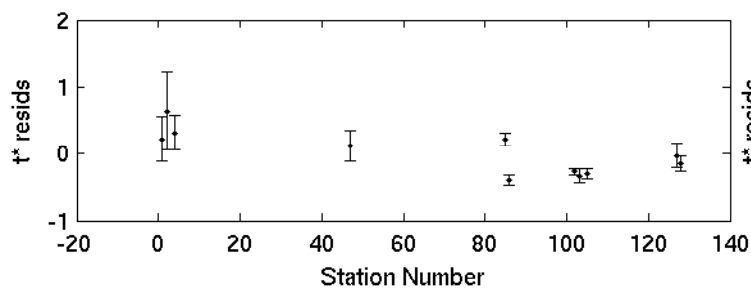


# Event\_2006\_236\_21\_50\_36

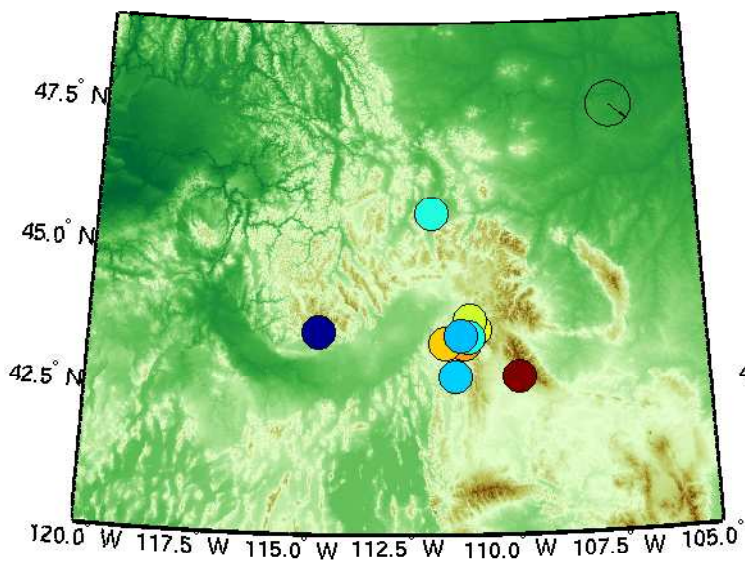
Stack



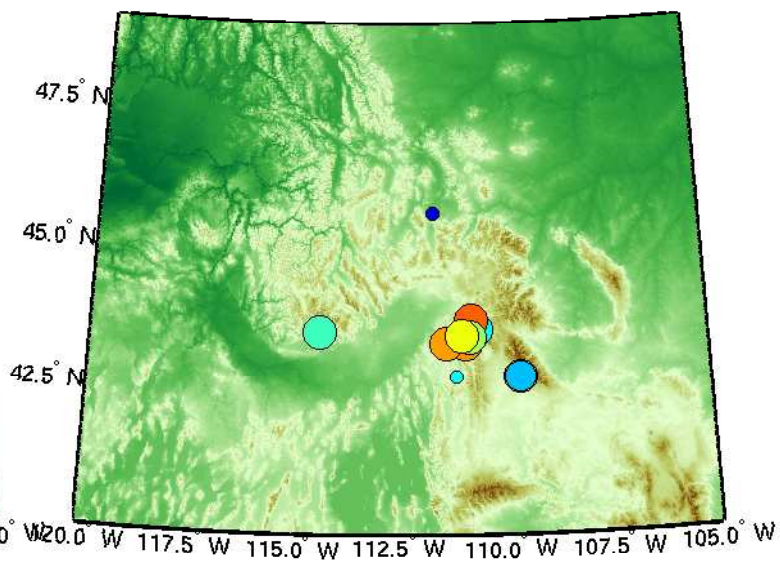
Baz = 312.3116  
Mean xcor value = 0.78545  
Range of  $t^*$  values is 1.0436  
Median  $t^*$  err is 0.11425  
Slope = 0.062242 +/- 0.19152



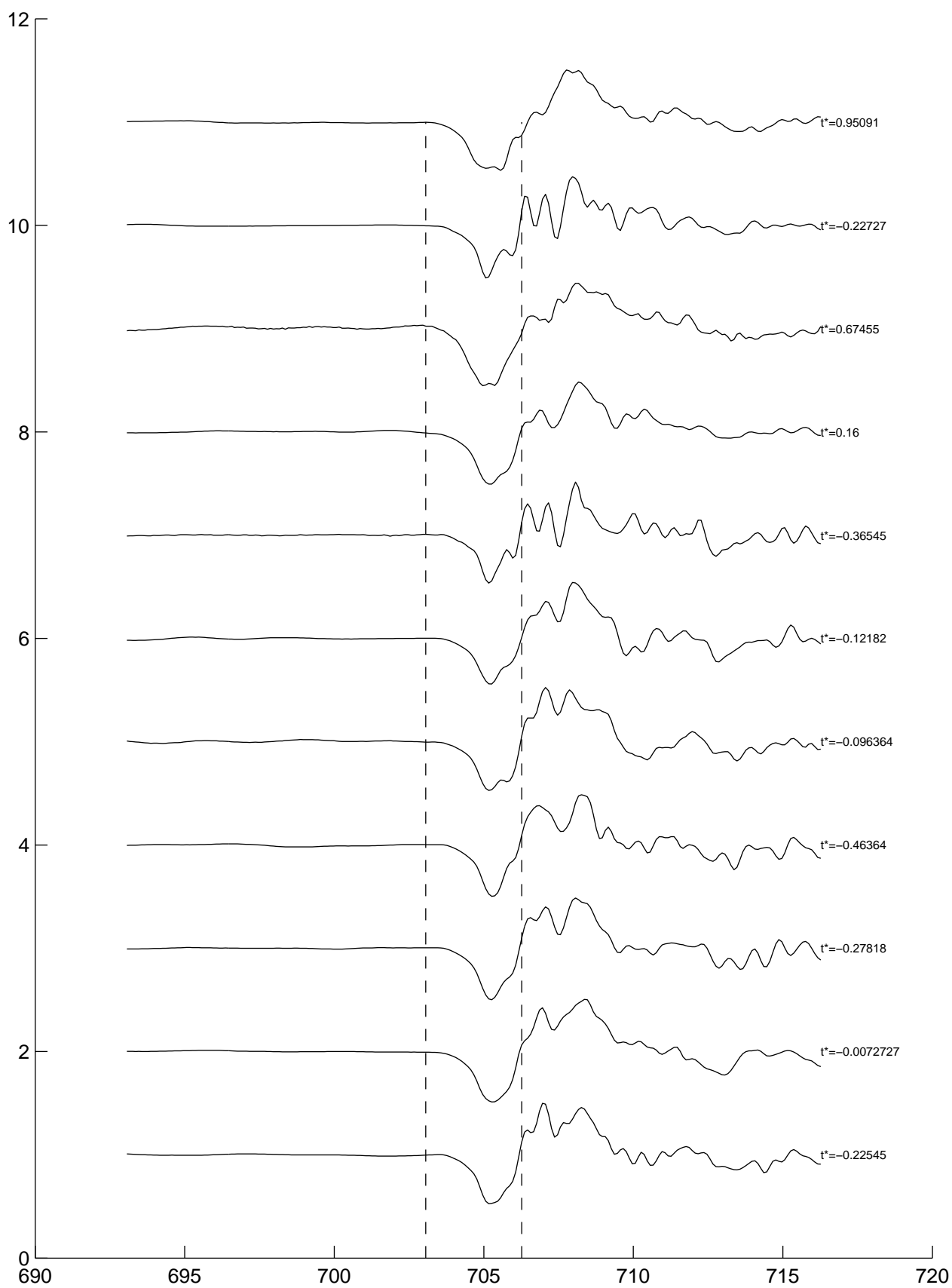
travel time residuals



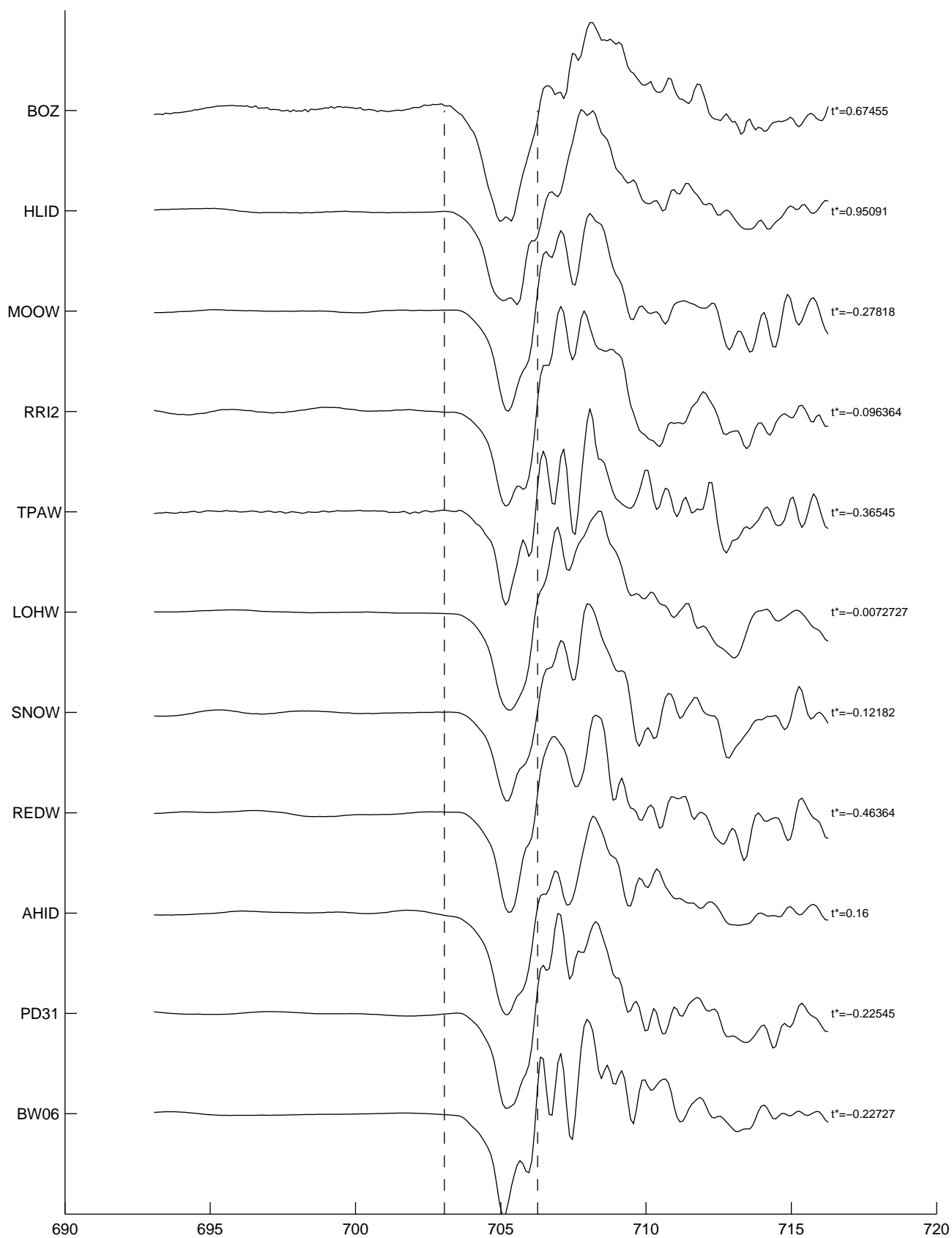
$t^*$  values



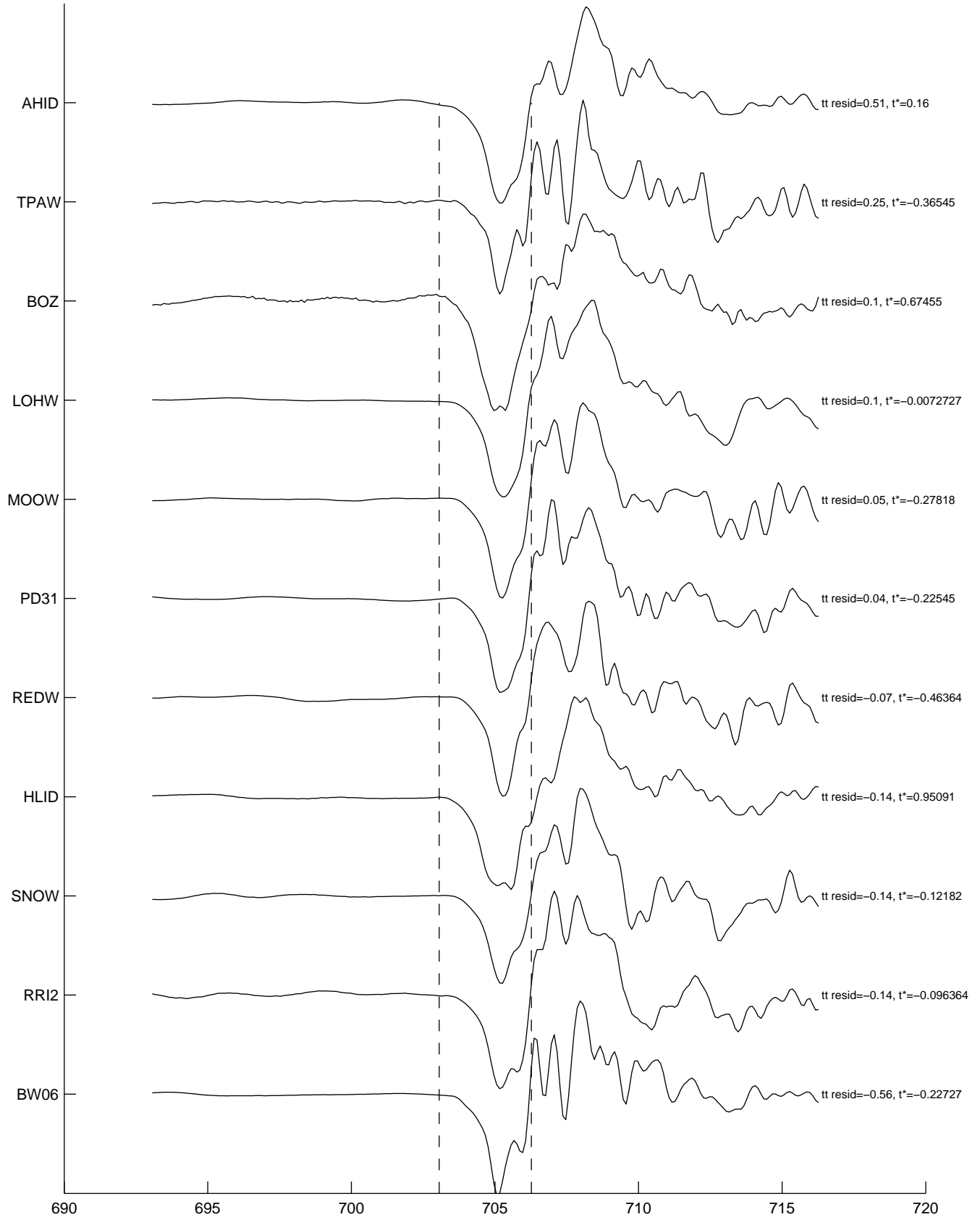
# Event\_2006\_237\_00\_44\_46



# Sorted by Delta:Event\_2006\_237\_00\_44\_46

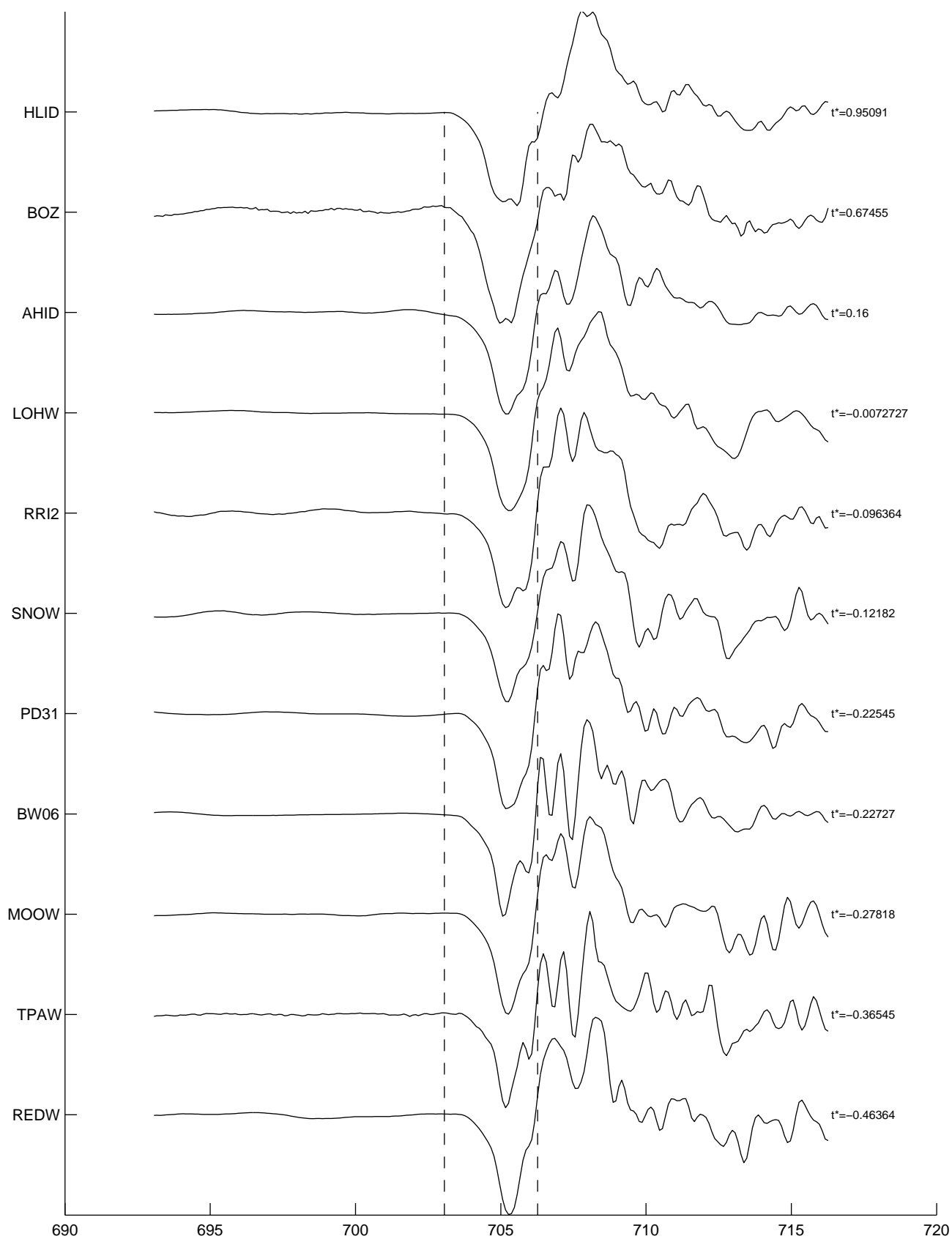


# Sorted by travel time:Event\_2006\_237\_00\_44\_46



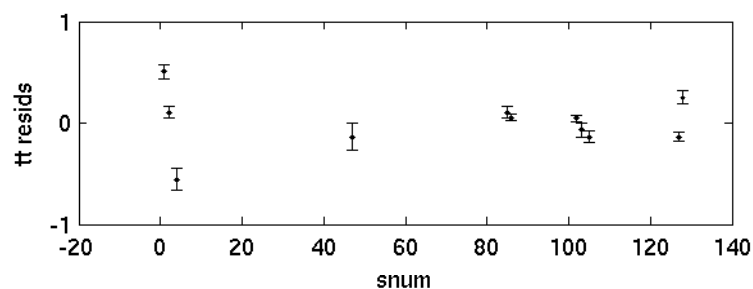
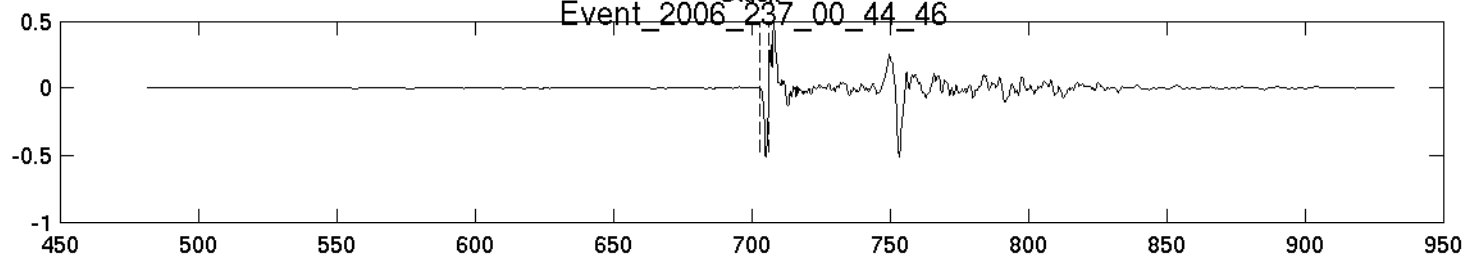


Sorted by  $t^*$ :Event\_2006\_237\_00\_44\_46

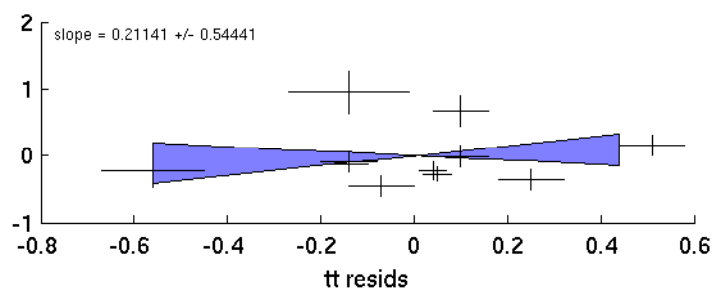
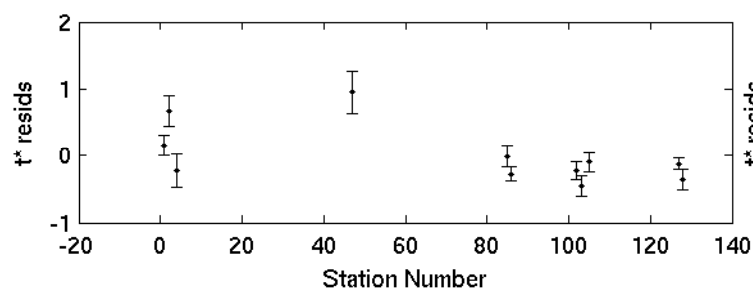


Event\_2006\_237\_00\_44\_46

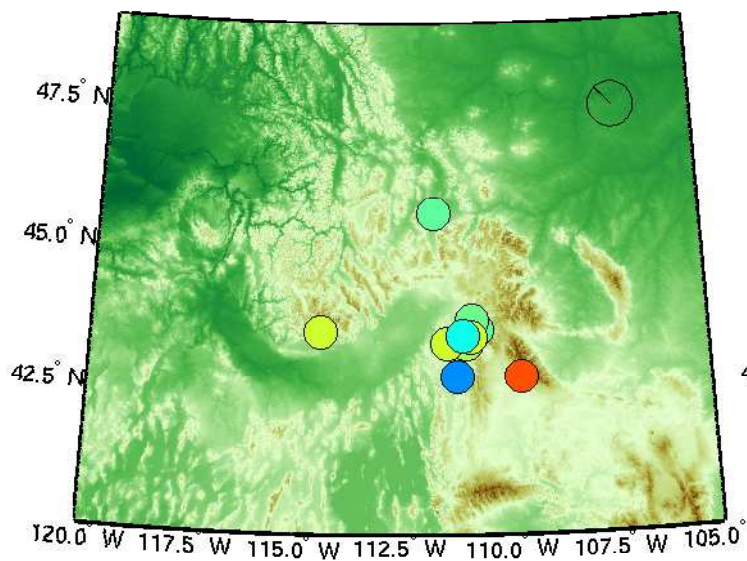
Stack



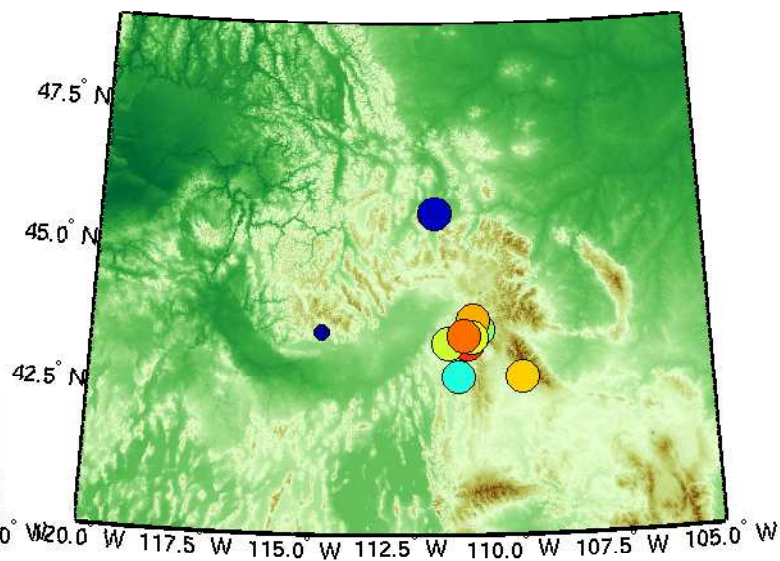
Baz = 139.7032  
Mean xcor value = 0.81364  
Range of  $t^*$  values is 1.4145  
Median  $t^*$  err is 0.15589  
Slope = 0.21141 +/- 0.54441



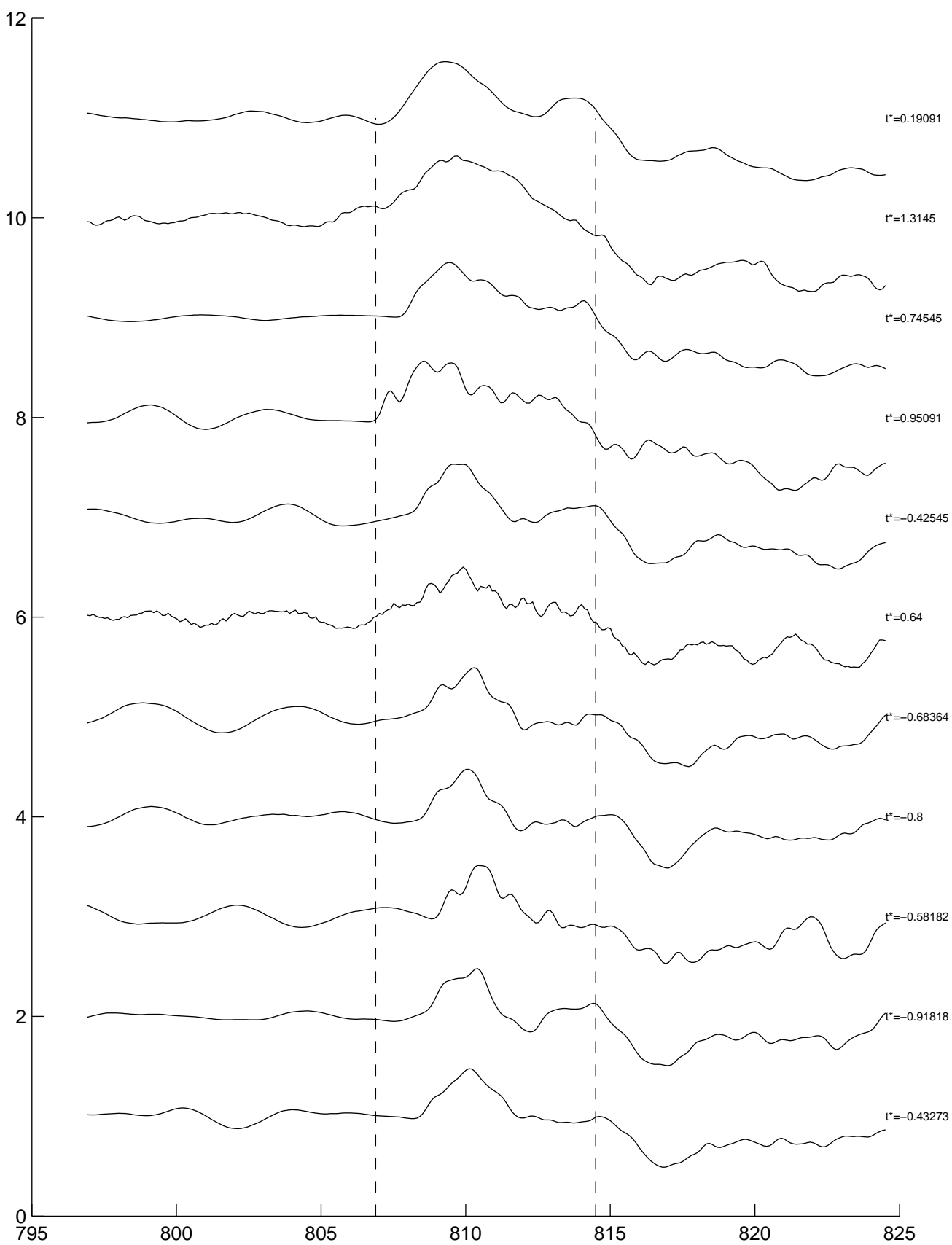
travel time residuals



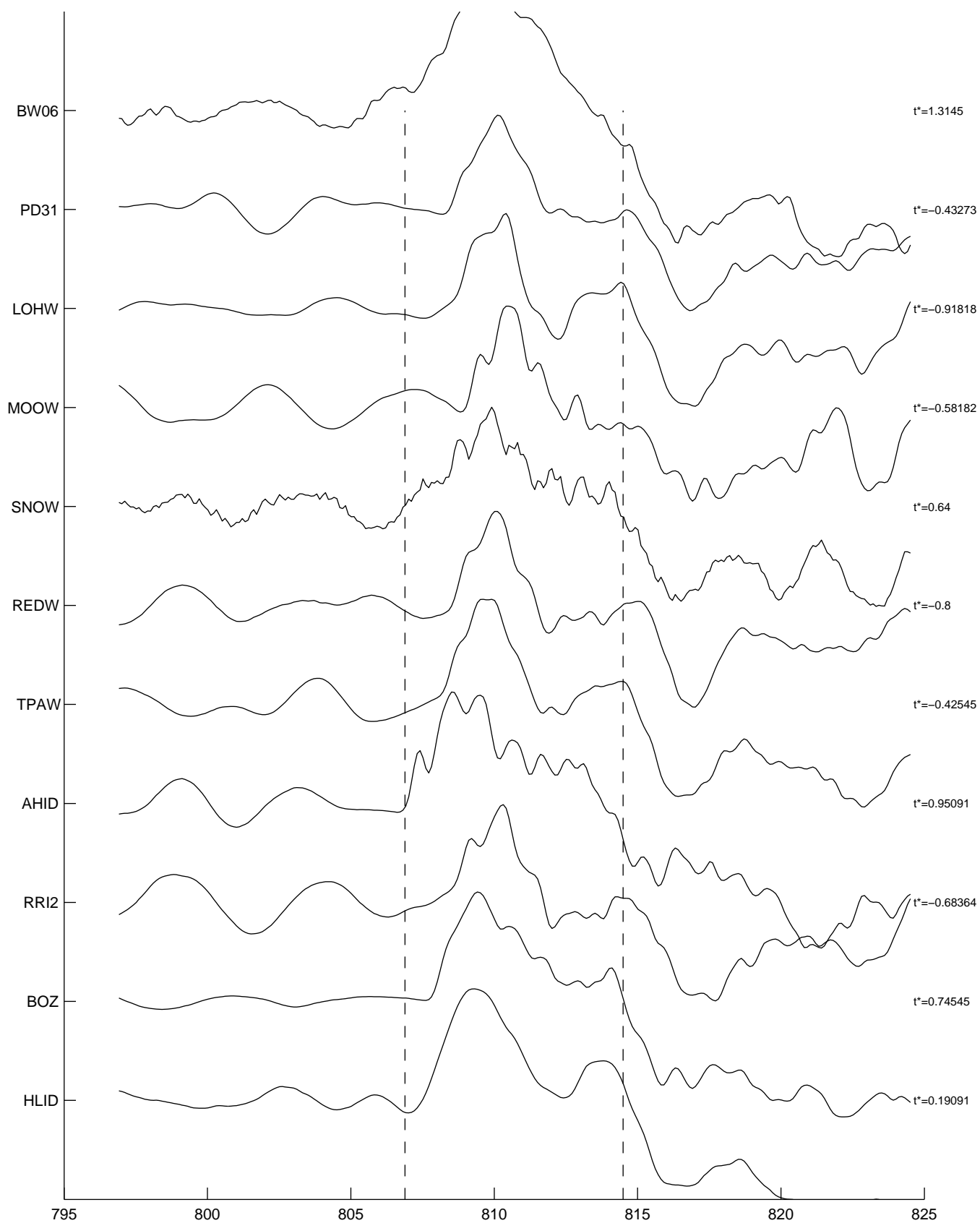
$t^*$  values



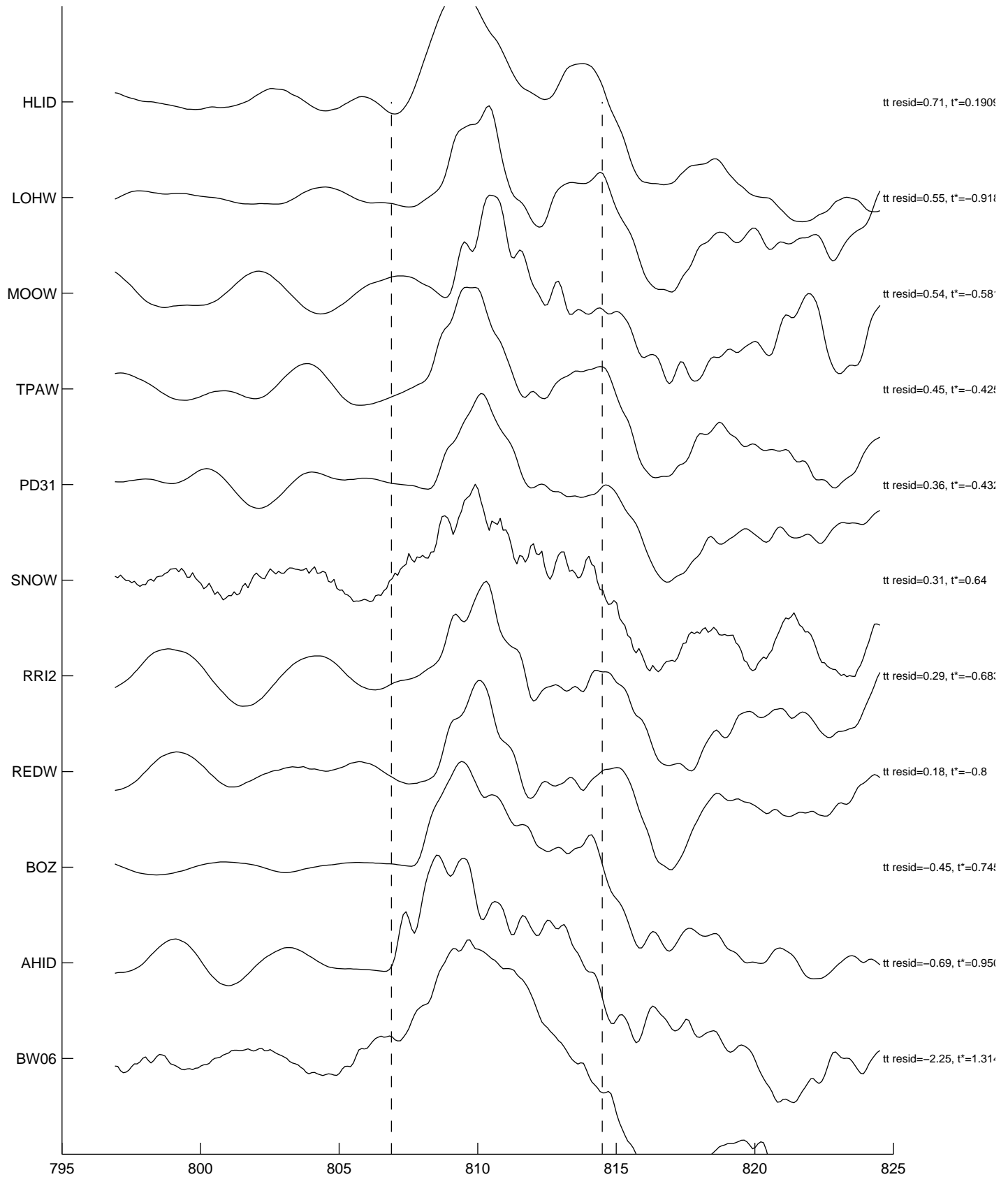
# Event\_2006\_244\_10\_18\_51



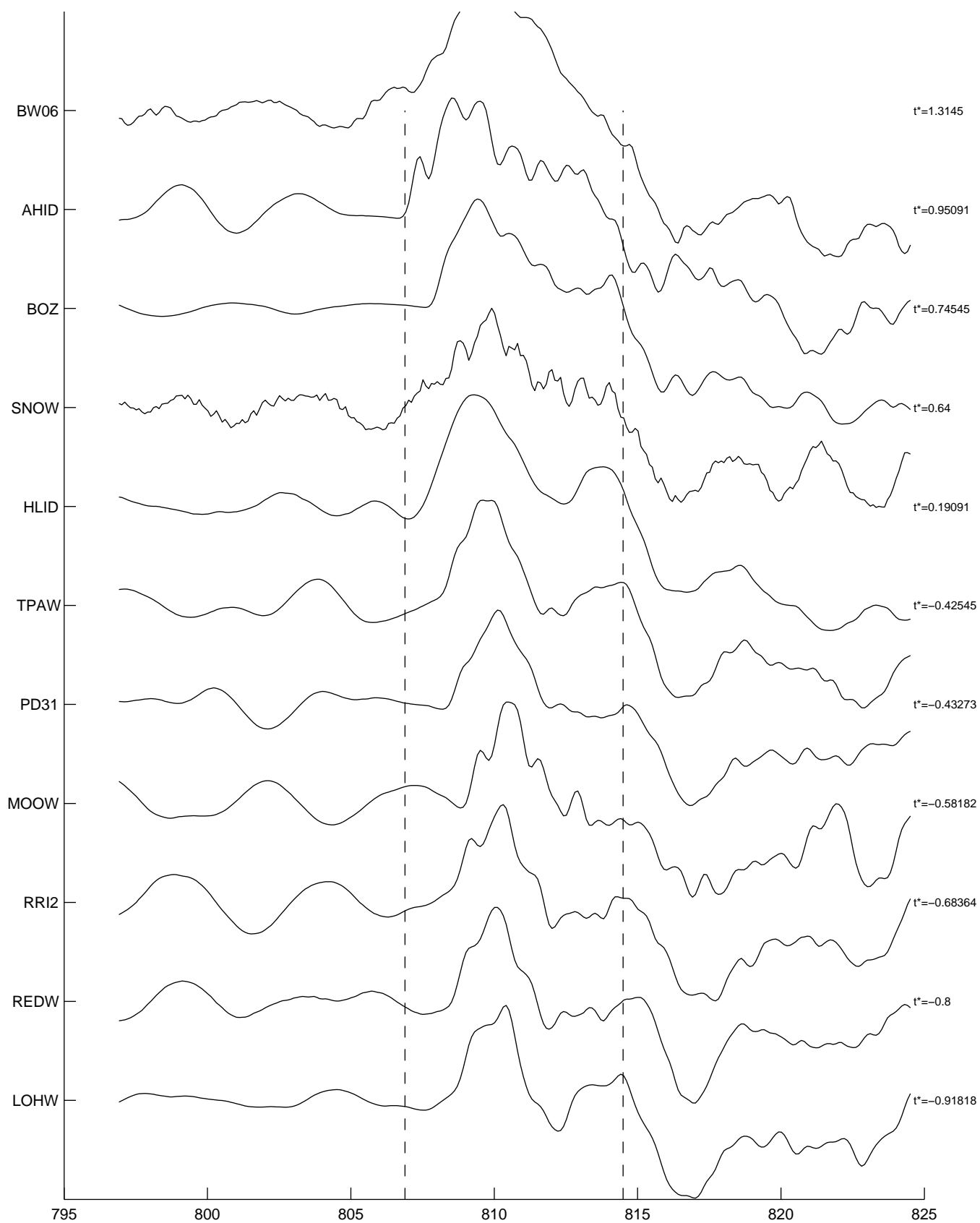
# Sorted by Delta:Event\_2006\_244\_10\_18\_51



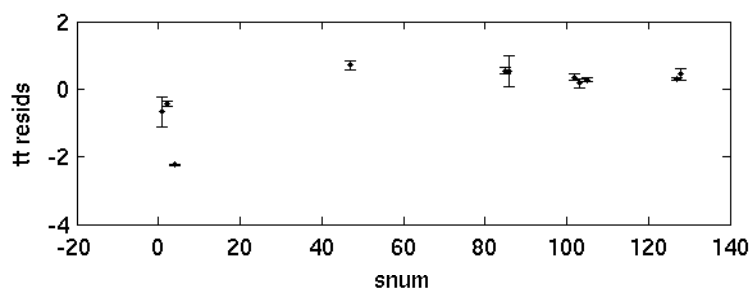
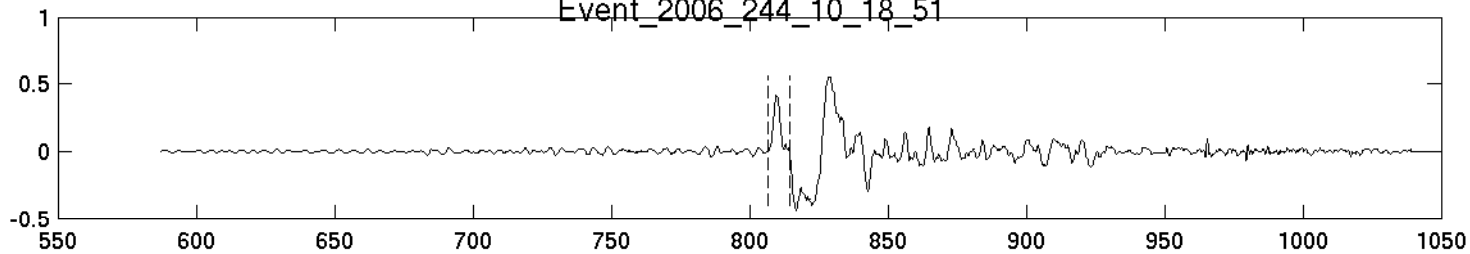
# Sorted by travel time:Event\_2006\_244\_10\_18\_51



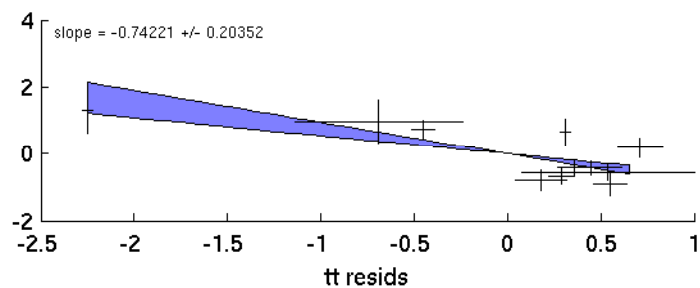
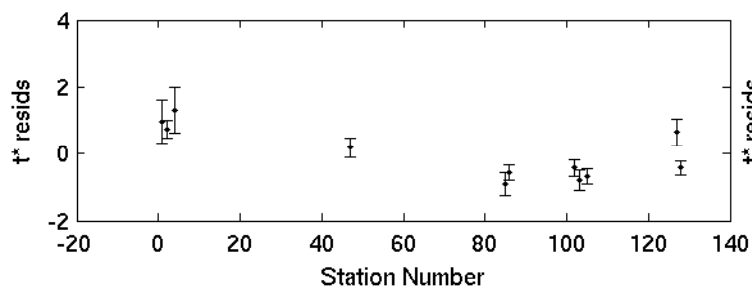
# Sorted by $t^*$ :Event\_2006\_244\_10\_18\_51



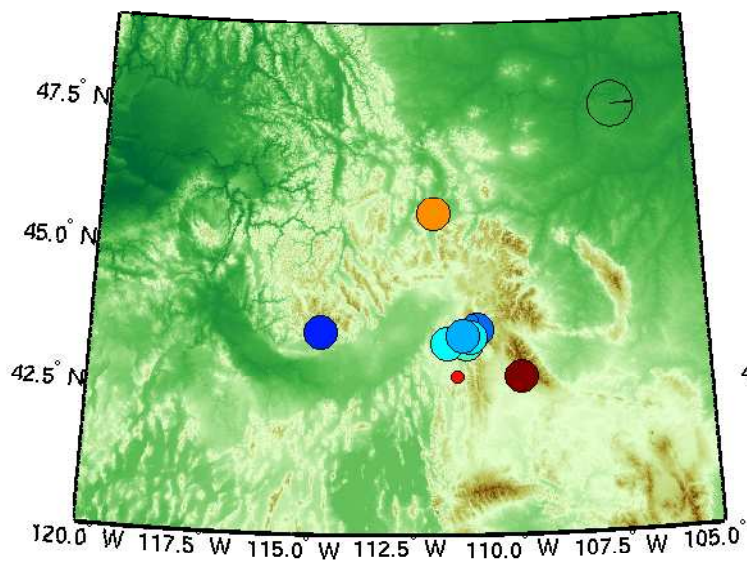
Stack  
Event\_2006\_244\_10\_18\_51



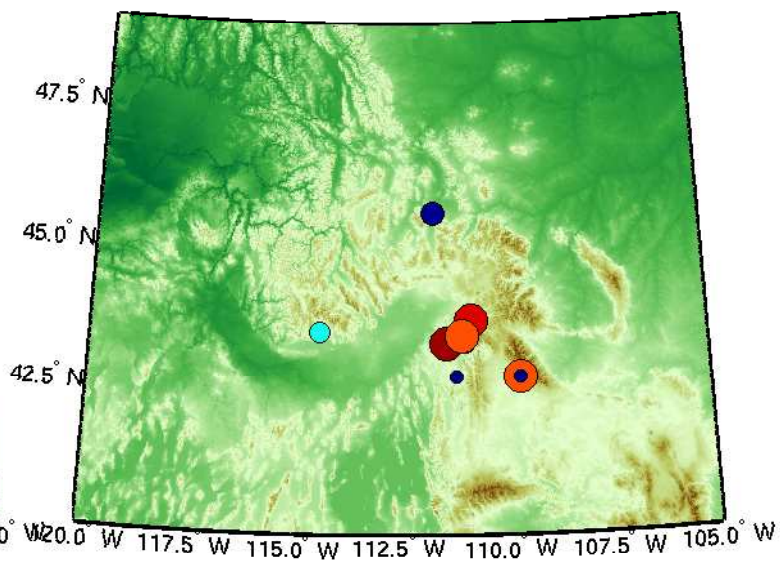
Baz = 267.3536  
Mean xcor value = 0.73364  
Range of  $t^*$  values is 2.2327  
Median  $t^*$  err is 0.28995  
Slope =  $-0.74221 \pm 0.20352$



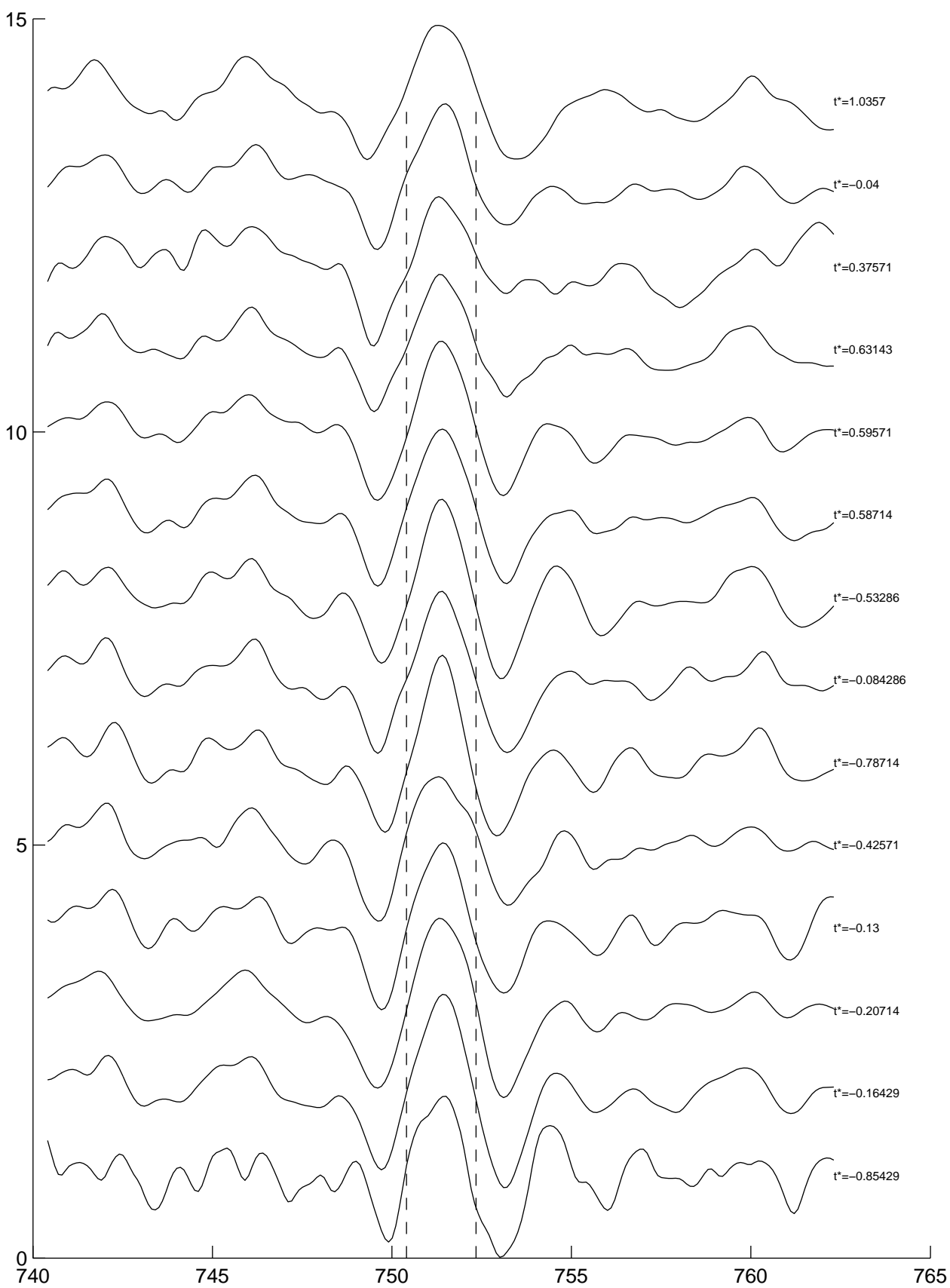
travel time residuals



$t^*$  values

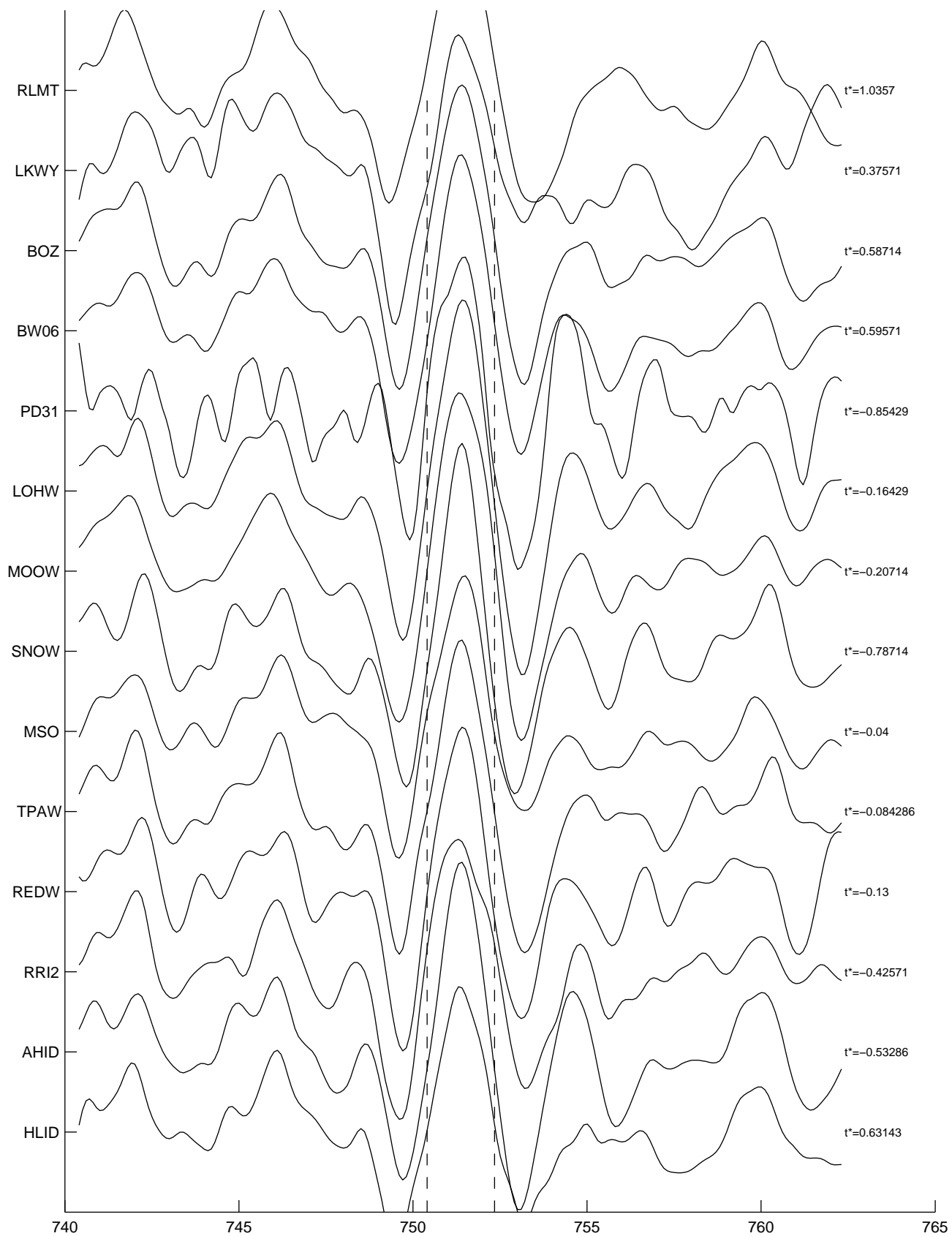


# Event\_2006\_271\_06\_22\_09

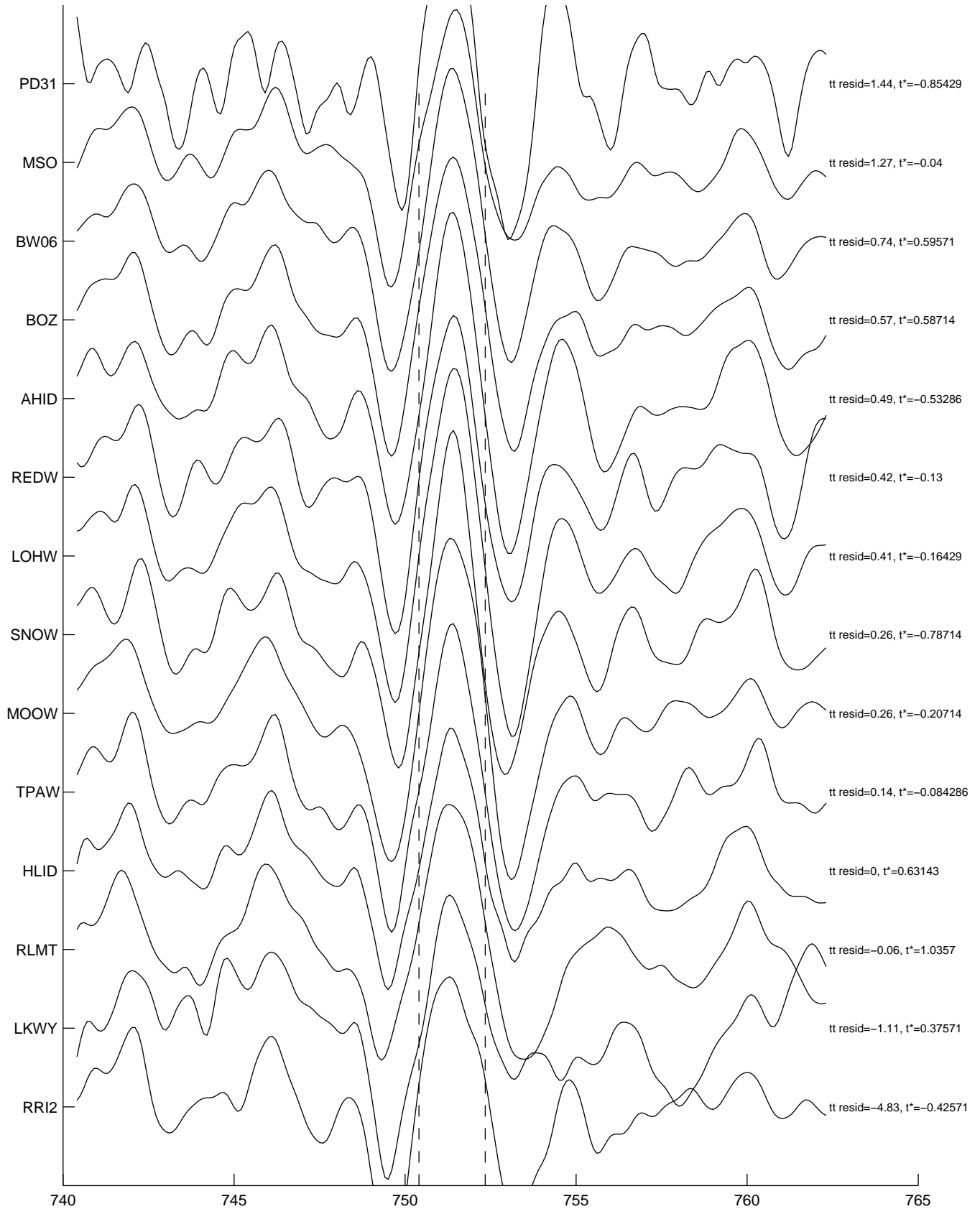




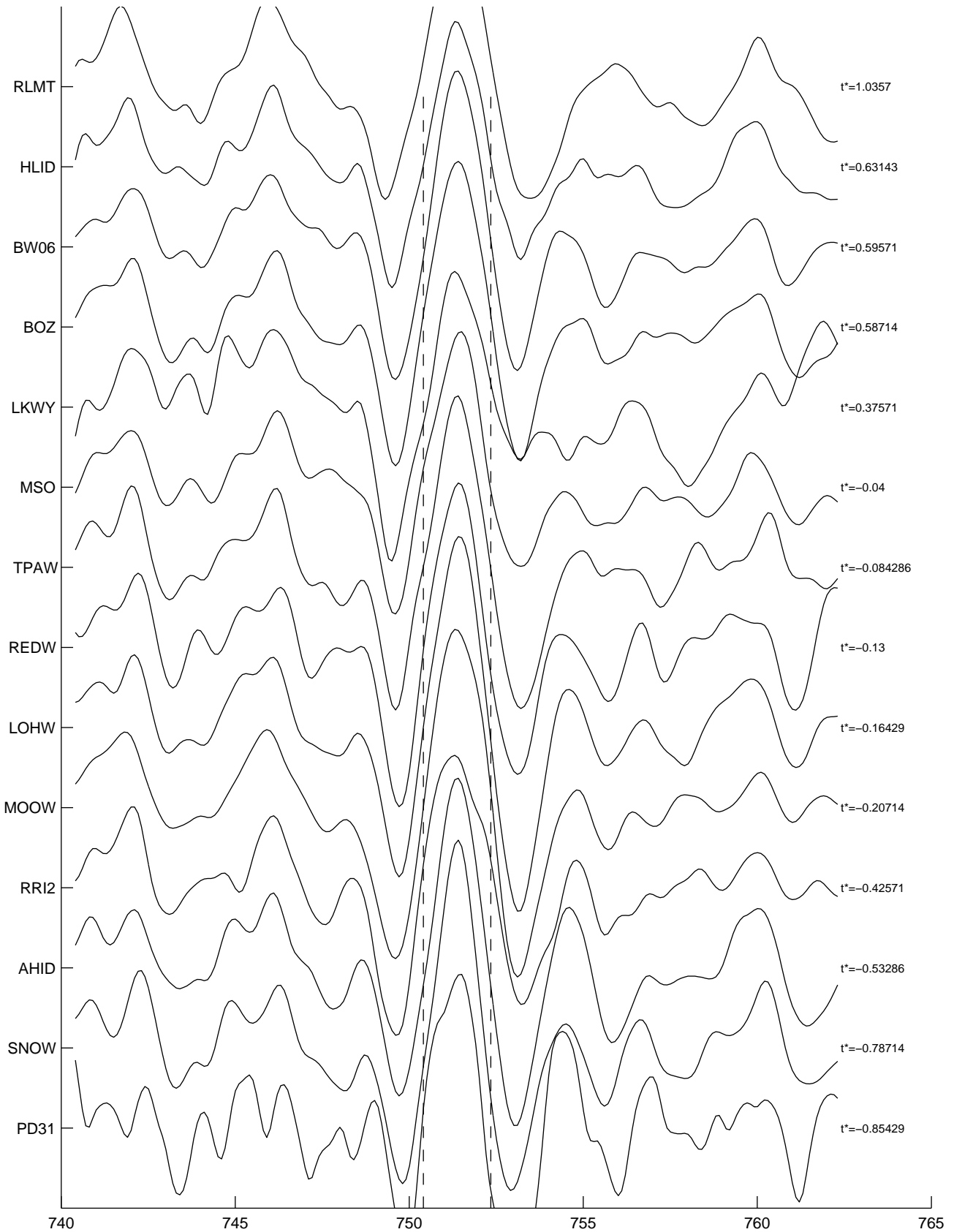
# Sorted by Delta:Event\_2006\_271\_06\_22\_09



# Sorted by travel time:Event\_2006\_271\_06\_22\_09

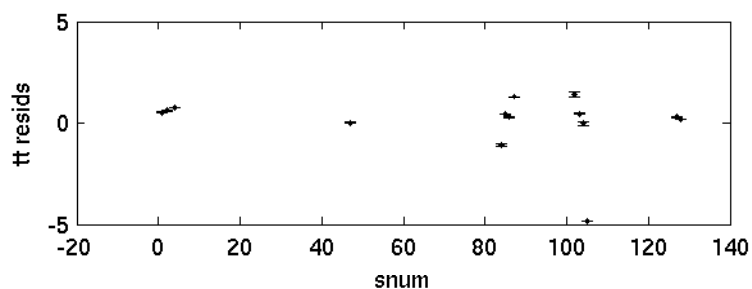
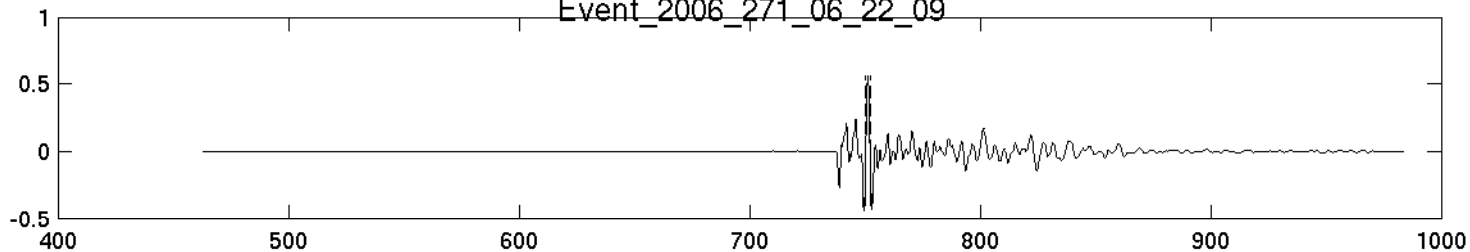


Sorted by  $t^*$ :Event\_2006\_271\_06\_22\_09

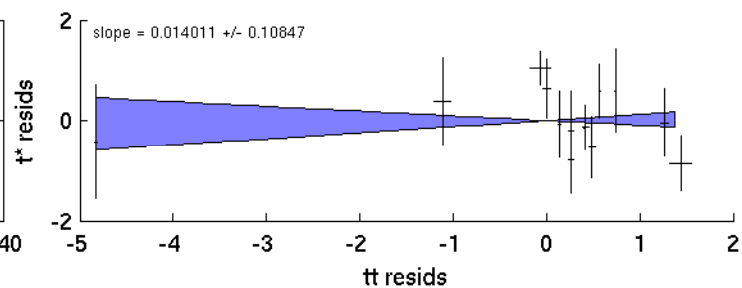
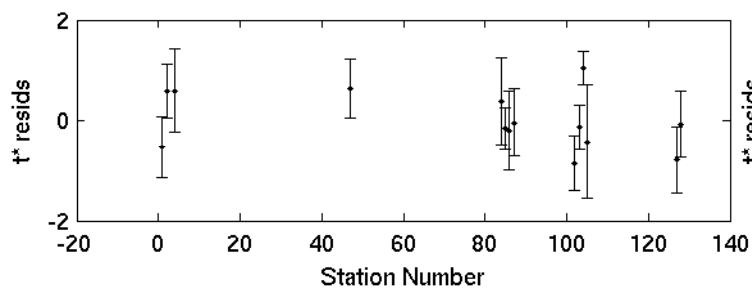


# Event\_2006\_271\_06\_22\_09

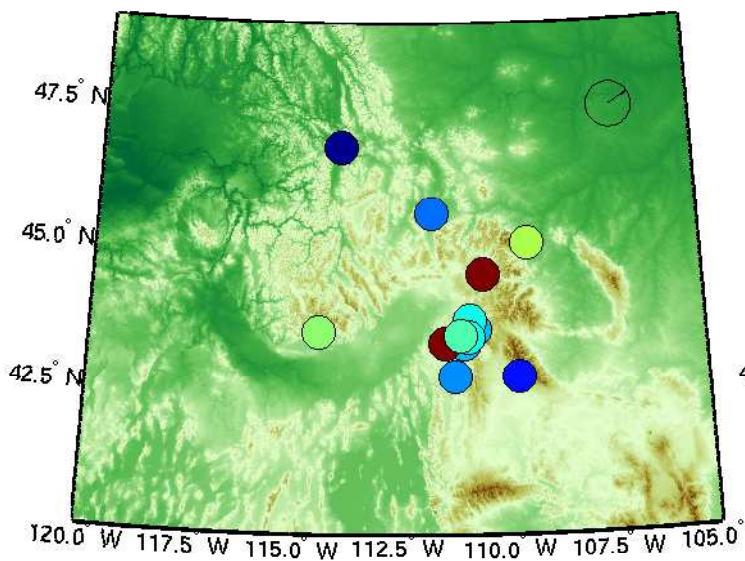
Stack



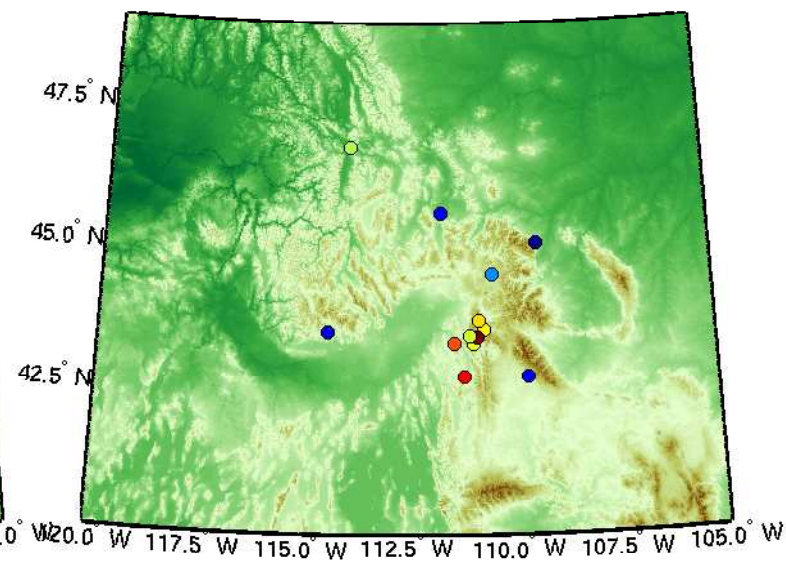
Baz = 237.7532  
Mean xcor value = 0.88071  
Range of  $t^*$  values is 1.89  
Median  $t^*$  err is 0.64018  
Slope = 0.014011 +/- 0.10847



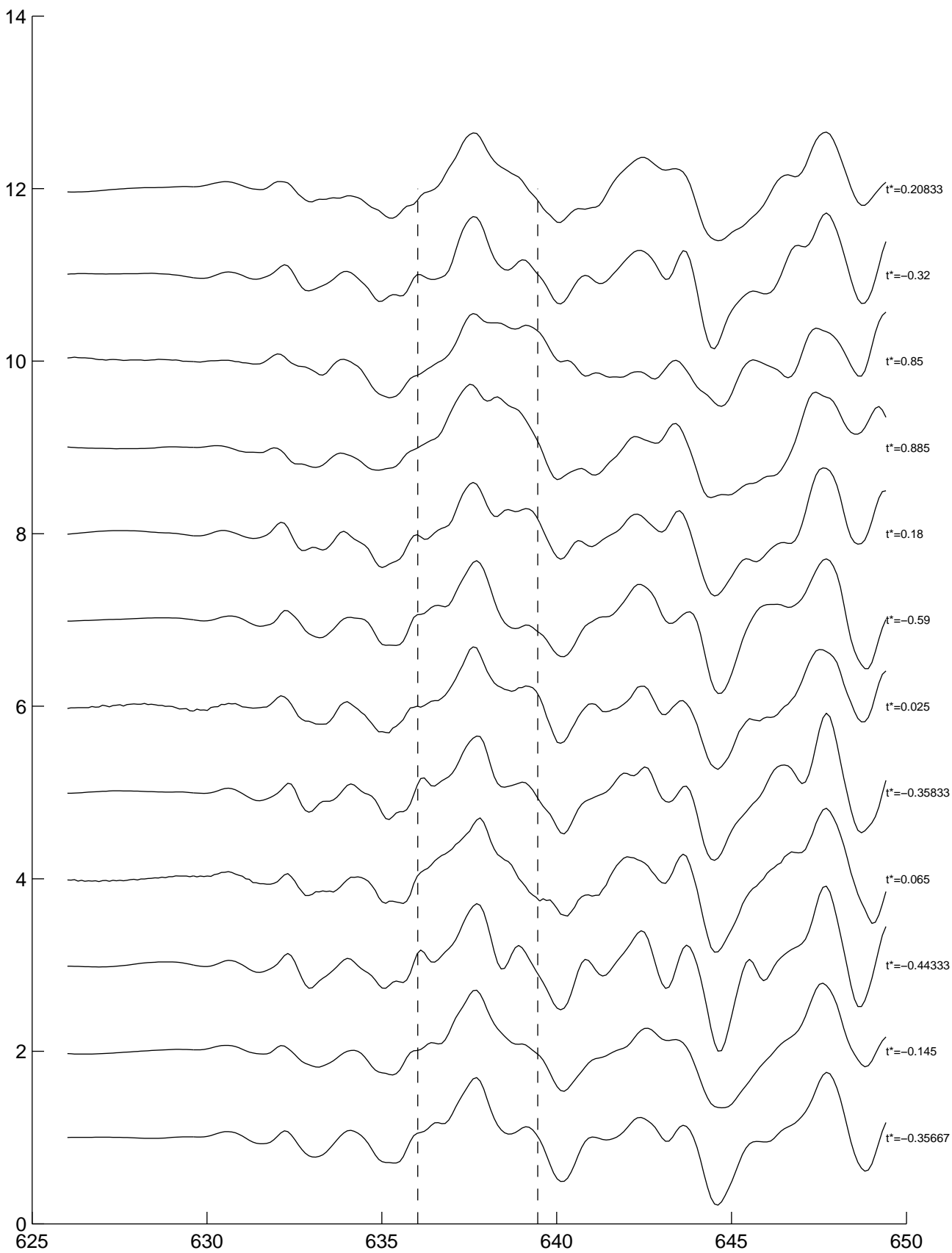
travel time residuals



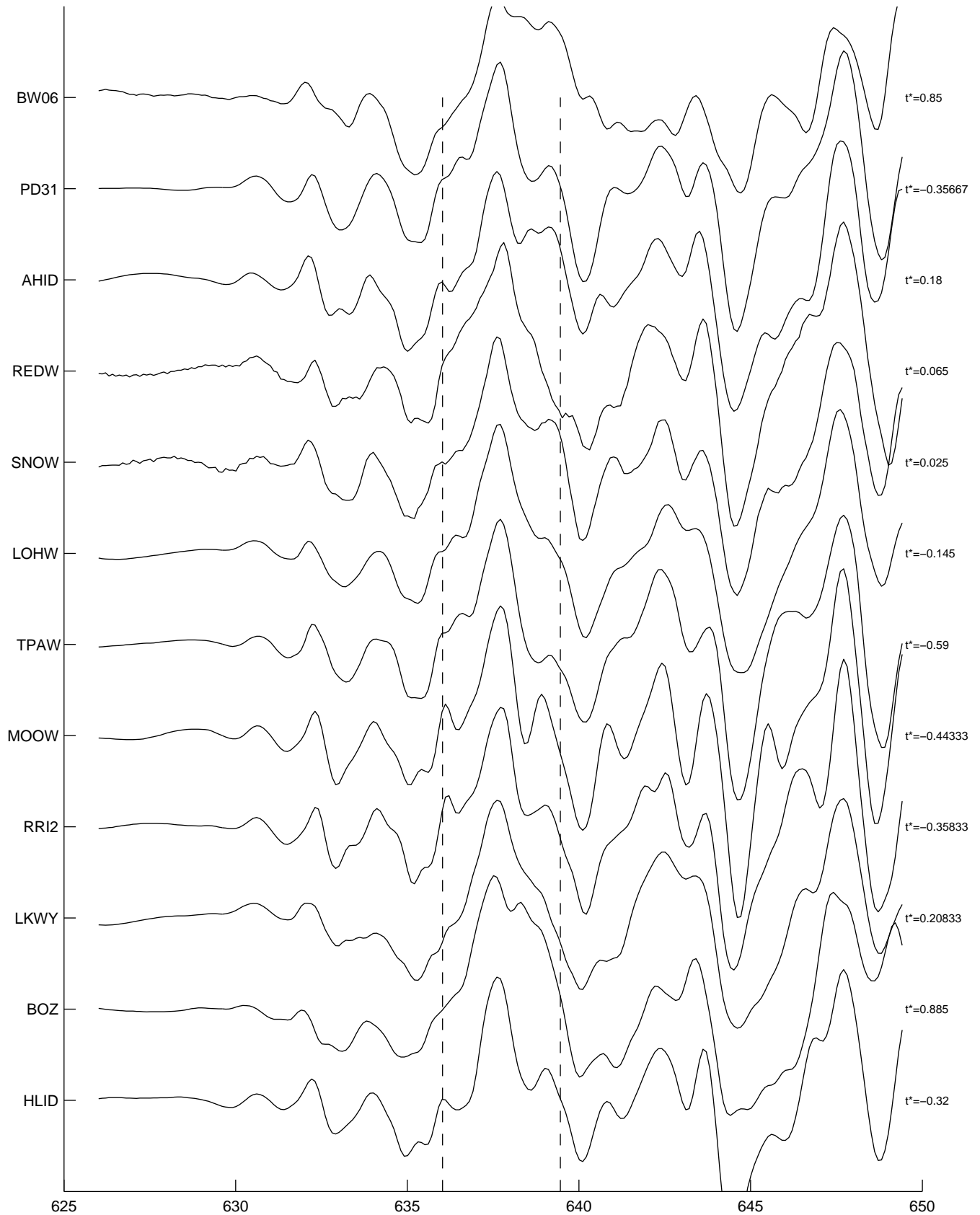
$t^*$  values



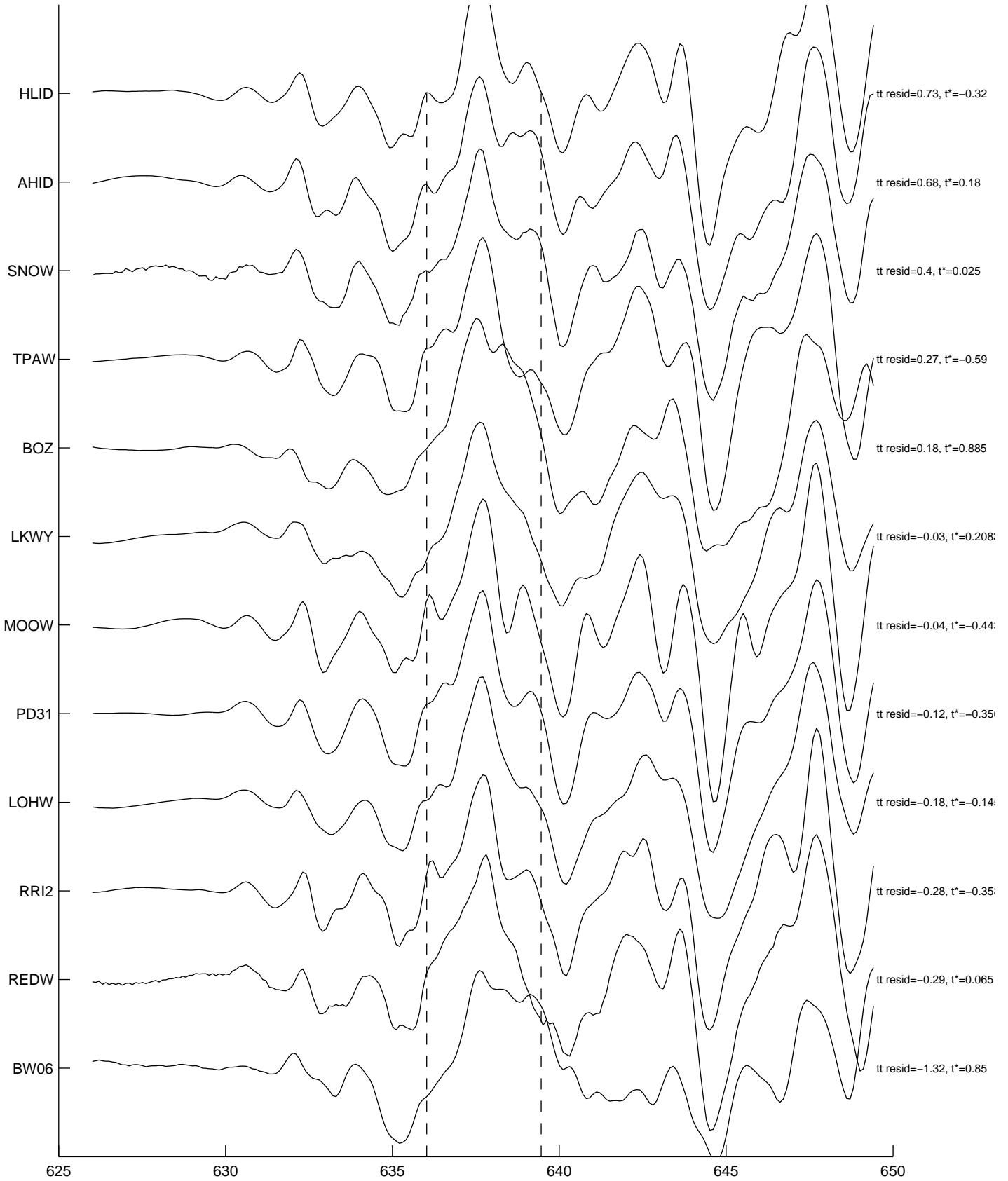
# Event\_2006\_273\_17\_50\_23



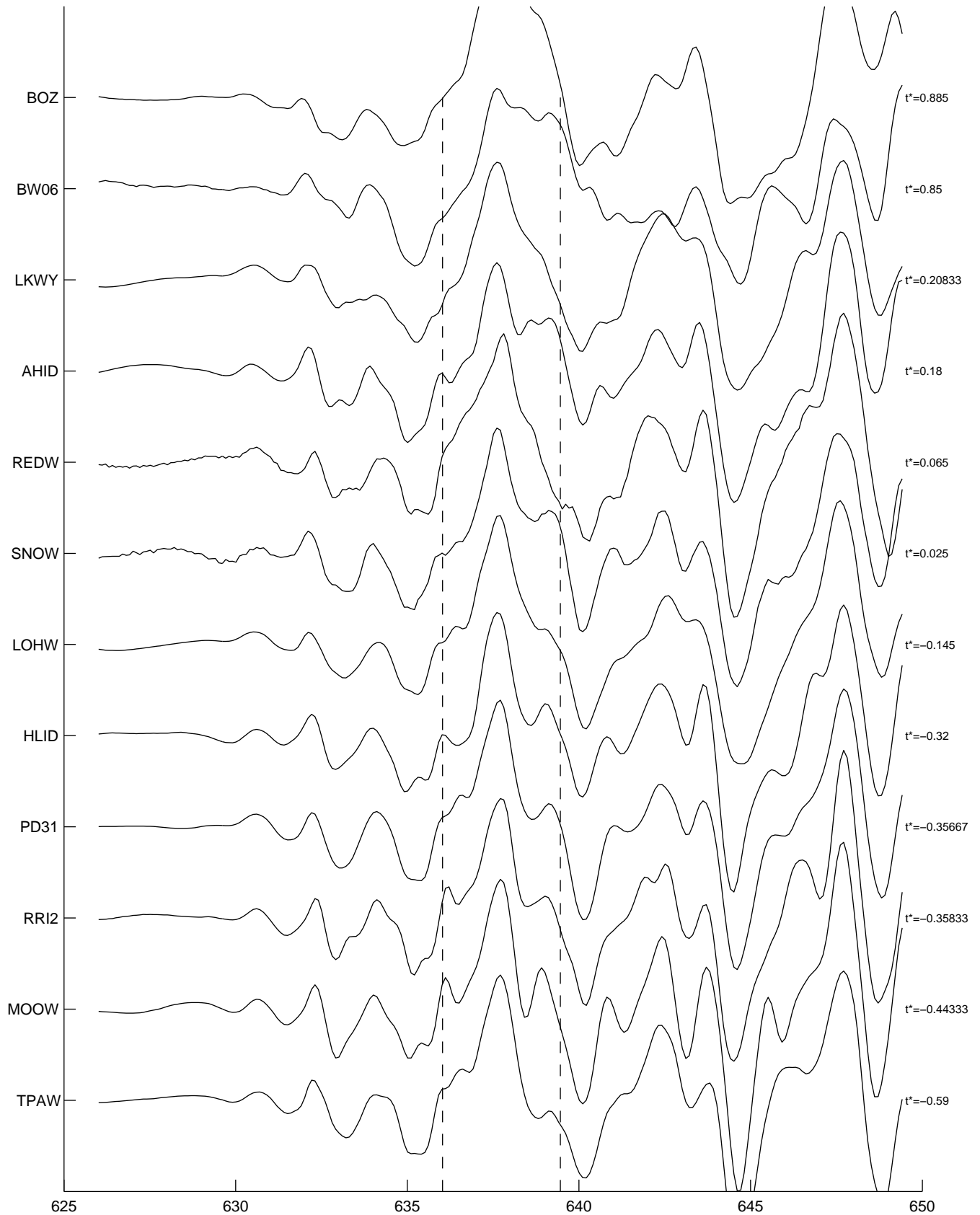
# Sorted by Delta:Event\_2006\_273\_17\_50\_23



# Sorted by travel time: Event\_2006\_273\_17\_50\_23

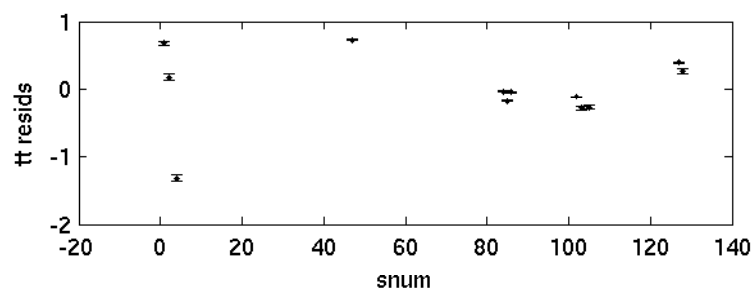
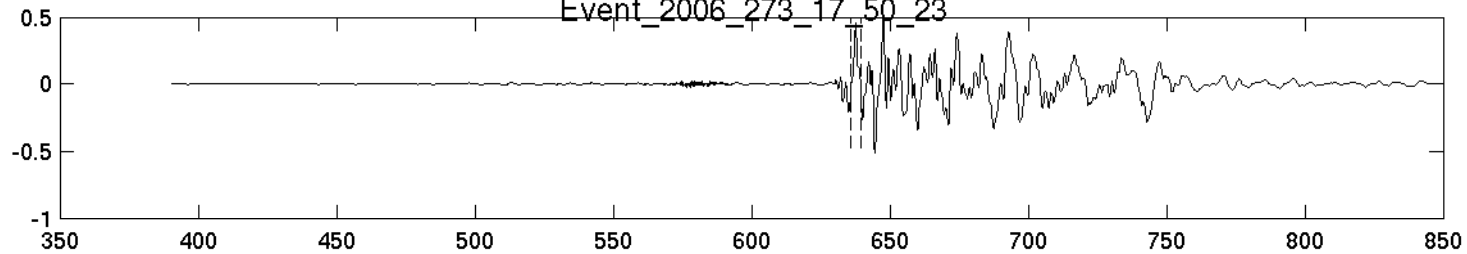


Sorted by  $t^*$ :Event\_2006\_273\_17\_50\_23

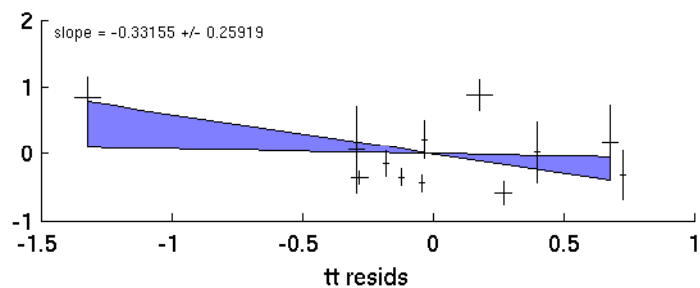
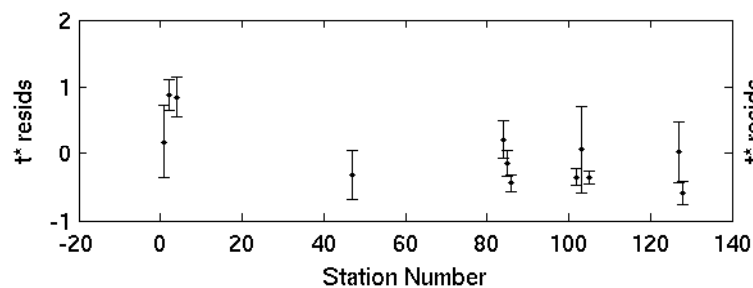




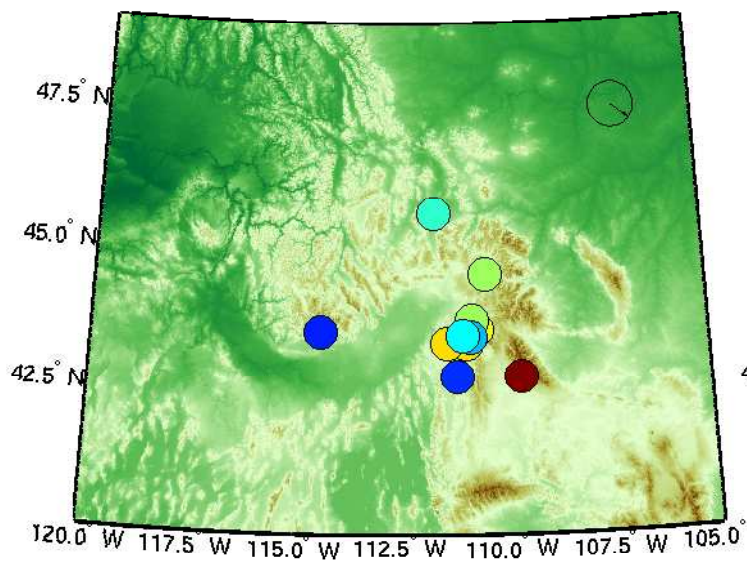
Stack  
Event\_2006\_273\_17\_50\_23



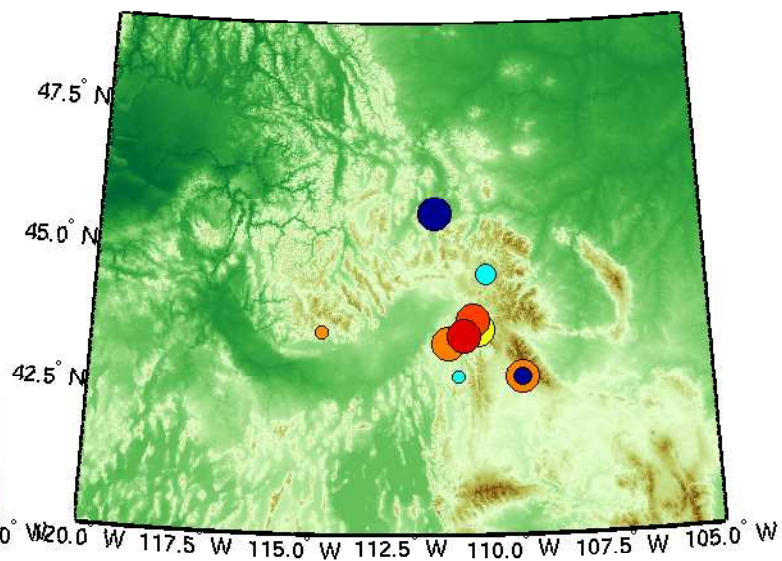
Baz = 309.6354  
Mean xcor value = 0.80583  
Range of  $t^*$  values is 1.475  
Median  $t^*$  err is 0.25902  
Slope = -0.33155 +/- 0.25919



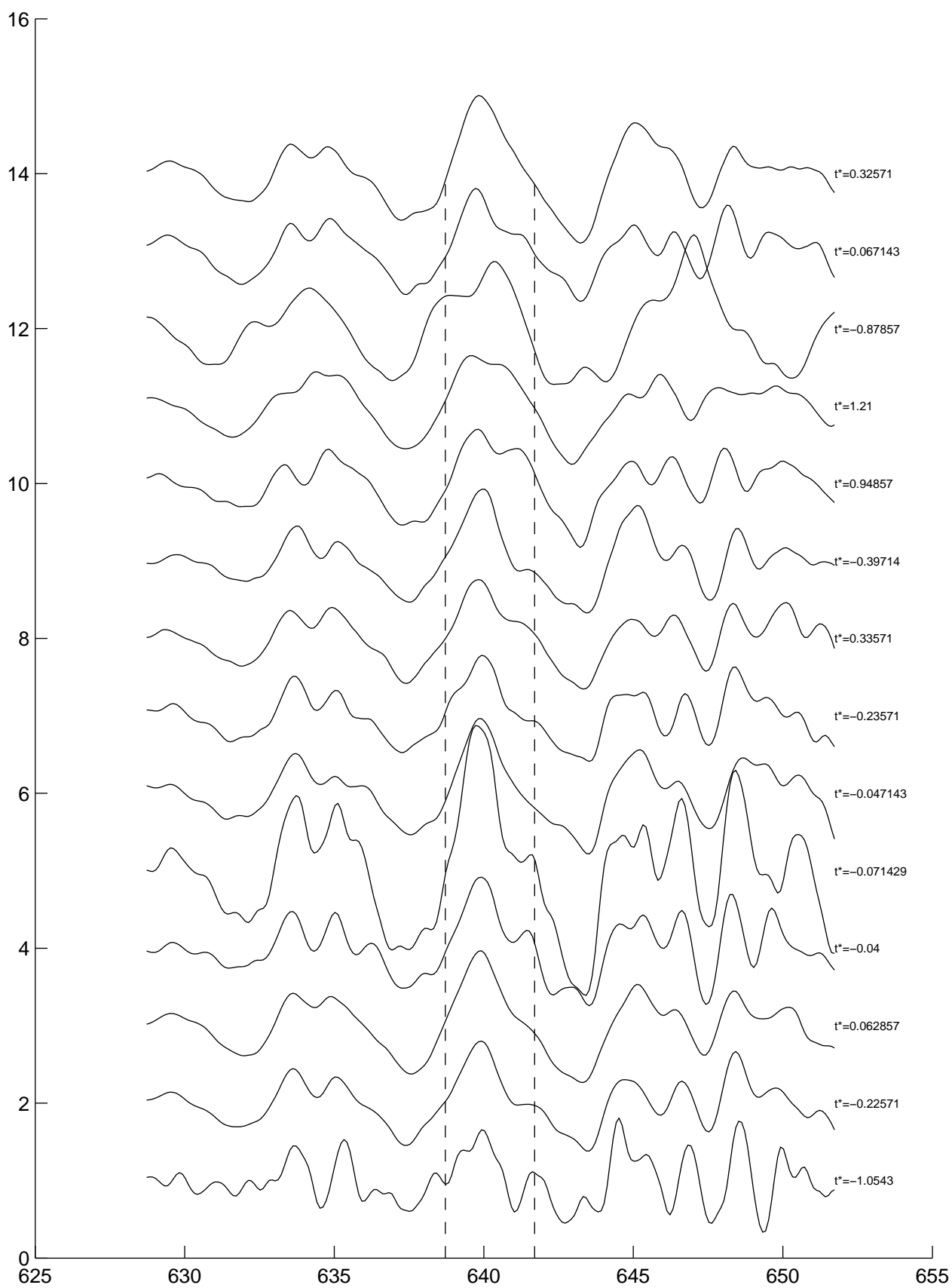
travel time residuals



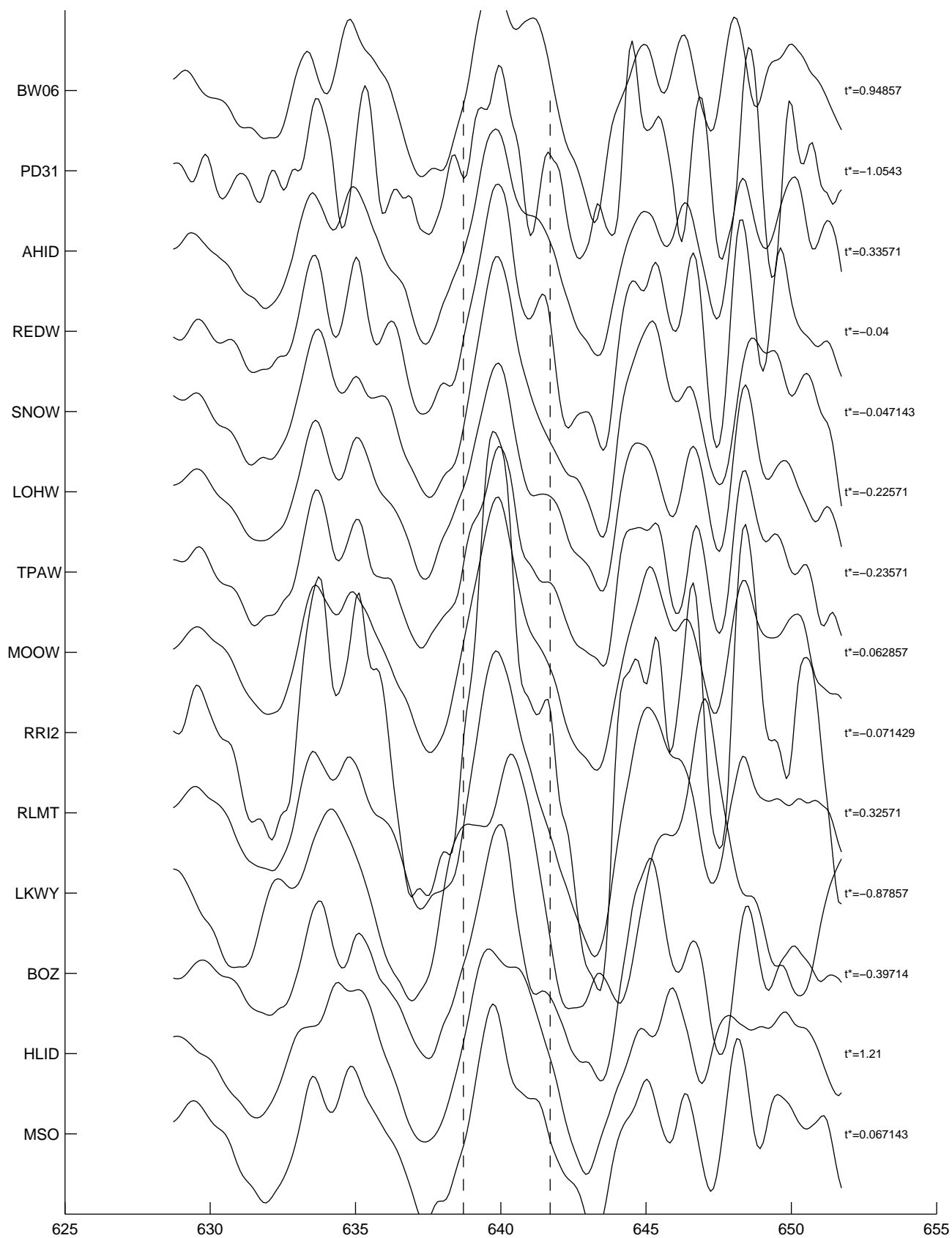
$t^*$  values



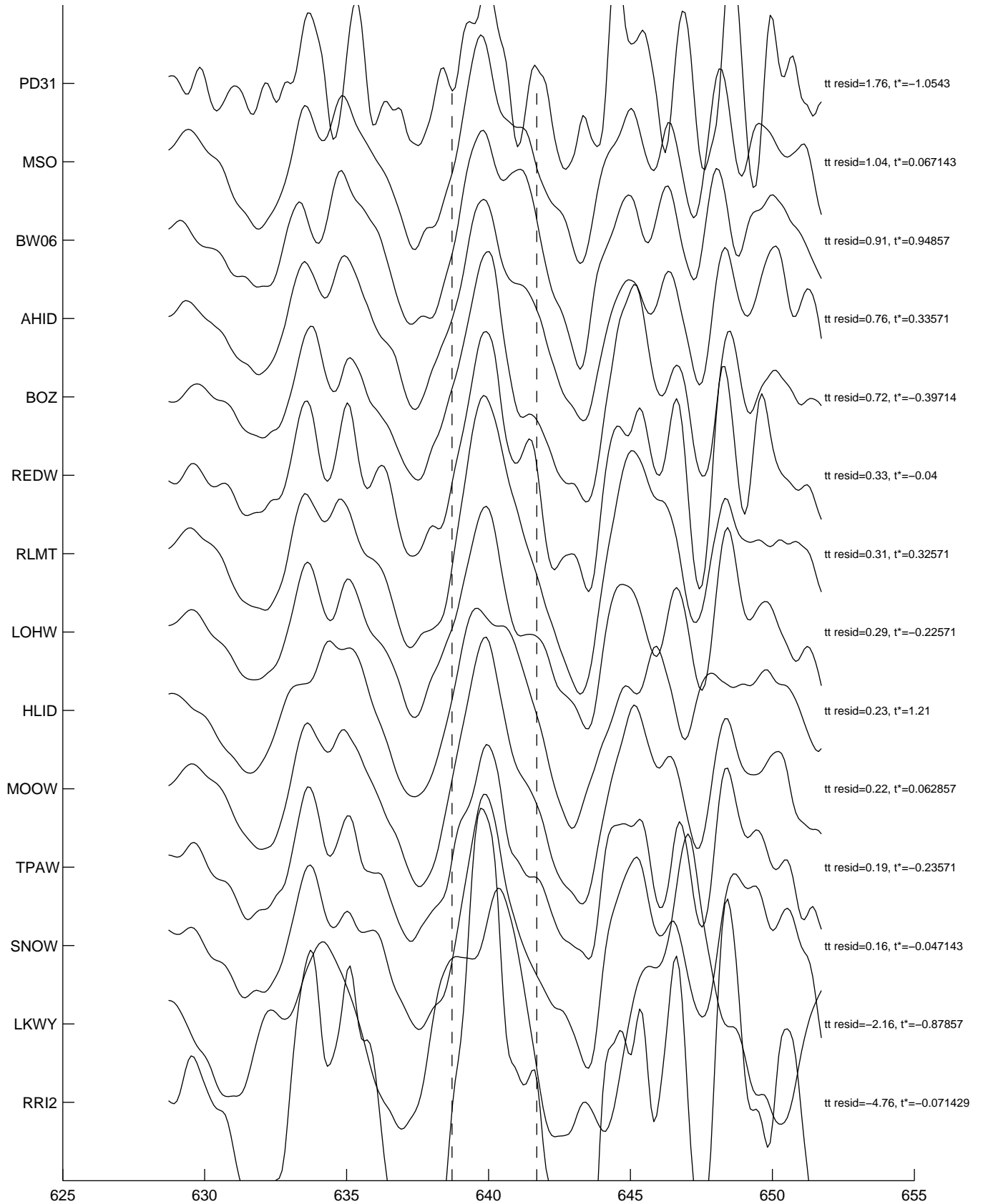
# Event\_2006\_274\_09\_06\_02



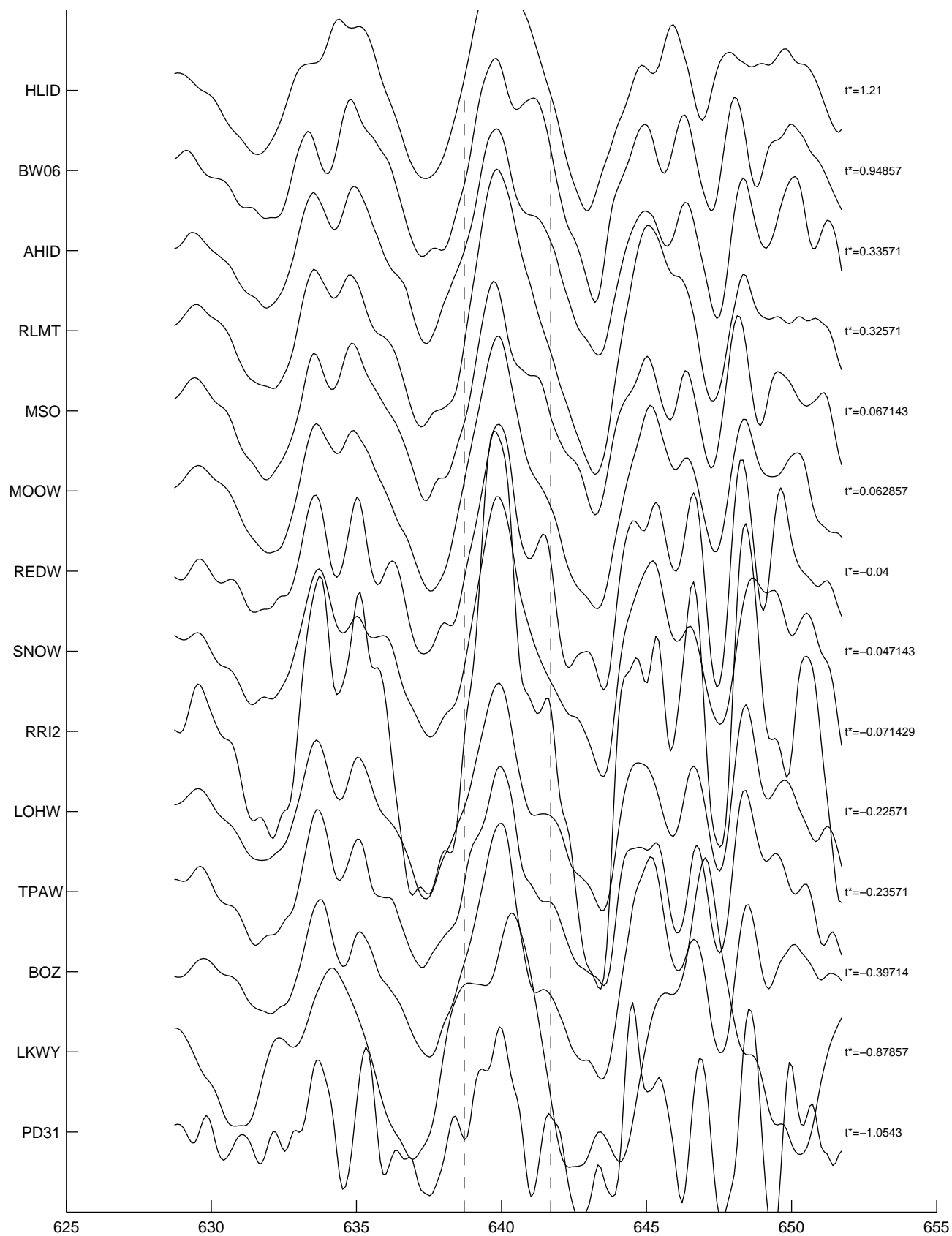
# Sorted by Delta:Event\_2006\_274\_09\_06\_02



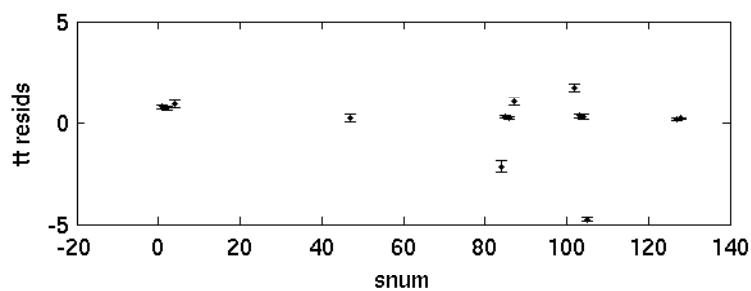
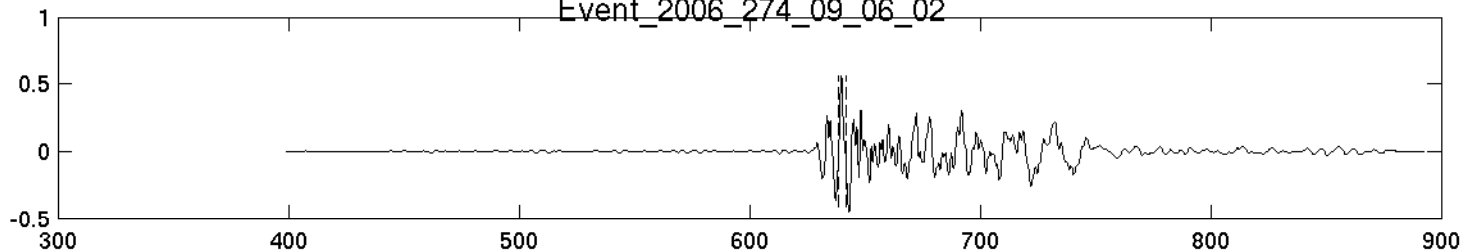
# Sorted by travel time:Event\_2006\_274\_09\_06\_02



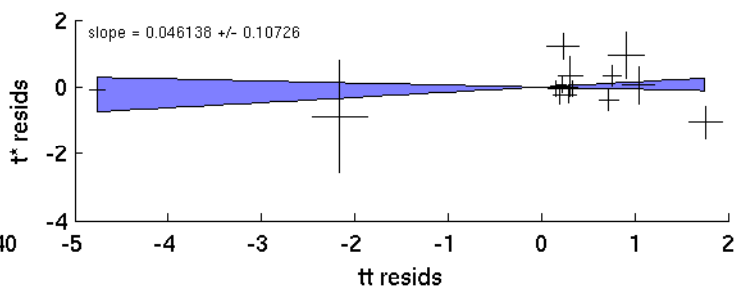
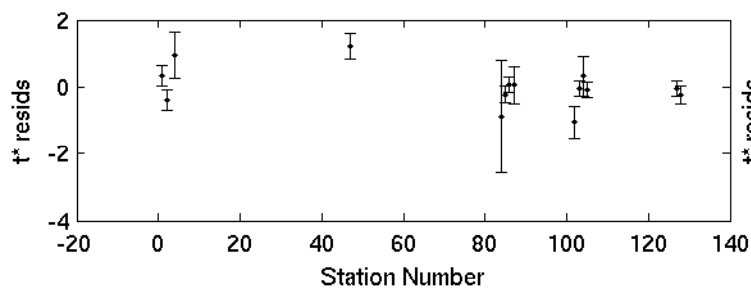
Sorted by  $t^*$ :Event\_2006\_274\_09\_06\_02



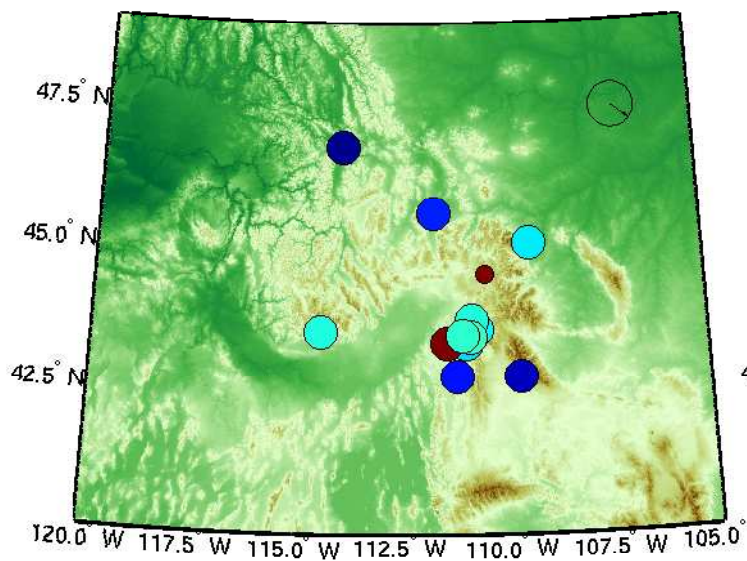
Stack  
Event\_2006\_274\_09\_06\_02



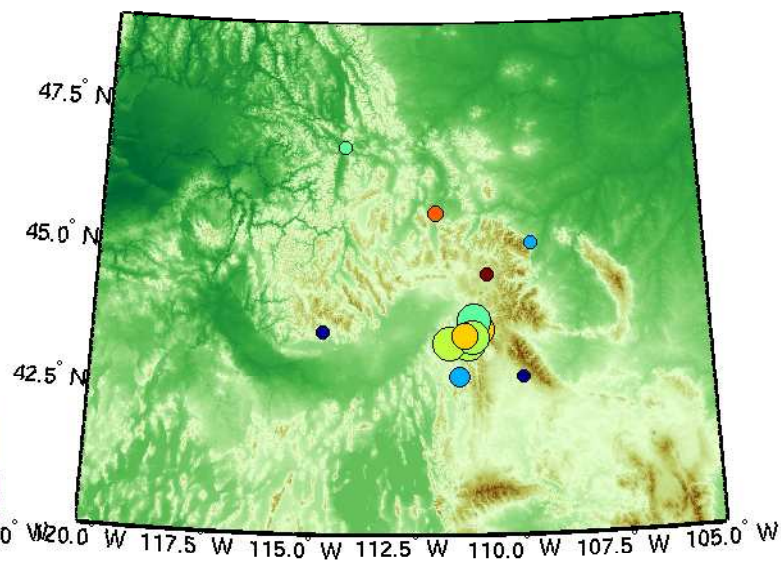
Baz = 309.7086  
Mean xcor value = 0.82214  
Range of  $t^*$  values is 2.2643  
Median  $t^*$  err is 0.30443  
Slope = 0.046138 +/- 0.10726



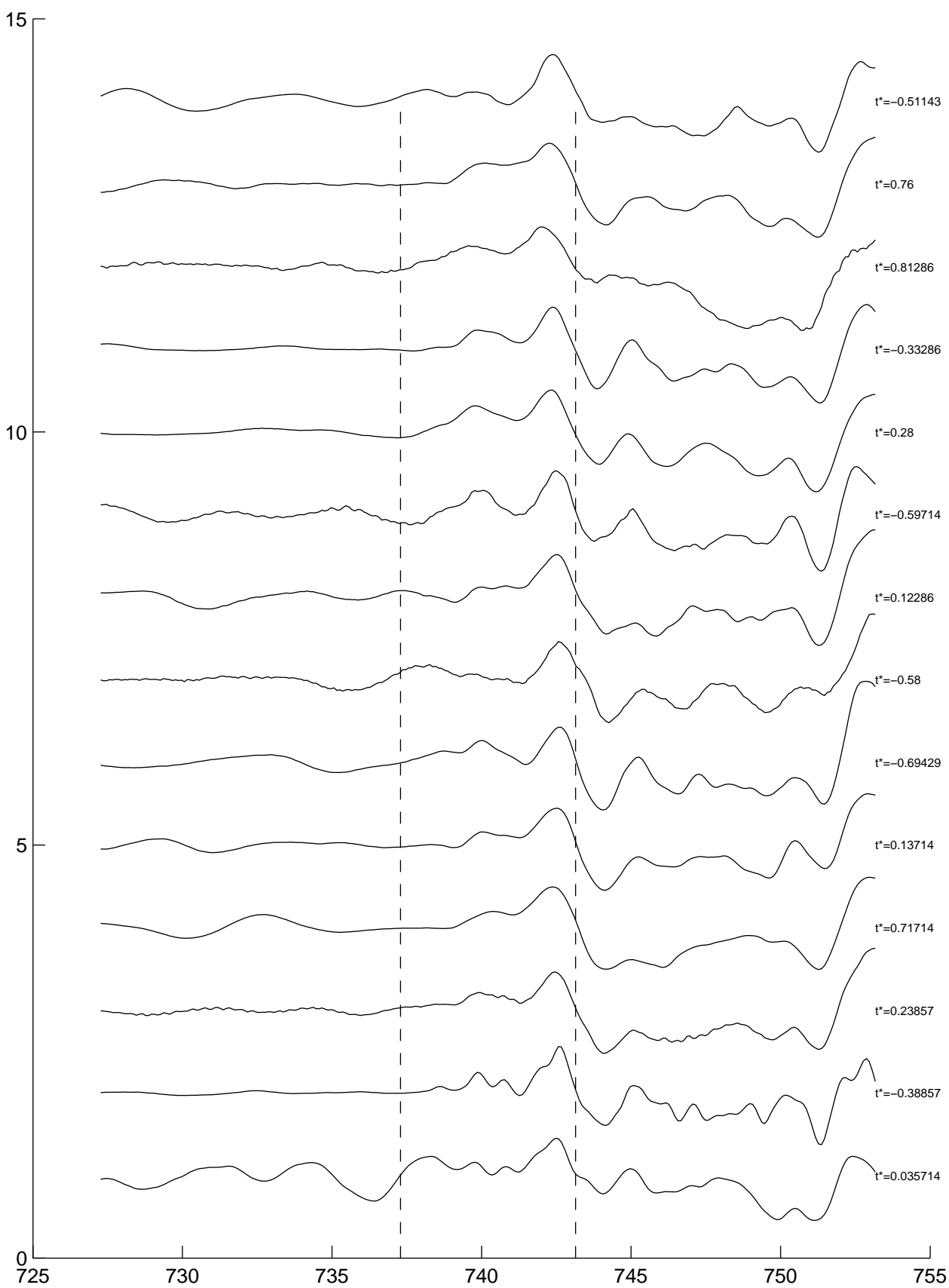
travel time residuals



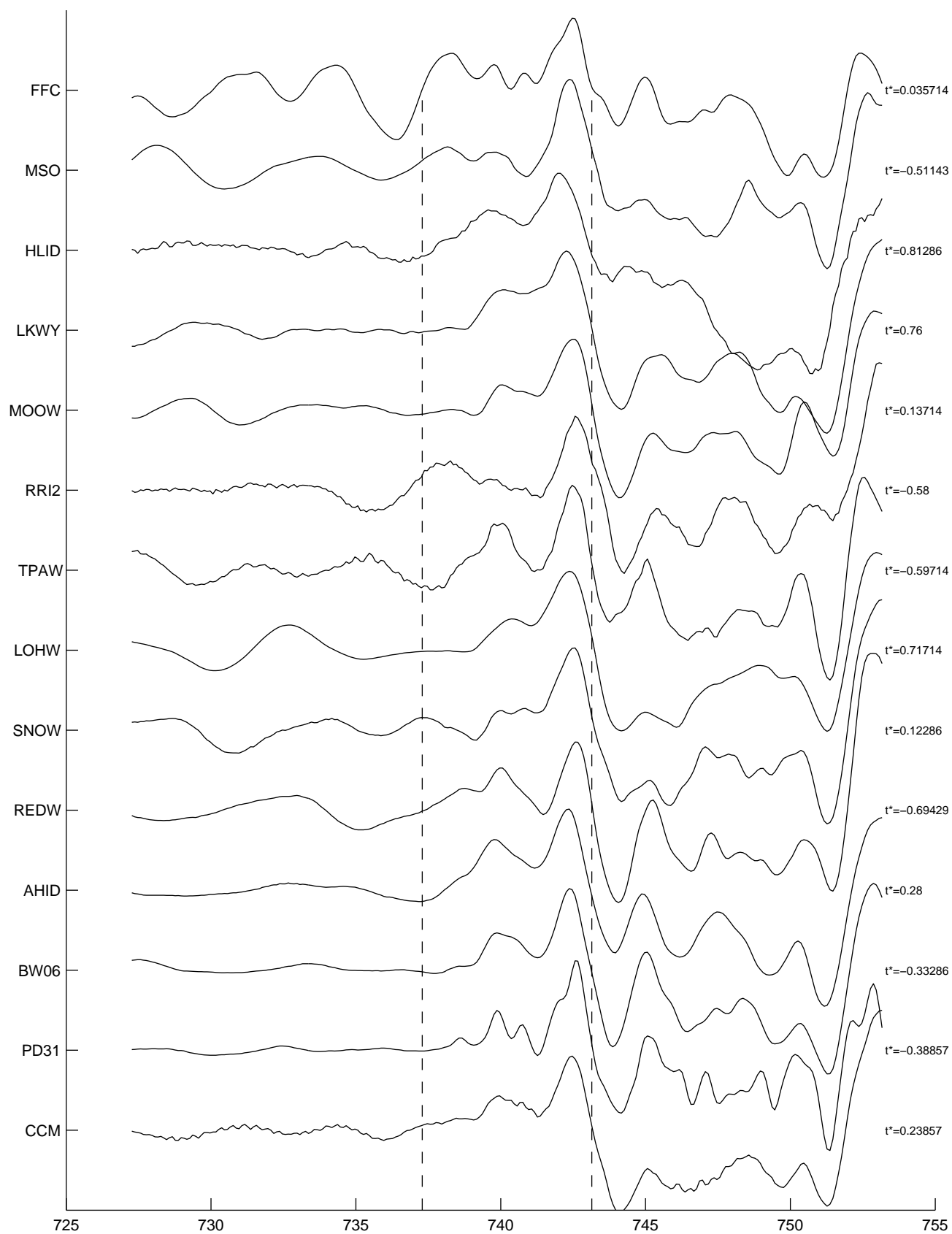
$t^*$  values



# Event\_2006\_285\_18\_05\_58

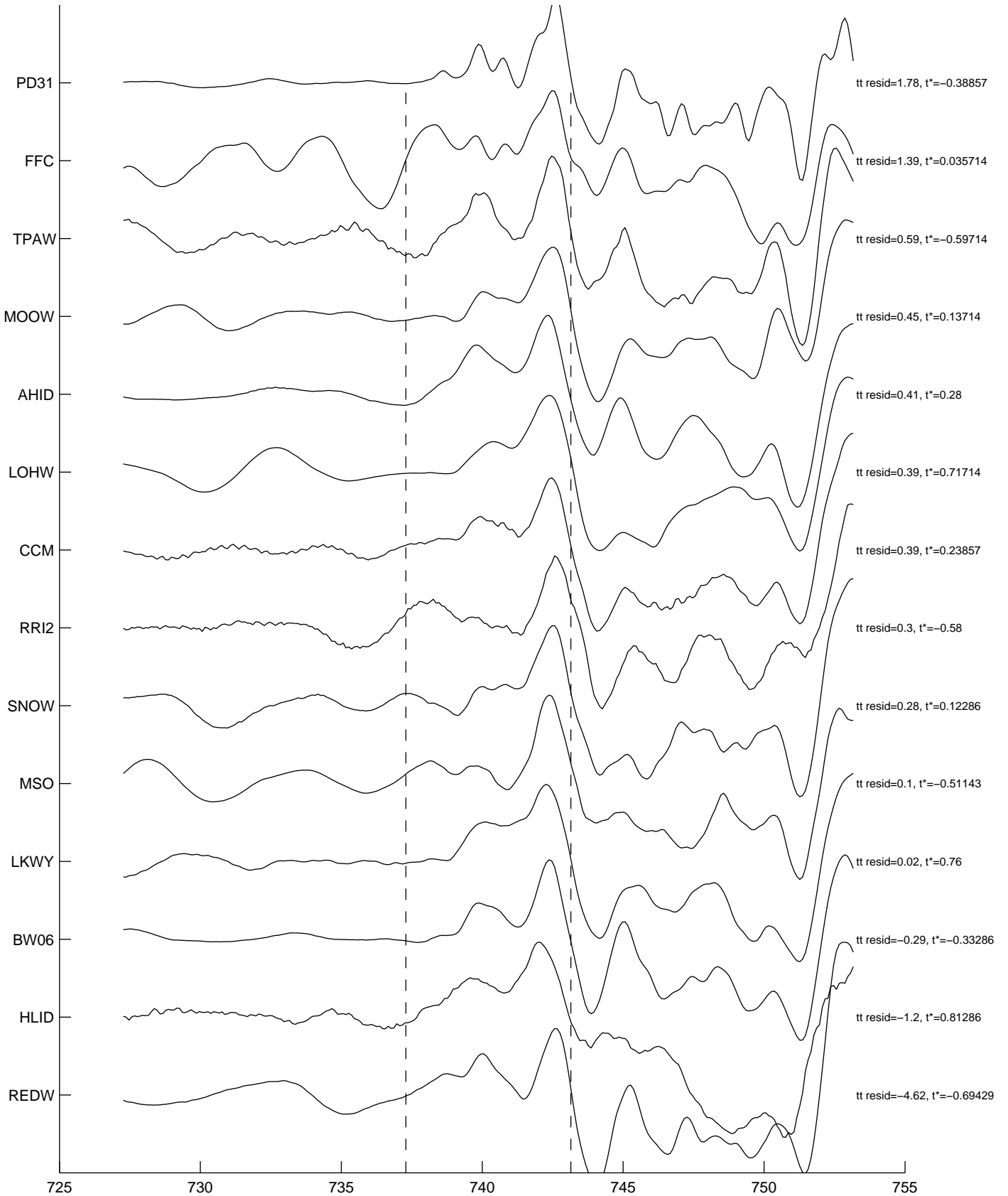


# Sorted by Delta:Event\_2006\_285\_18\_05\_58

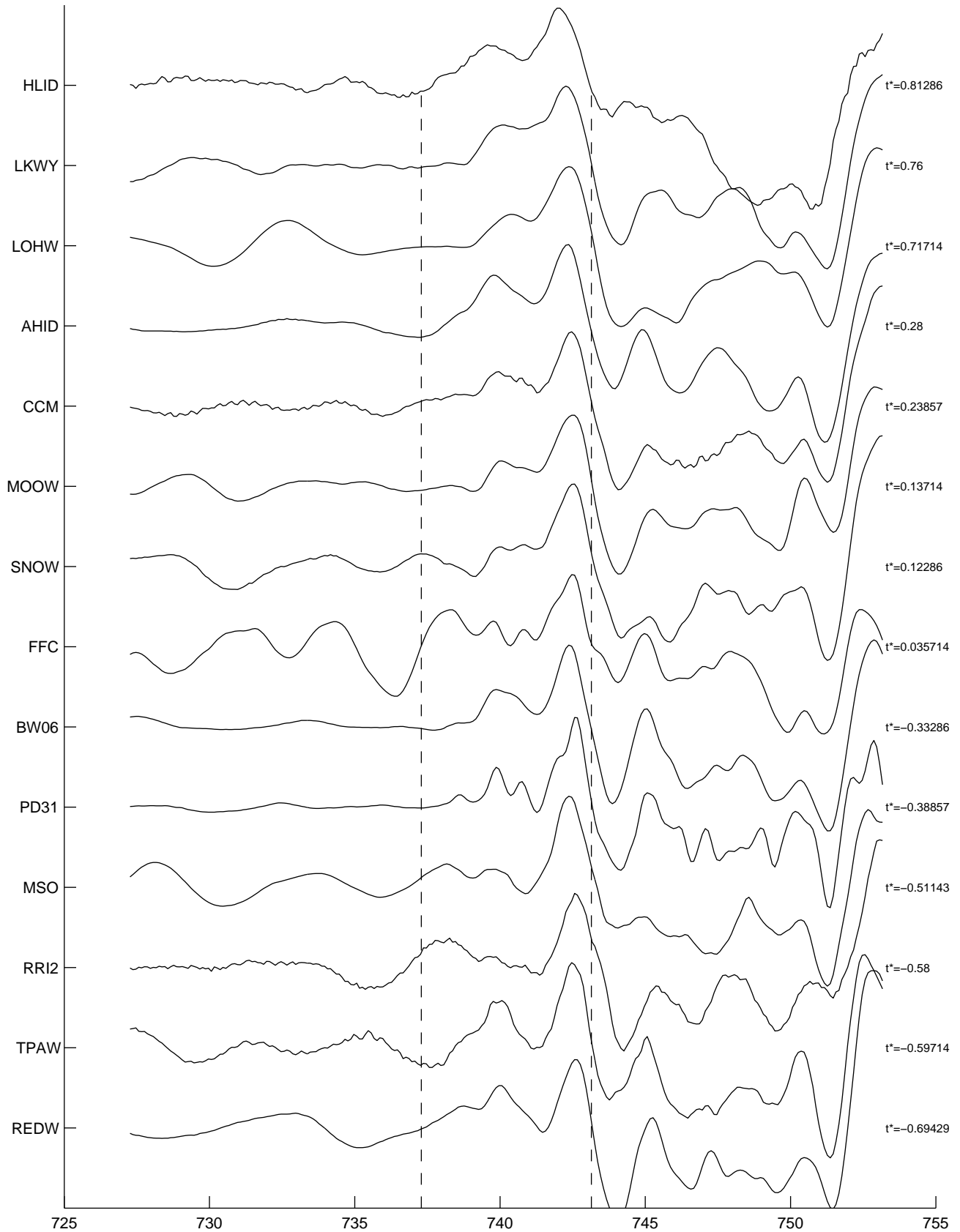




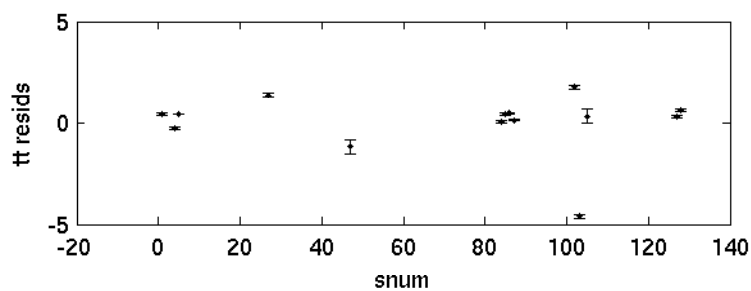
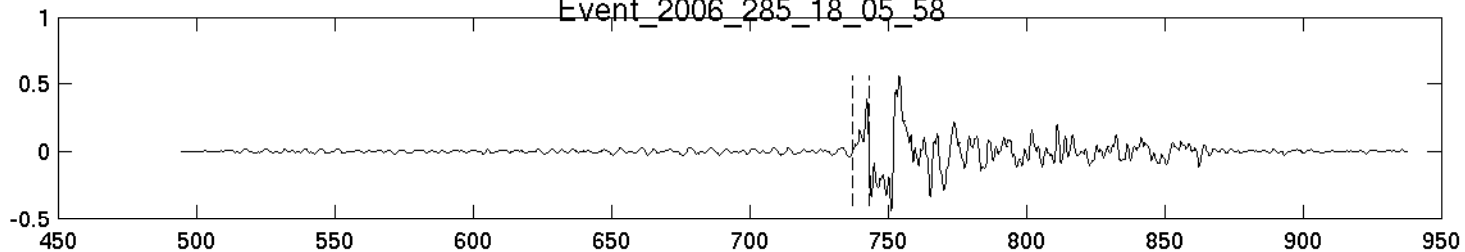
# Sorted by travel time:Event\_2006\_285\_18\_05\_58



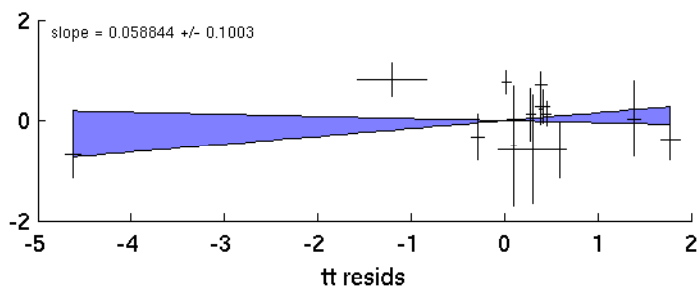
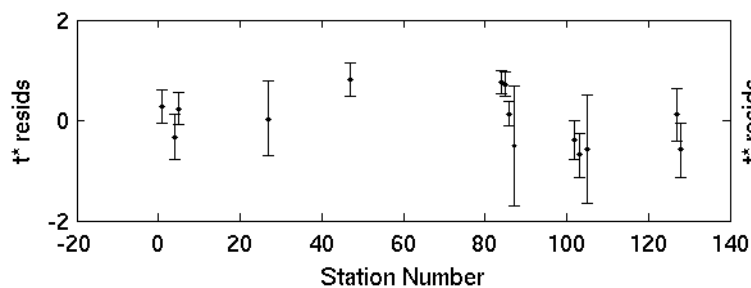
Sorted by  $t^*$ :Event\_2006\_285\_18\_05\_58



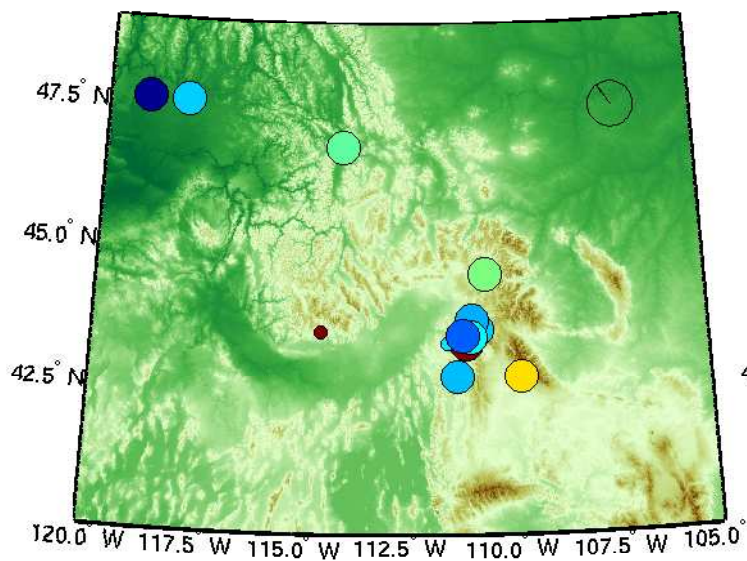
# Stack Event\_2006\_285\_18\_05\_58



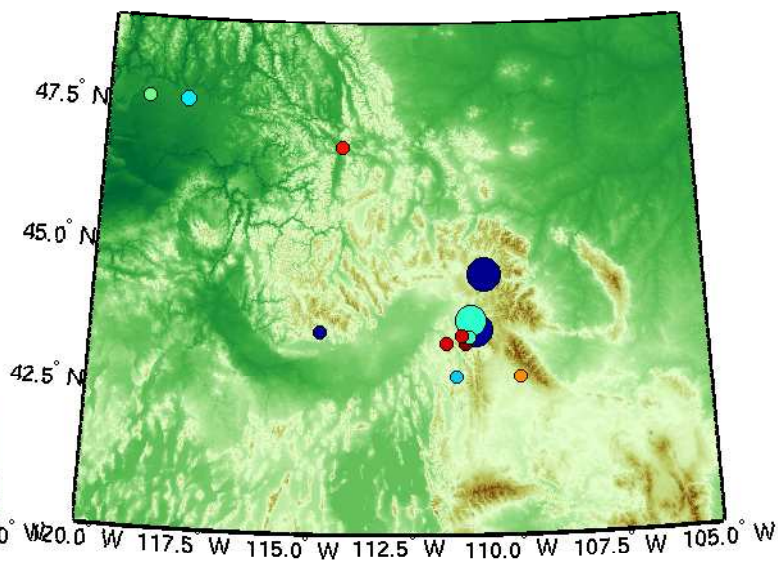
Baz = 148.1993  
Mean xcor value = 0.79857  
Range of  $t^*$  values is 1.5071  
Median  $t^*$  err is 0.42187  
Slope = 0.058844 +/- 0.1003



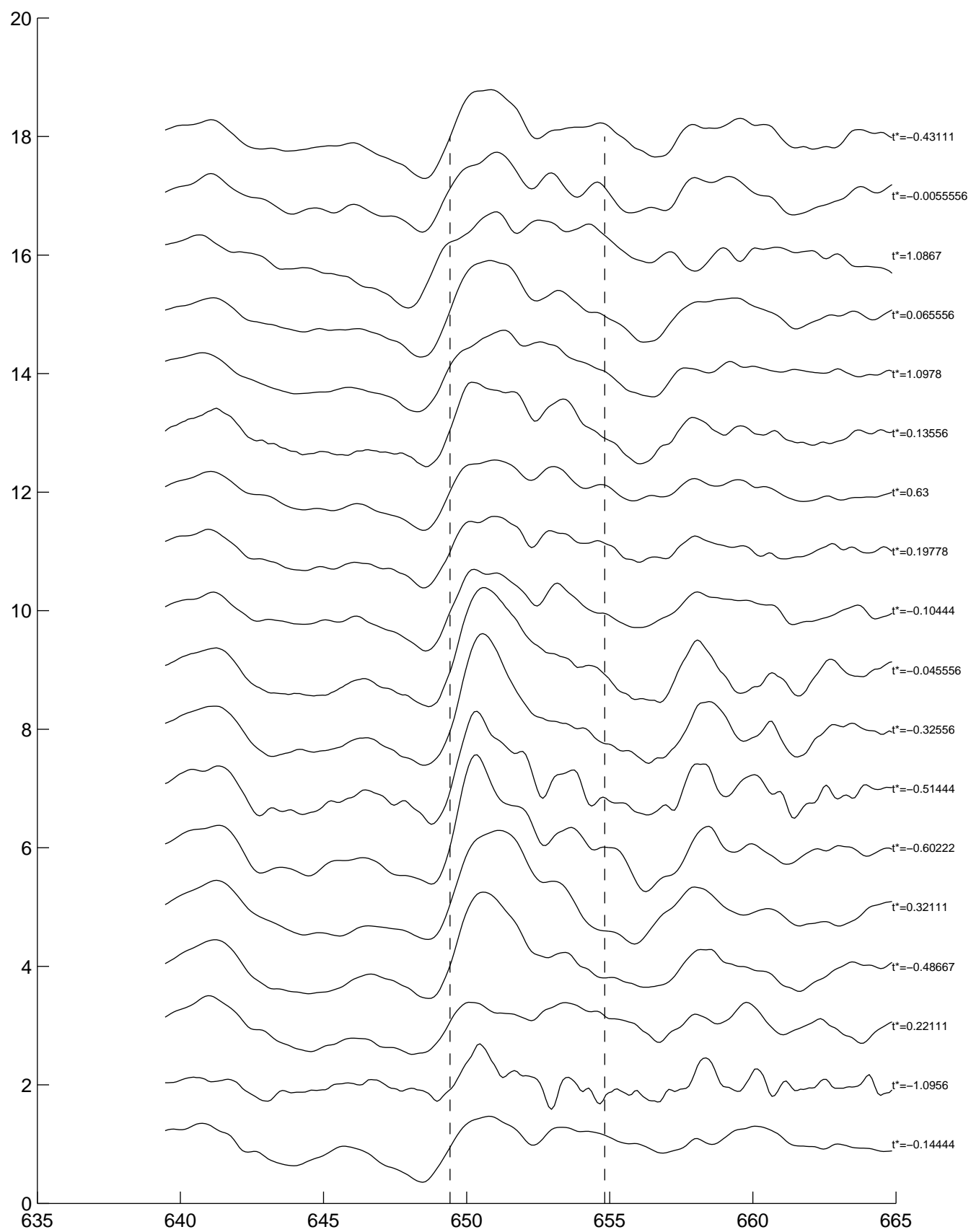
travel time residuals



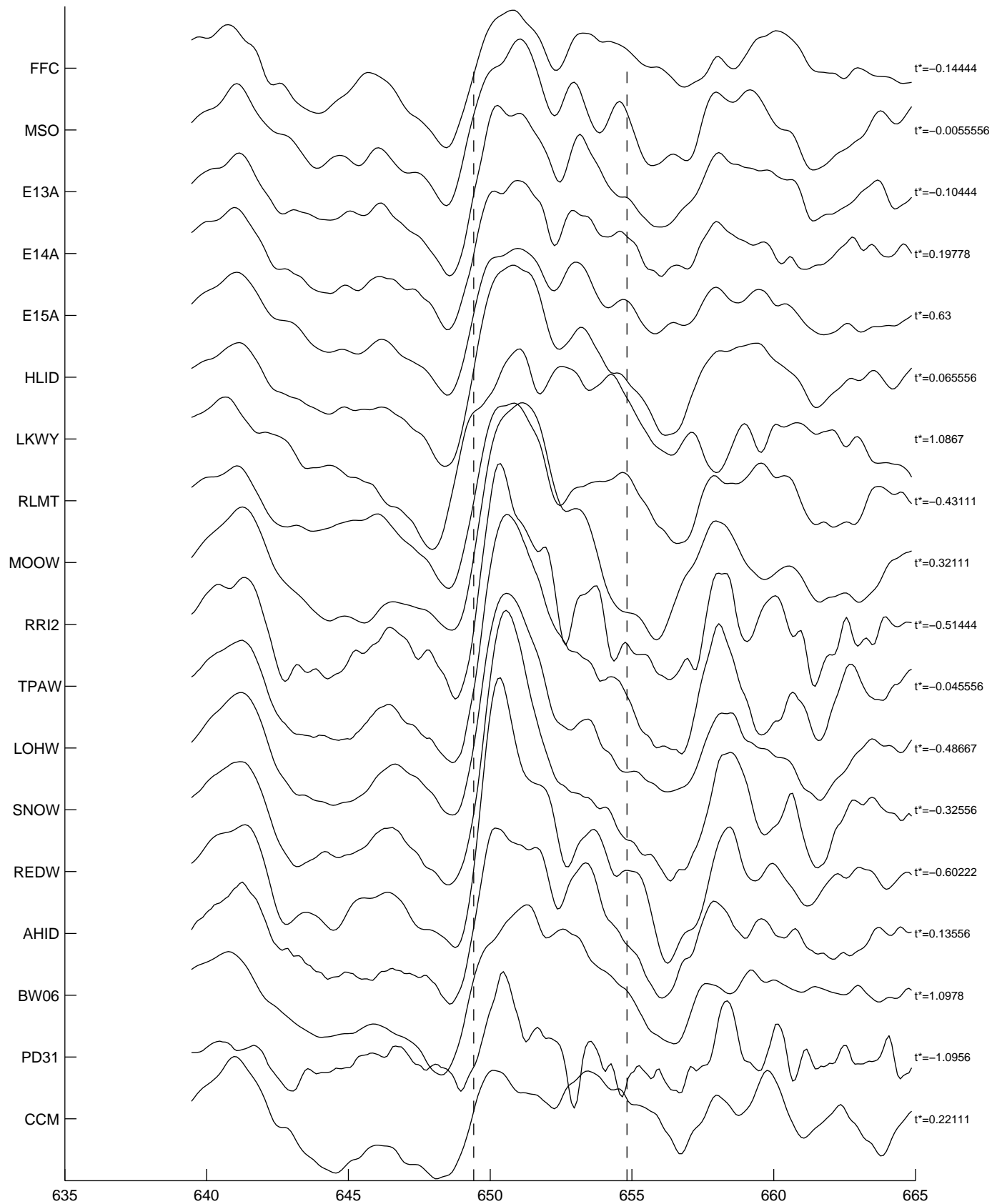
$t^*$  values



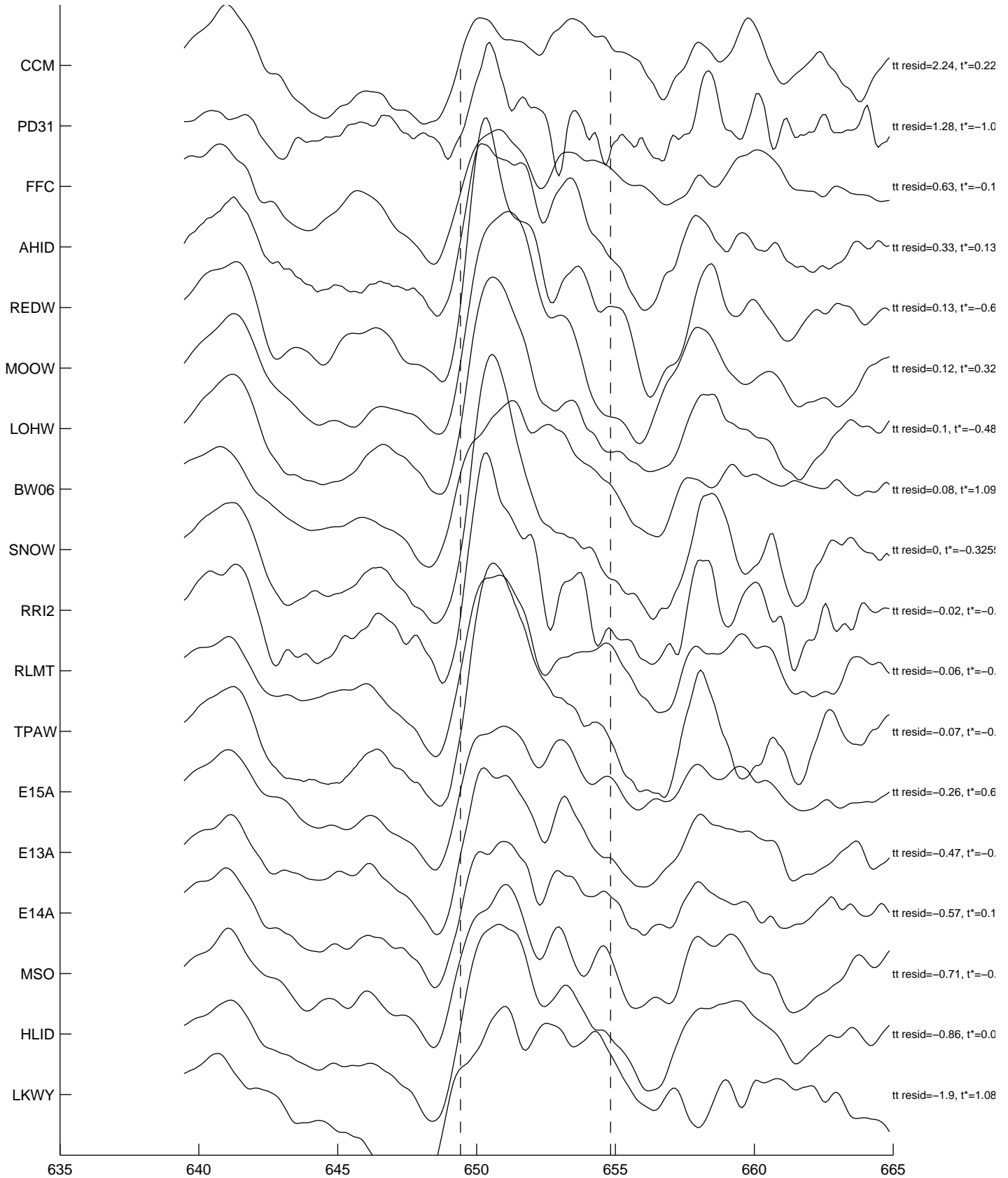
# Event\_2006\_293\_10\_48\_56



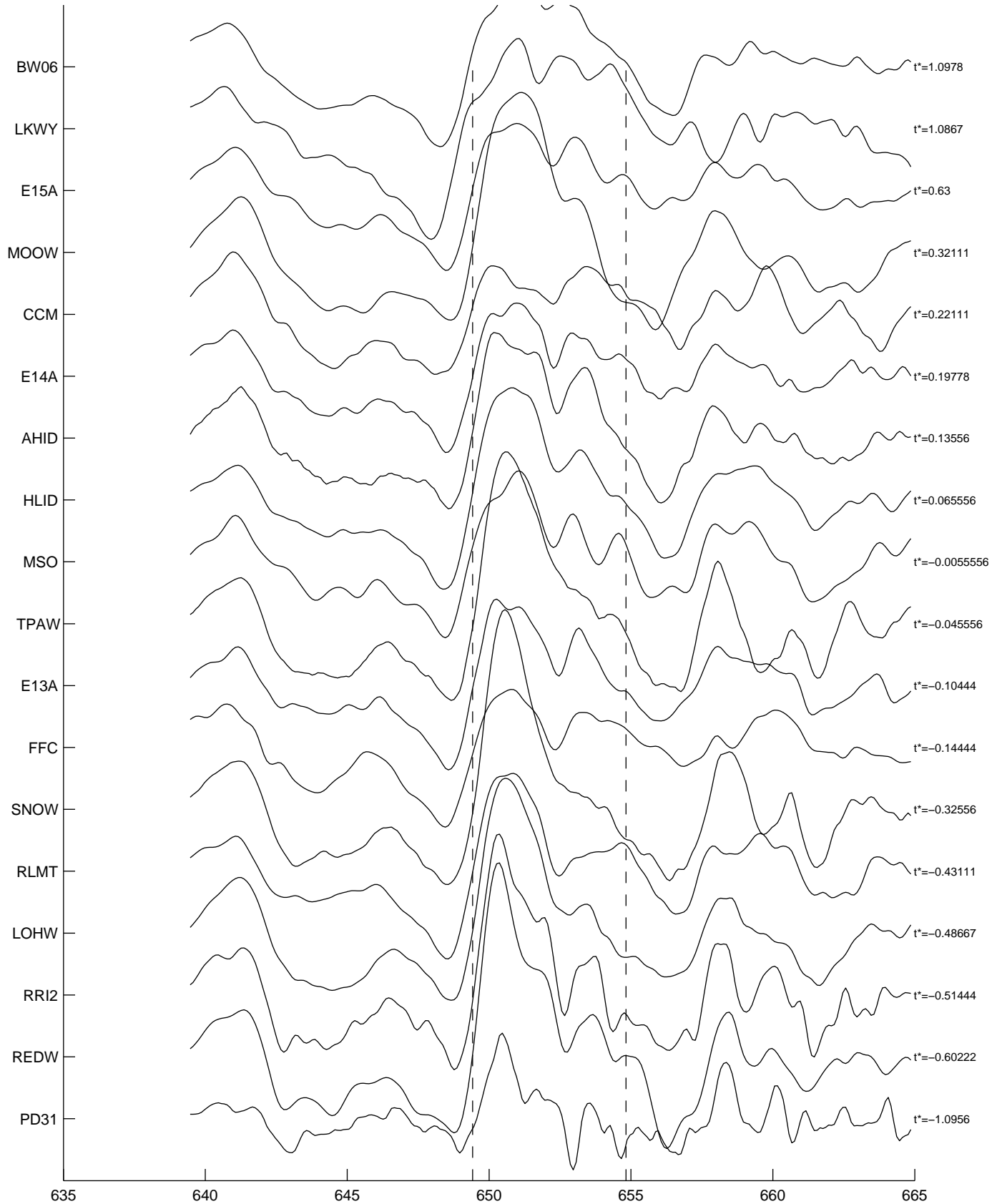
# Sorted by Delta:Event\_2006\_293\_10\_48\_56



# Sorted by travel time: Event\_2006\_293\_10\_48\_56

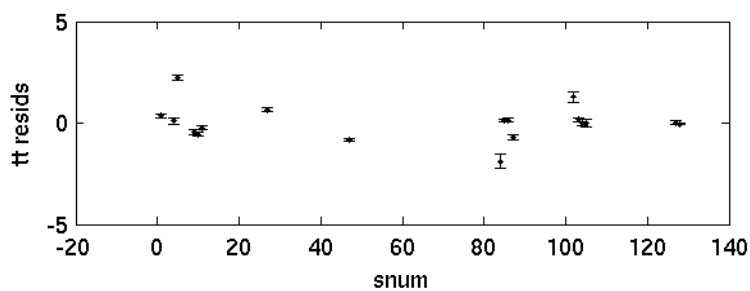
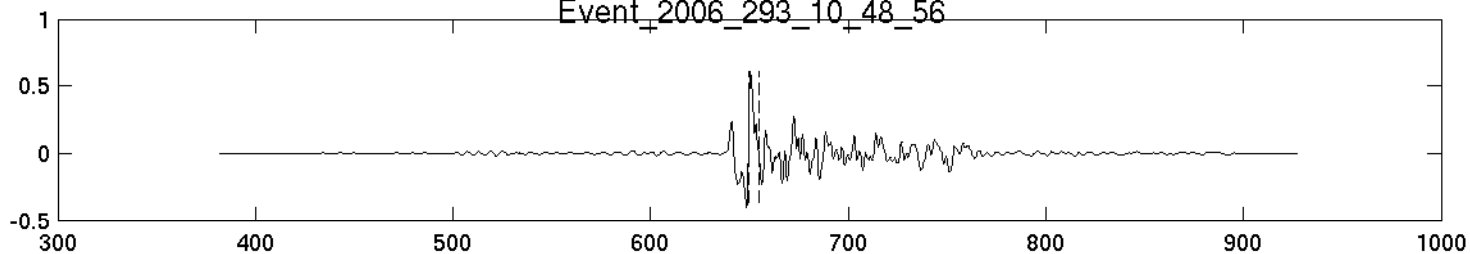


# Sorted by $t^*$ :Event\_2006\_293\_10\_48\_56

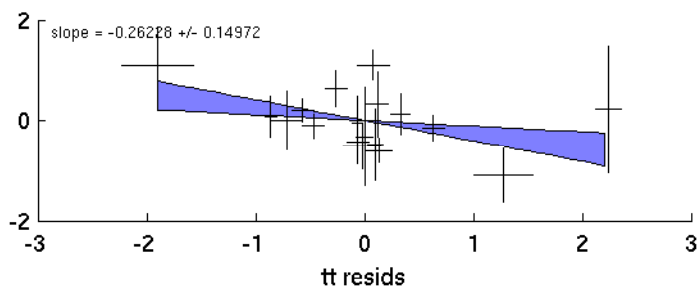
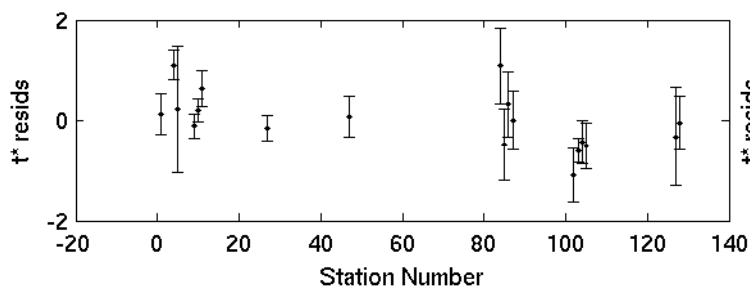


# Event\_2006\_293\_10\_48\_56

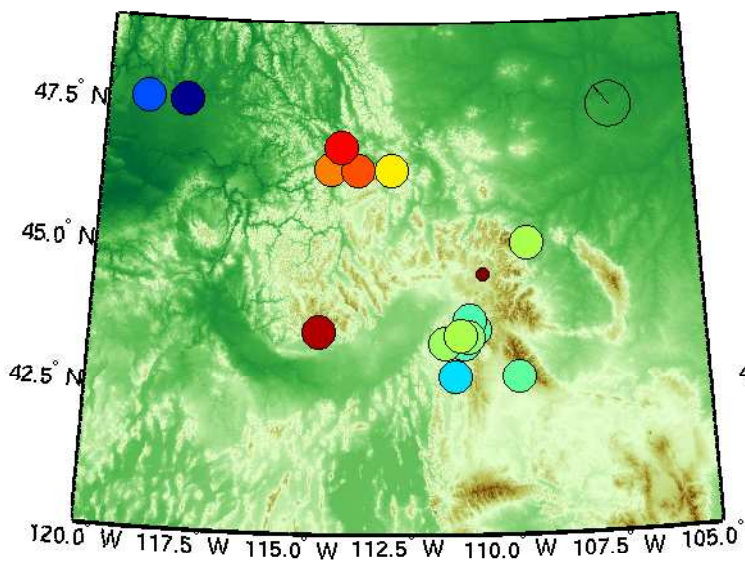
Stack



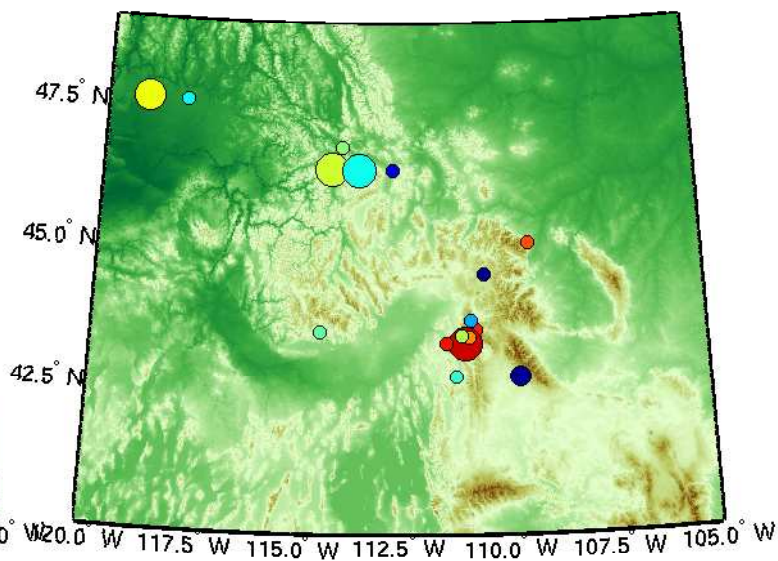
Baz = 144.2579  
Mean xcor value = 0.84944  
Range of  $t^*$  values is 2.1933  
Median  $t^*$  err is 0.44435  
Slope = -0.26228 +/- 0.14972



travel time residuals

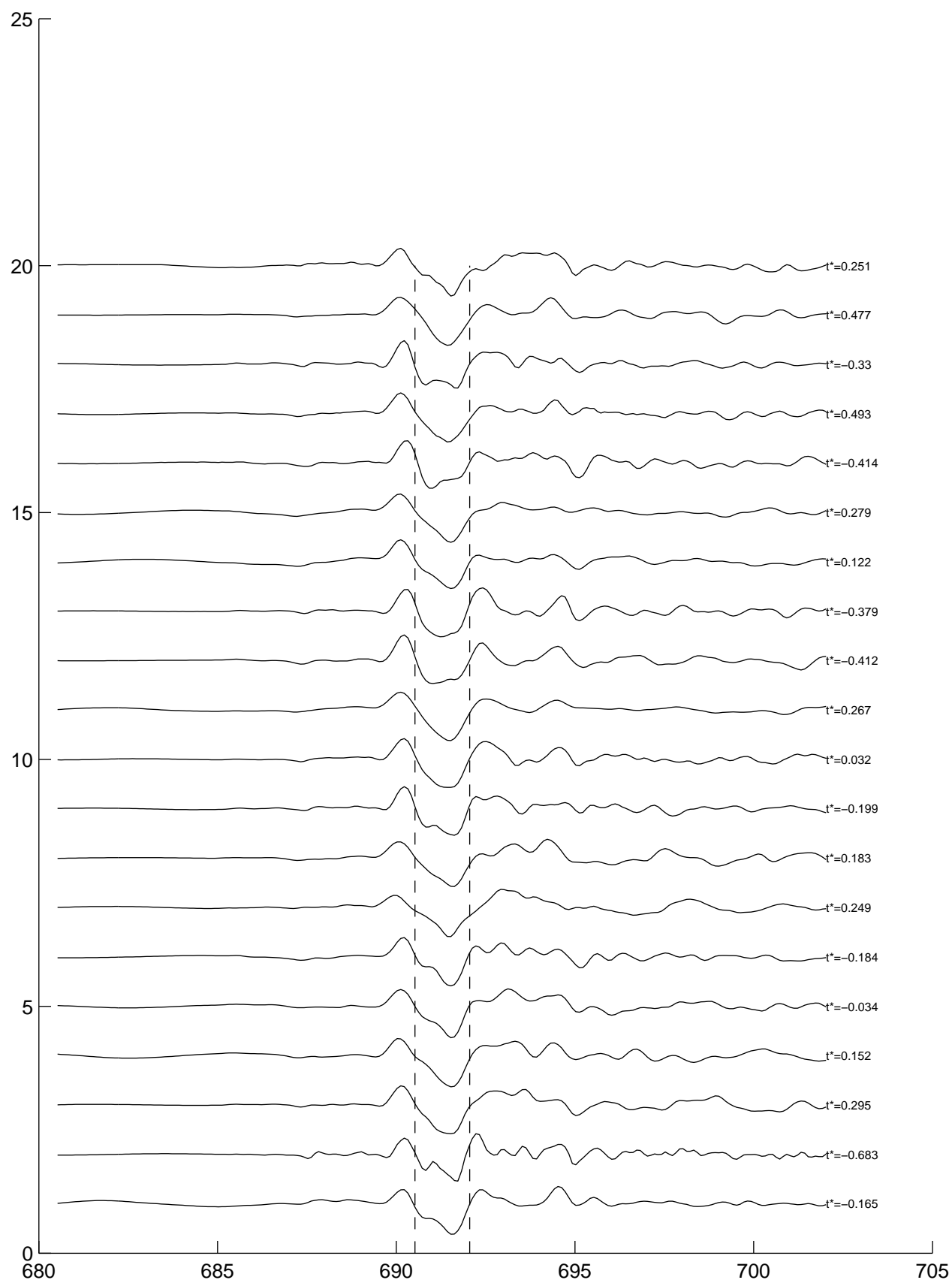


$t^*$  values

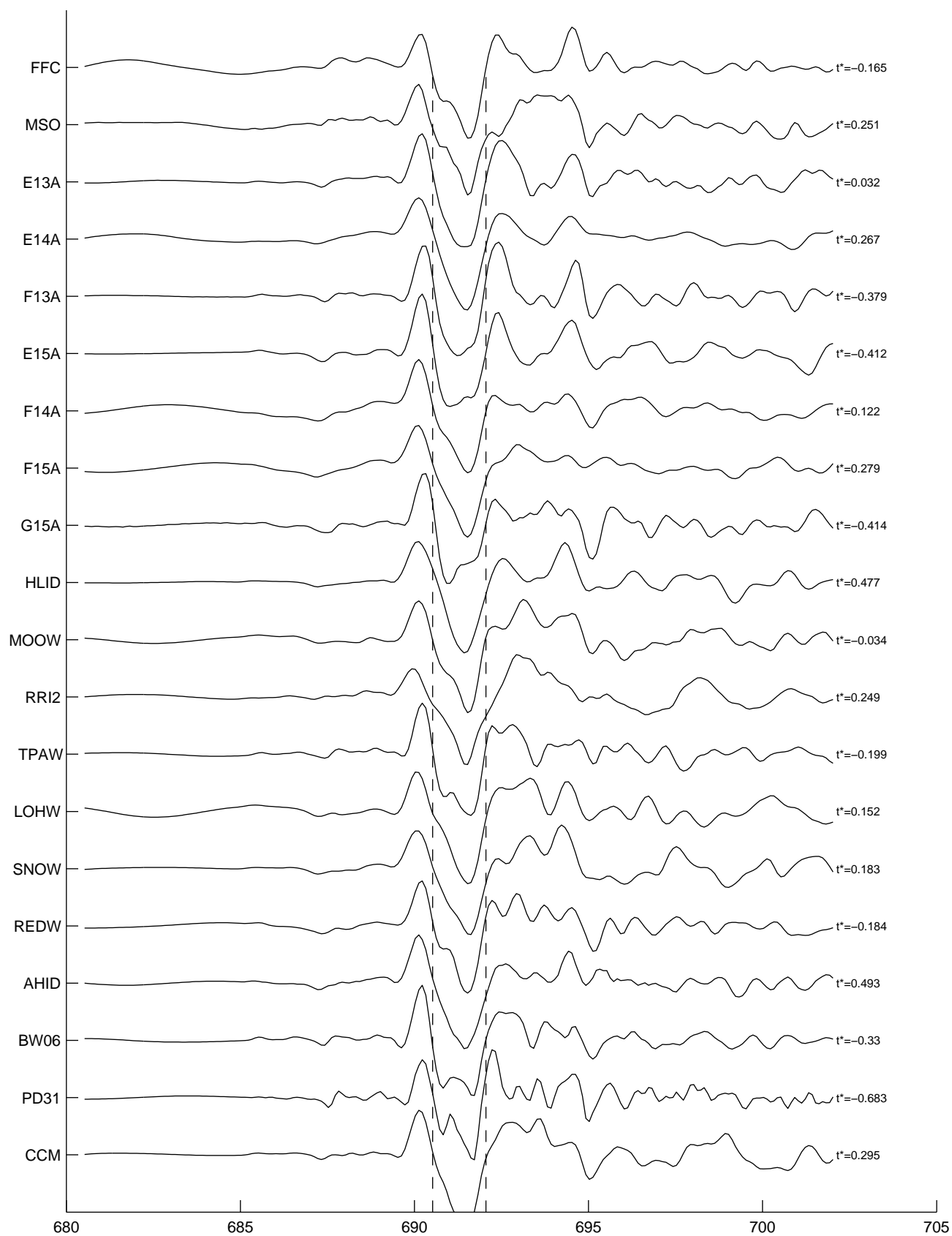




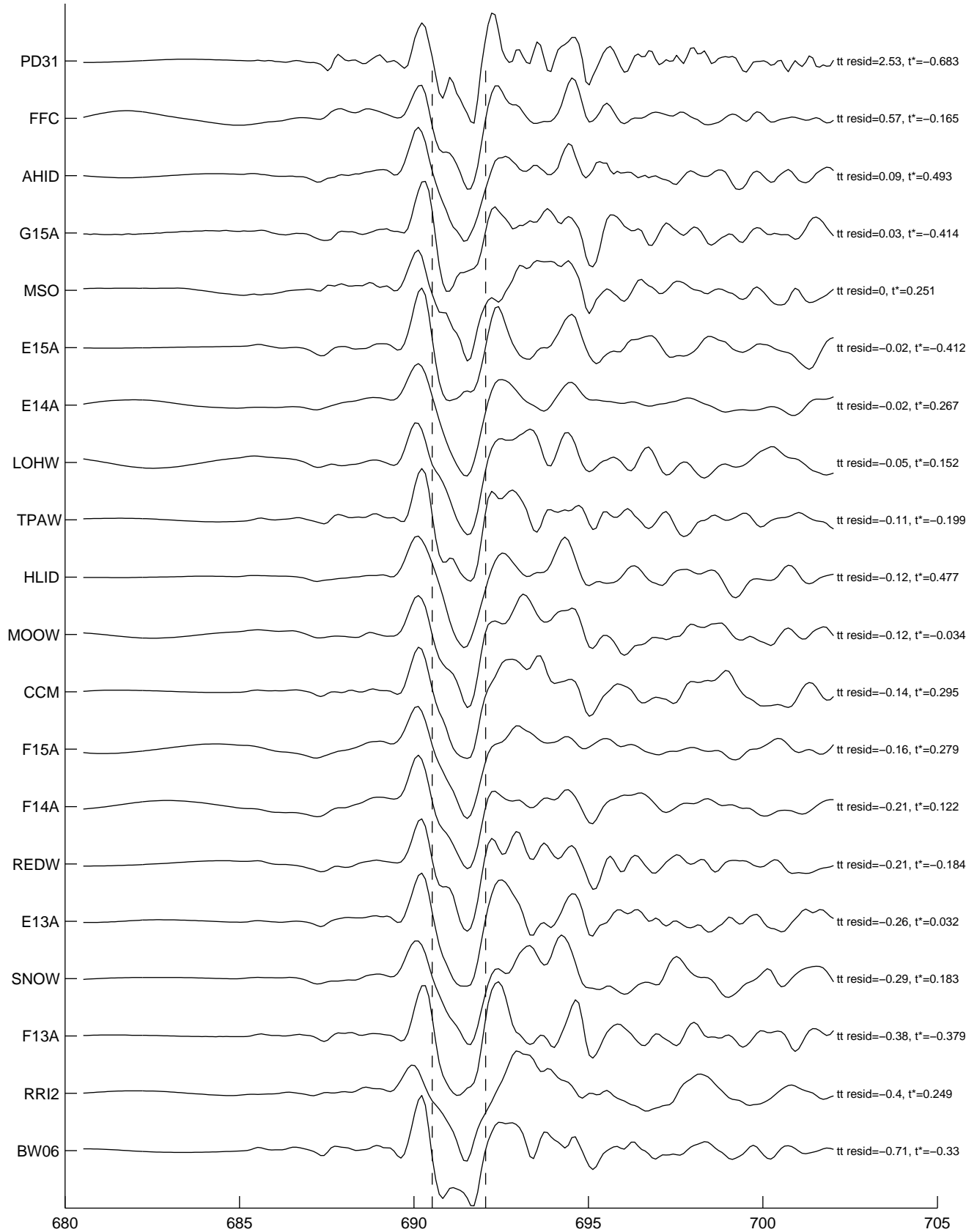
# Event\_2006\_317\_01\_26\_34



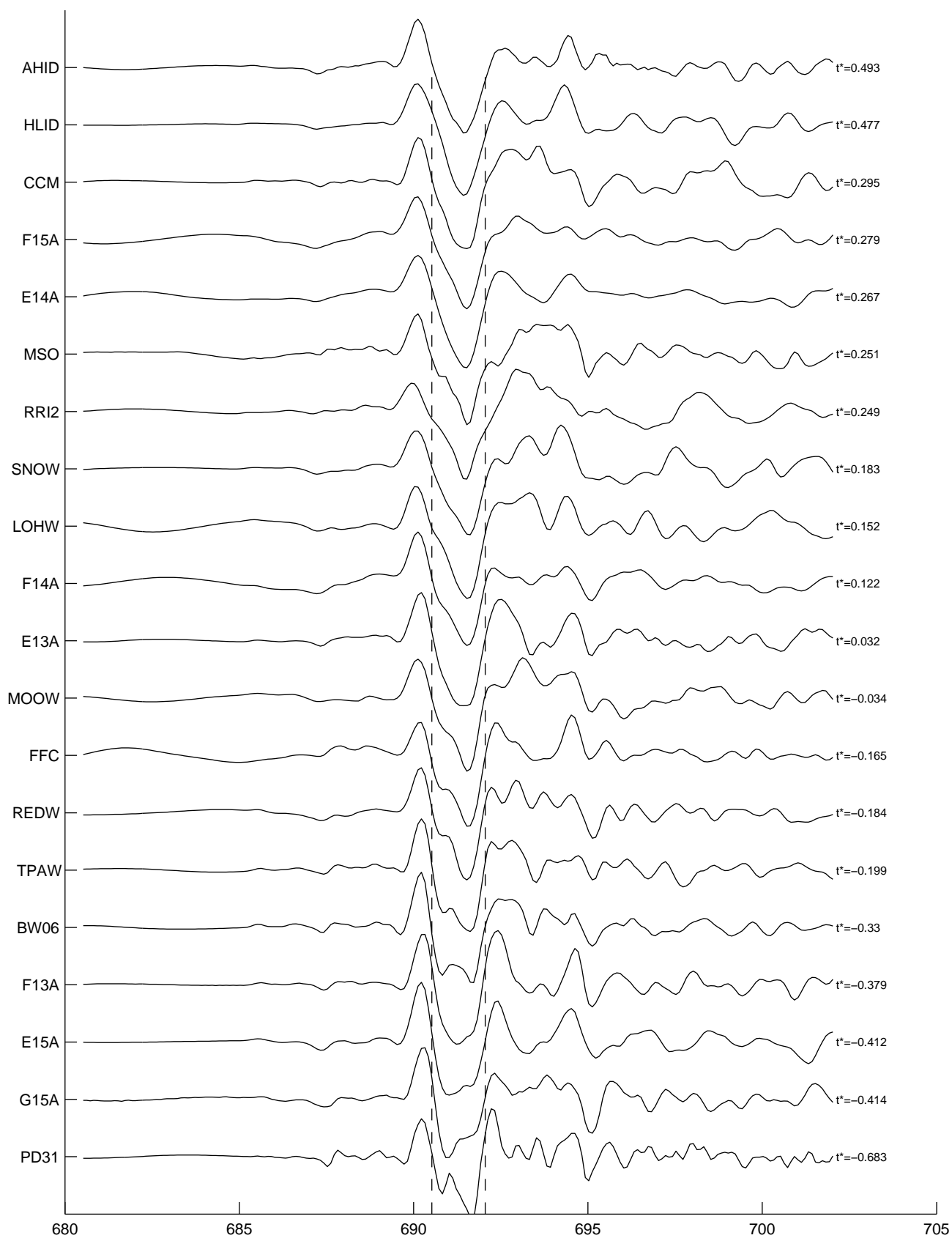
# Sorted by Delta:Event\_2006\_317\_01\_26\_34



# Sorted by travel time: Event\_2006\_317\_01\_26\_34

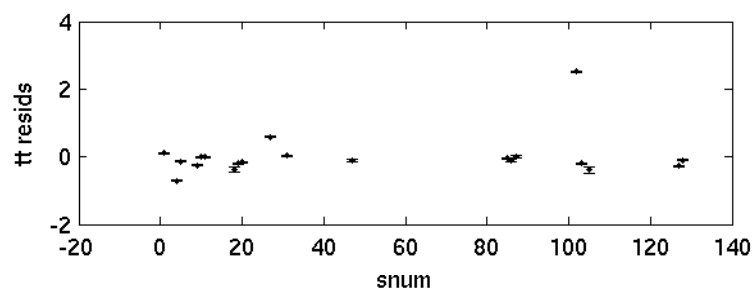
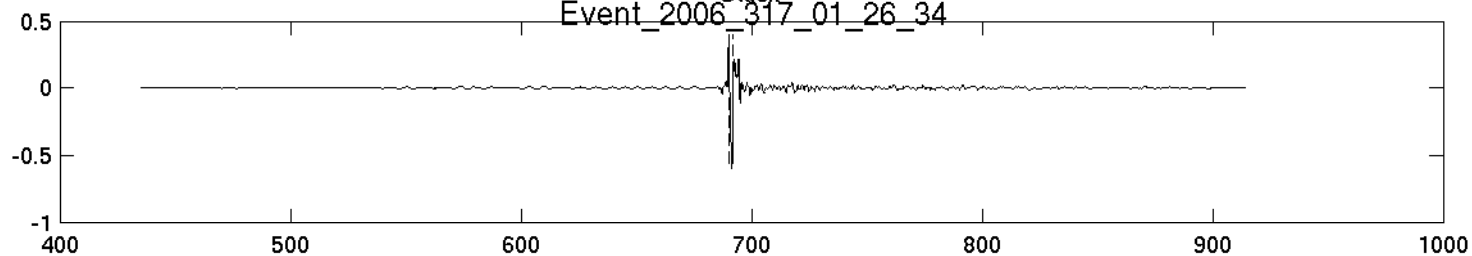


Sorted by  $t^*$ :Event\_2006\_317\_01\_26\_34

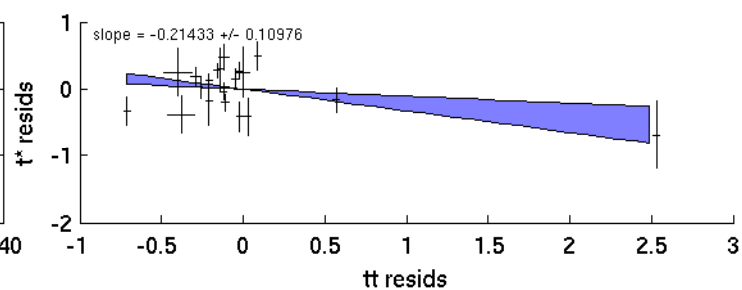
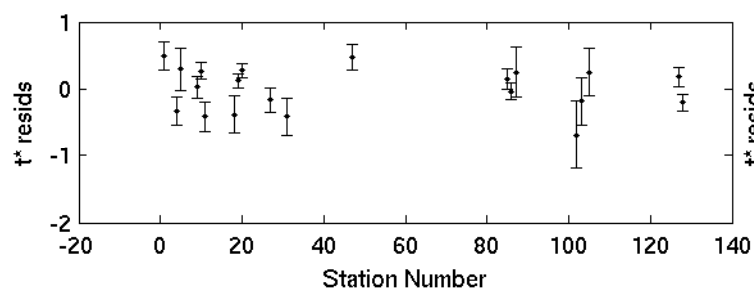


Event\_2006\_317\_01\_26\_34

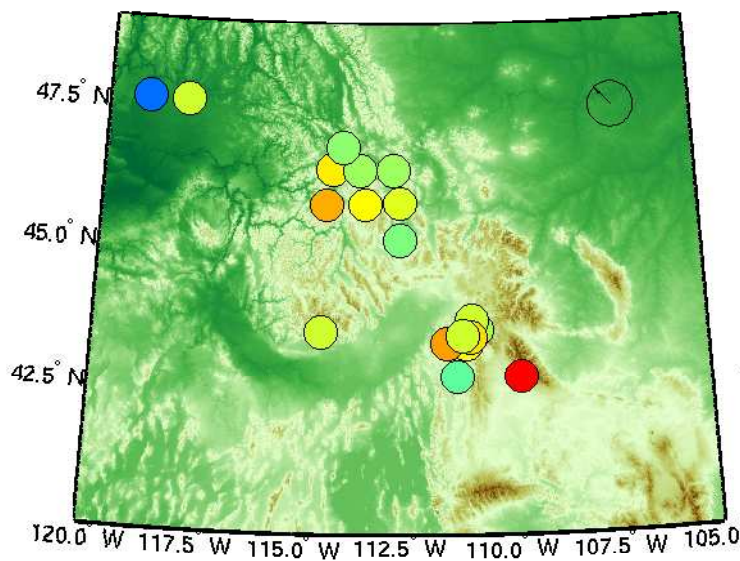
Stack



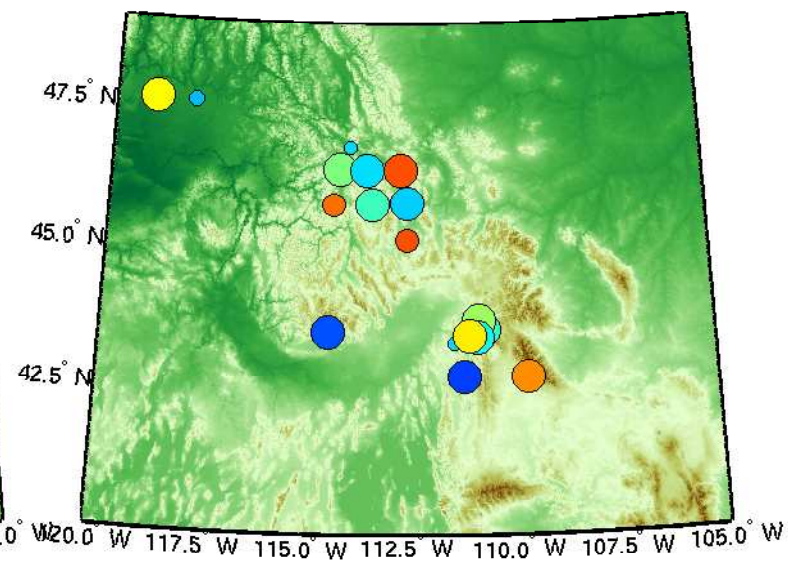
Baz = 138.3724  
Mean xcor value = 0.771  
Range of  $t^*$  values is 1.176  
Median  $t^*$  err is 0.19582  
Slope = -0.21433 +/- 0.10976



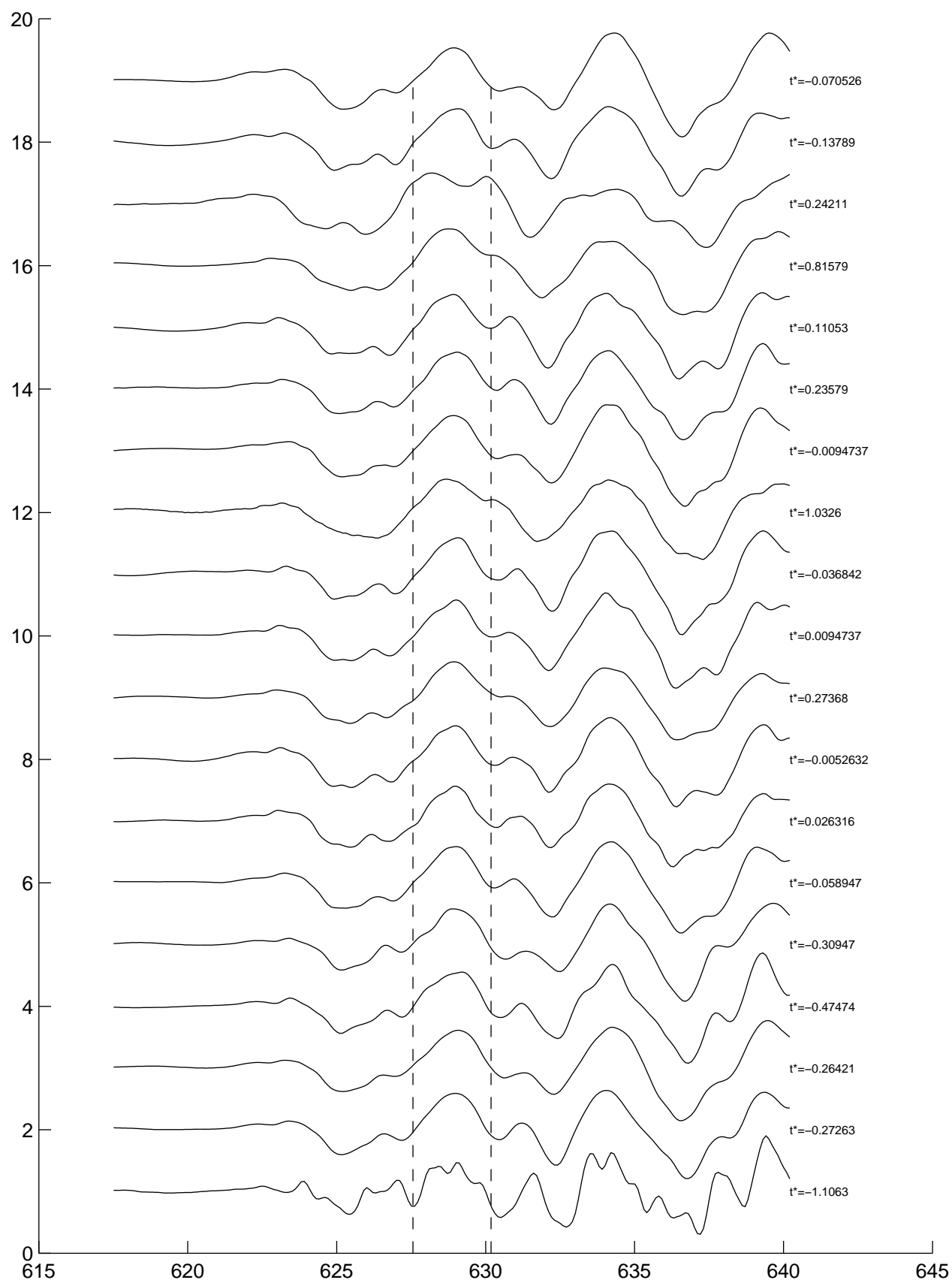
travel time residuals



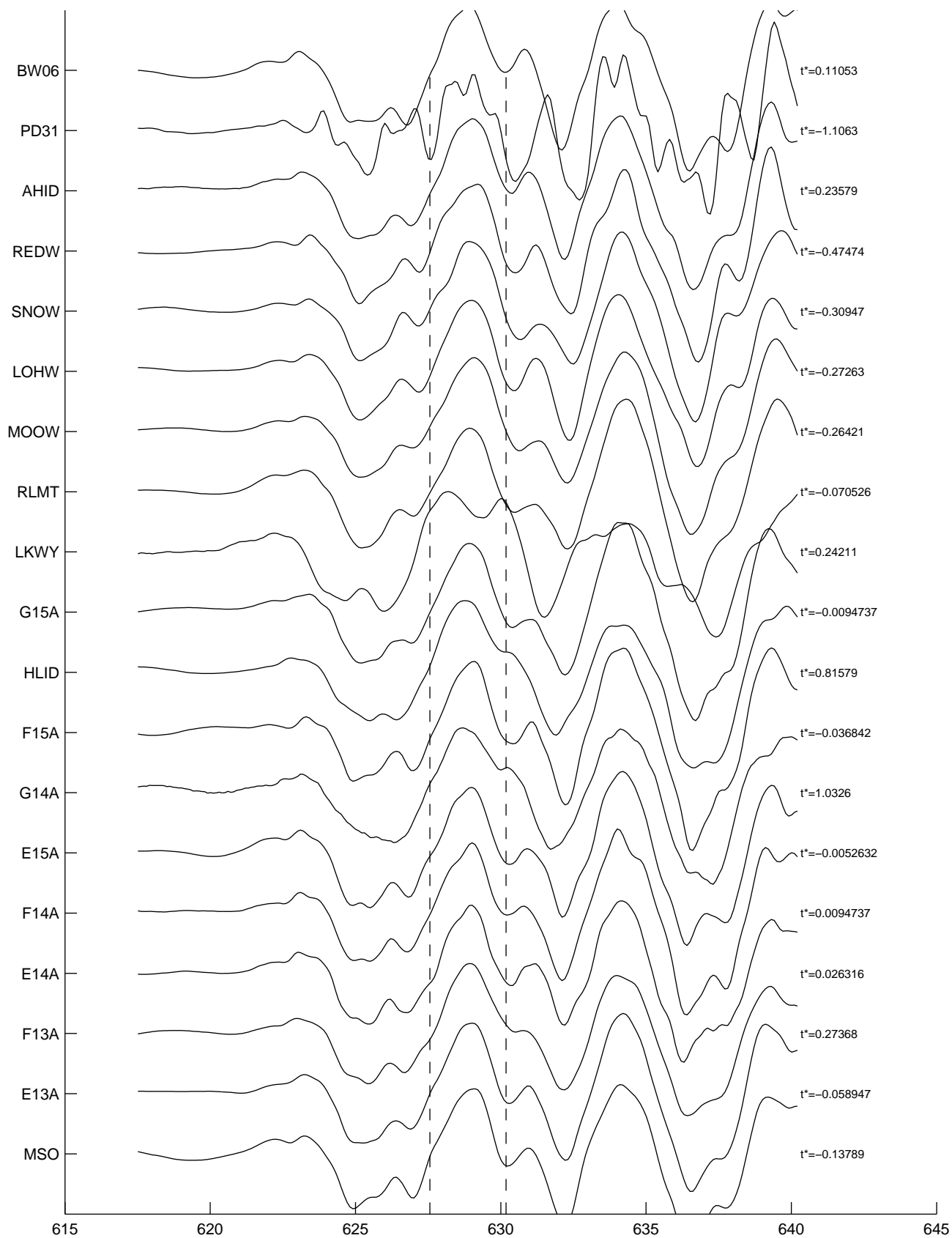
$t^*$  values



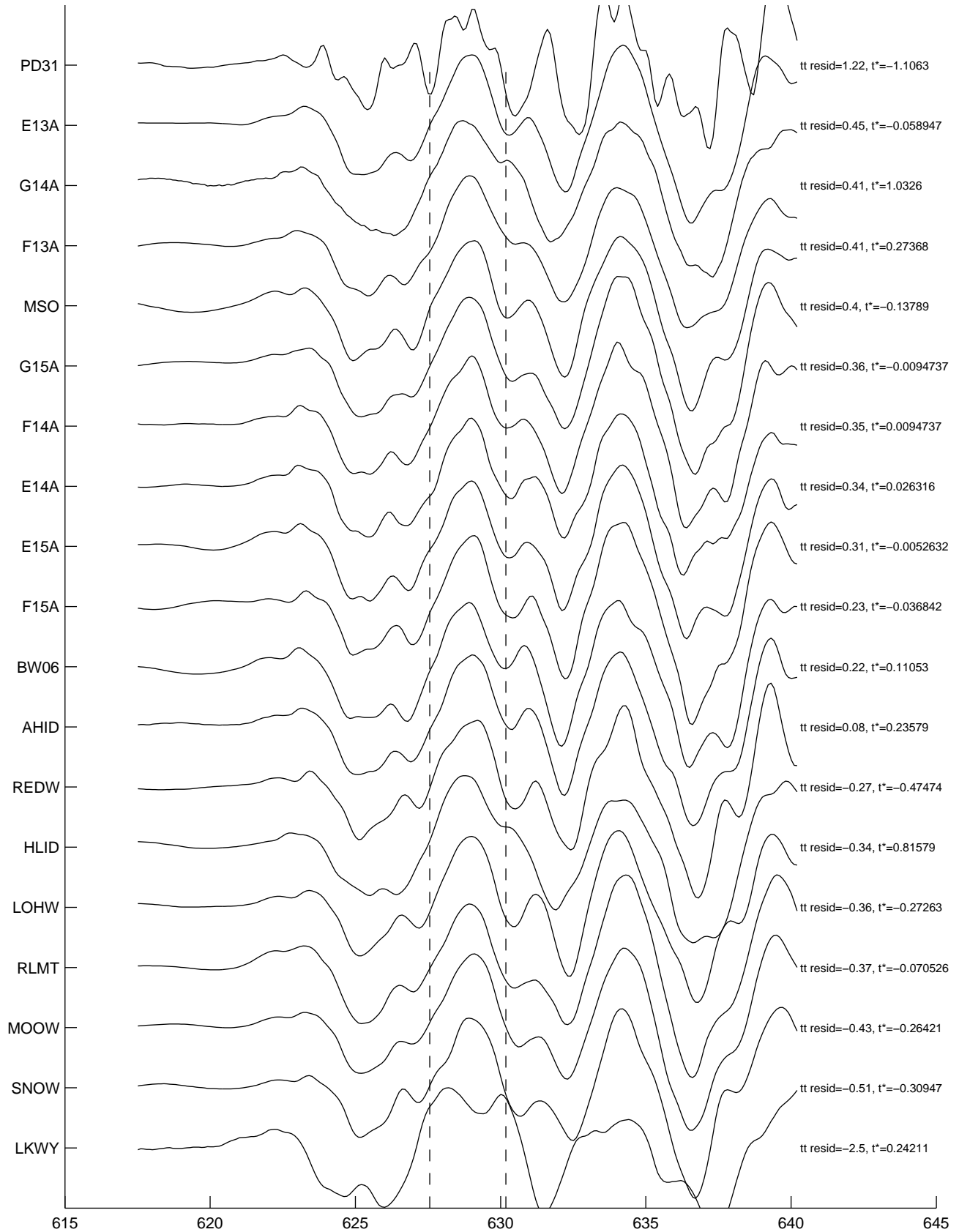
# Event\_2006\_319\_11\_14\_13



# Sorted by Delta:Event\_2006\_319\_11\_14\_13

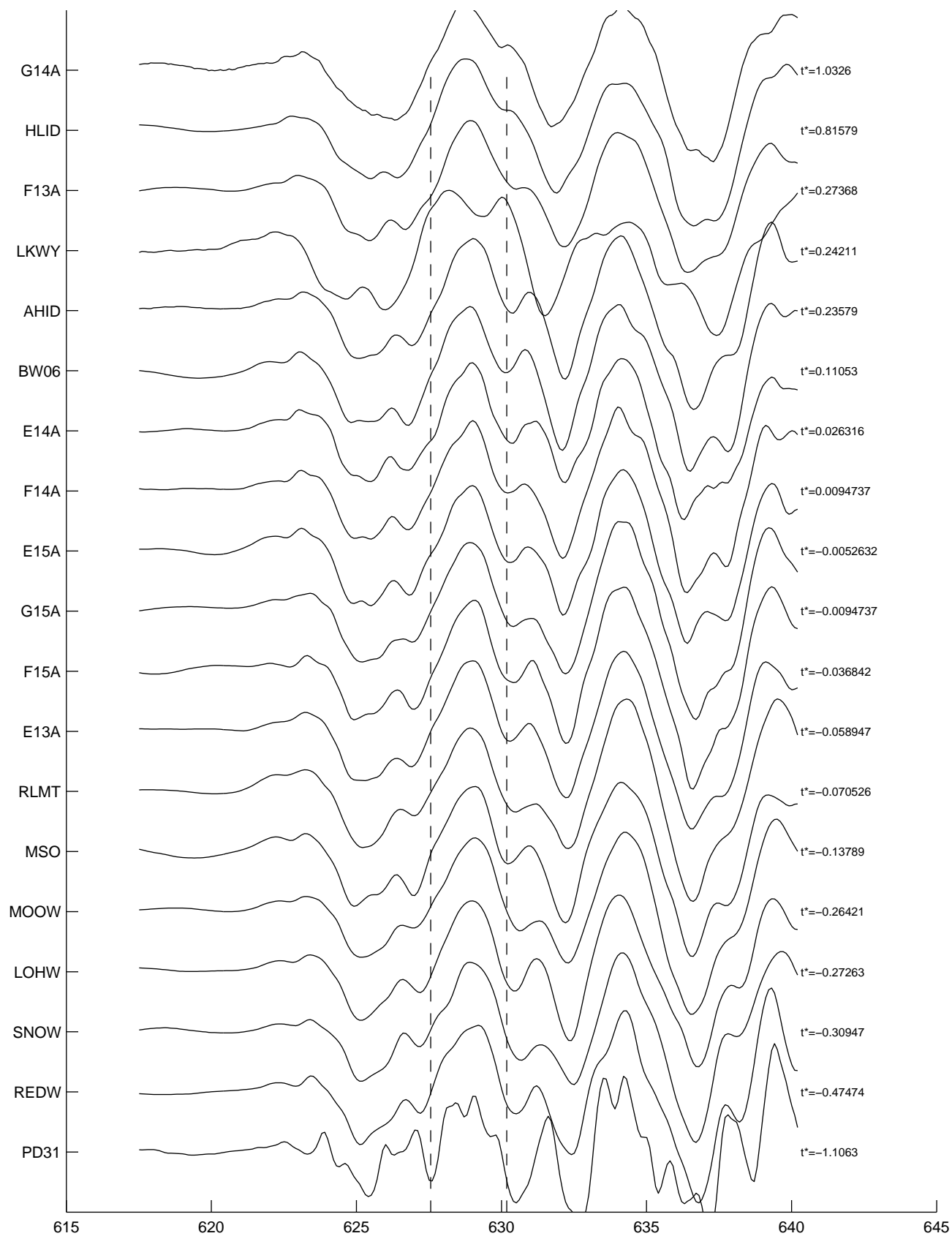


# Sorted by travel time:Event\_2006\_319\_11\_14\_13



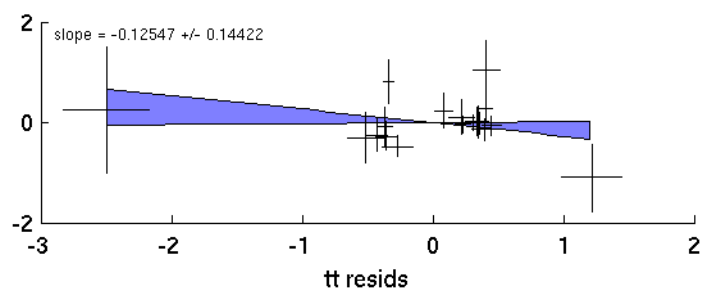
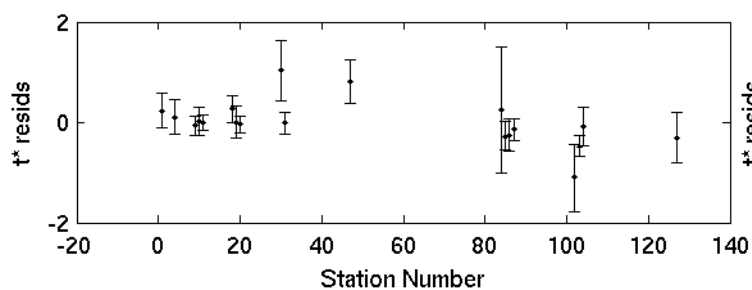
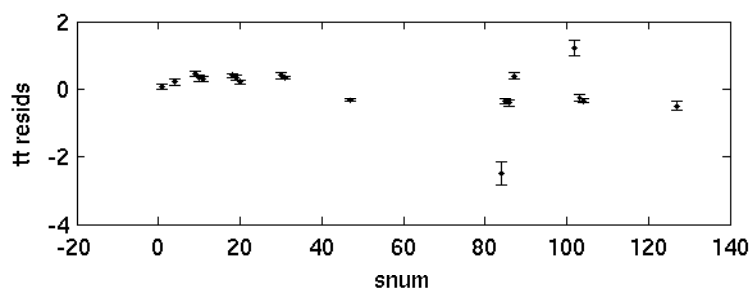
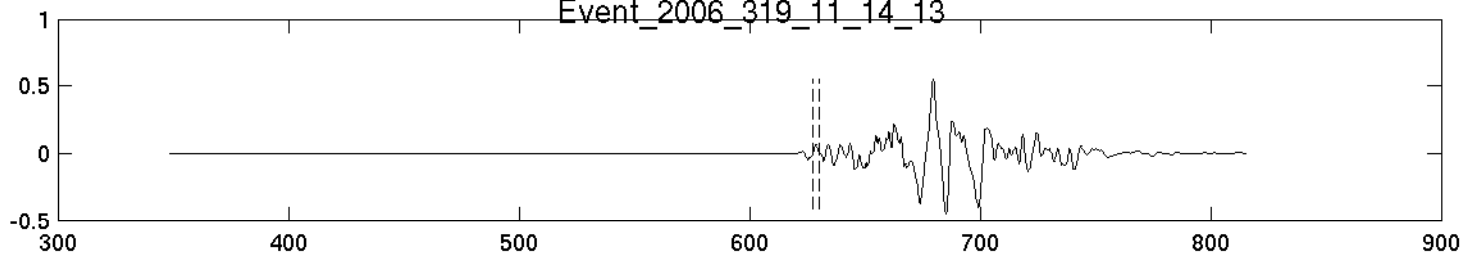


Sorted by  $t^*$ :Event\_2006\_319\_11\_14\_13

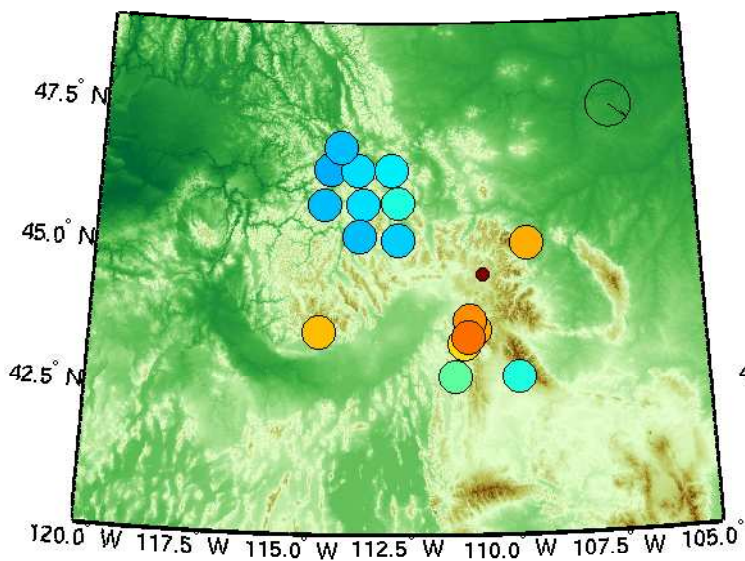


# Event\_2006\_319\_11\_14\_13

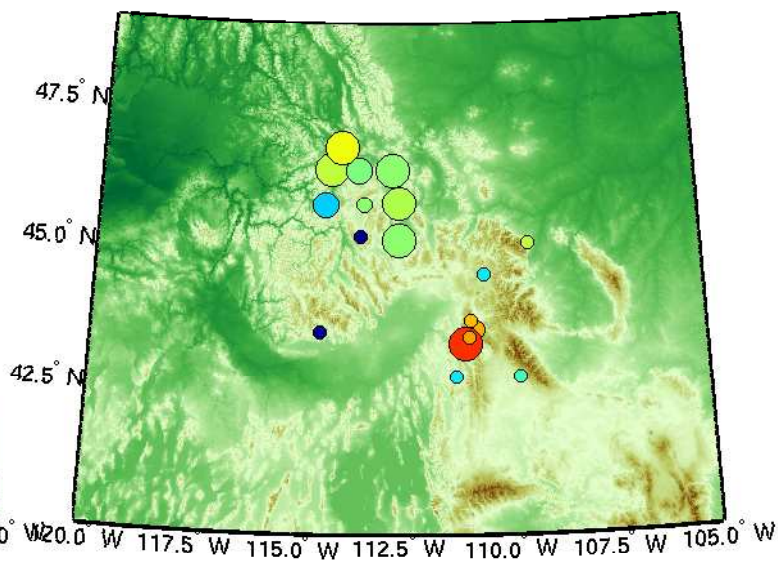
Stack



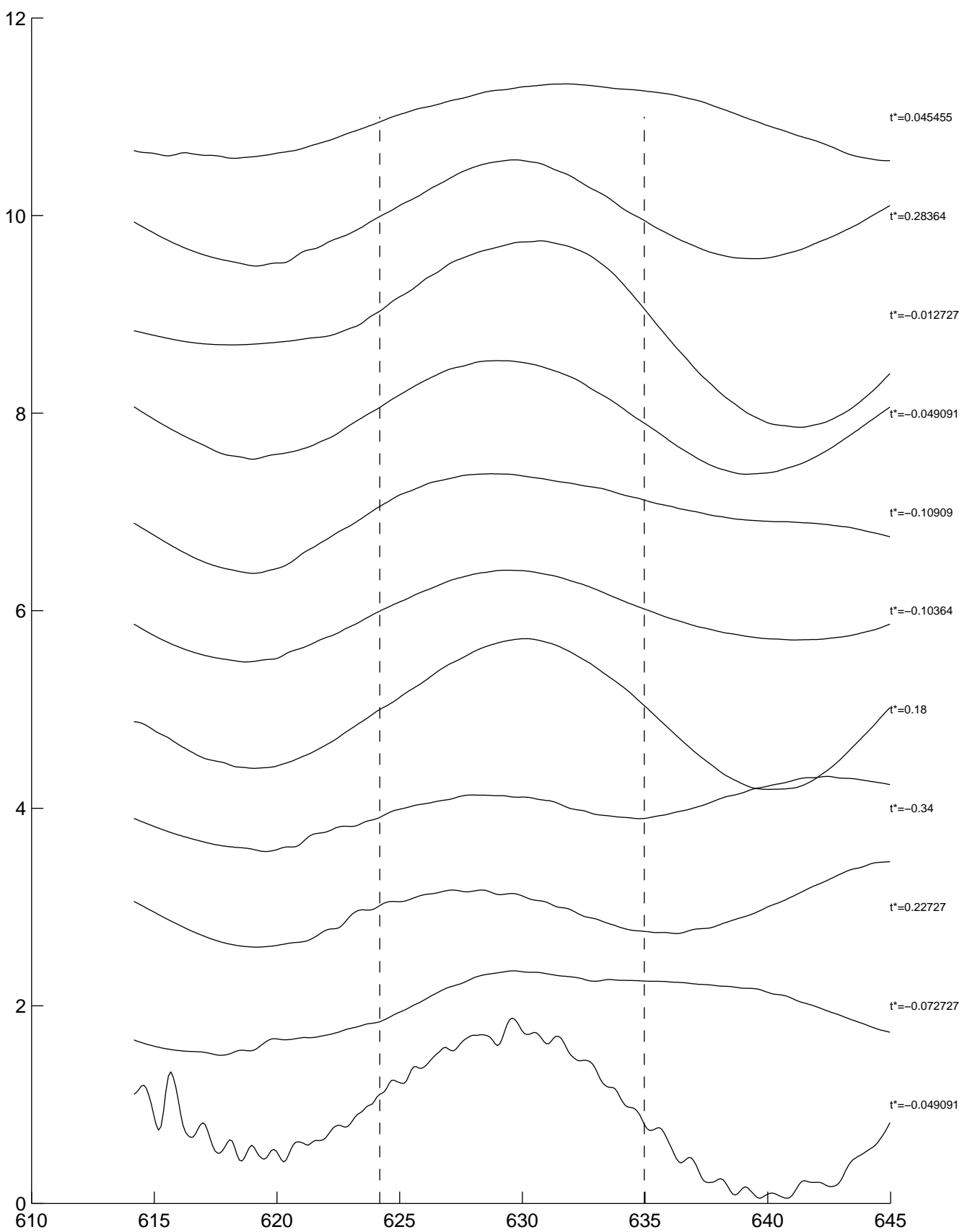
travel time residuals



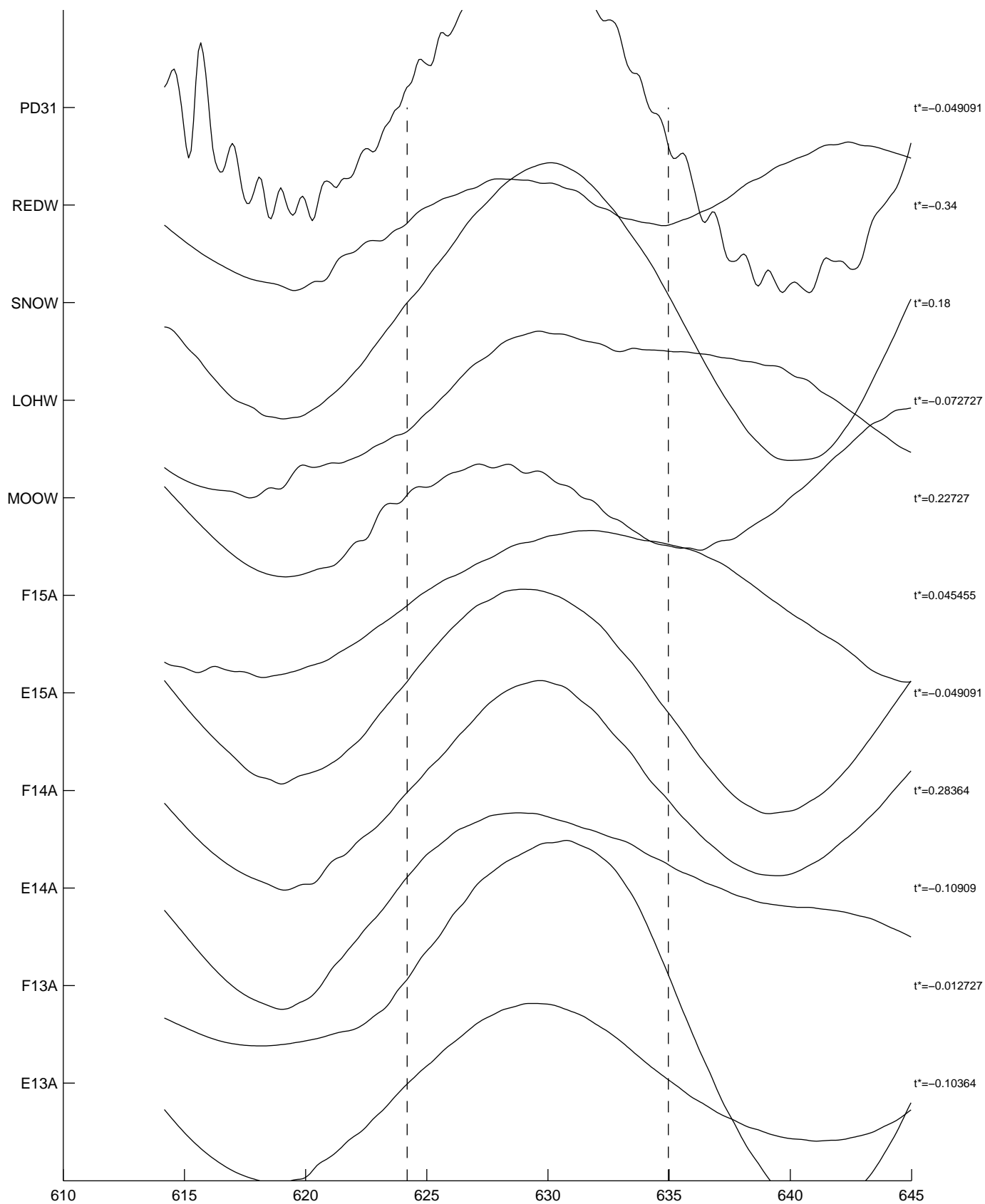
t\* values



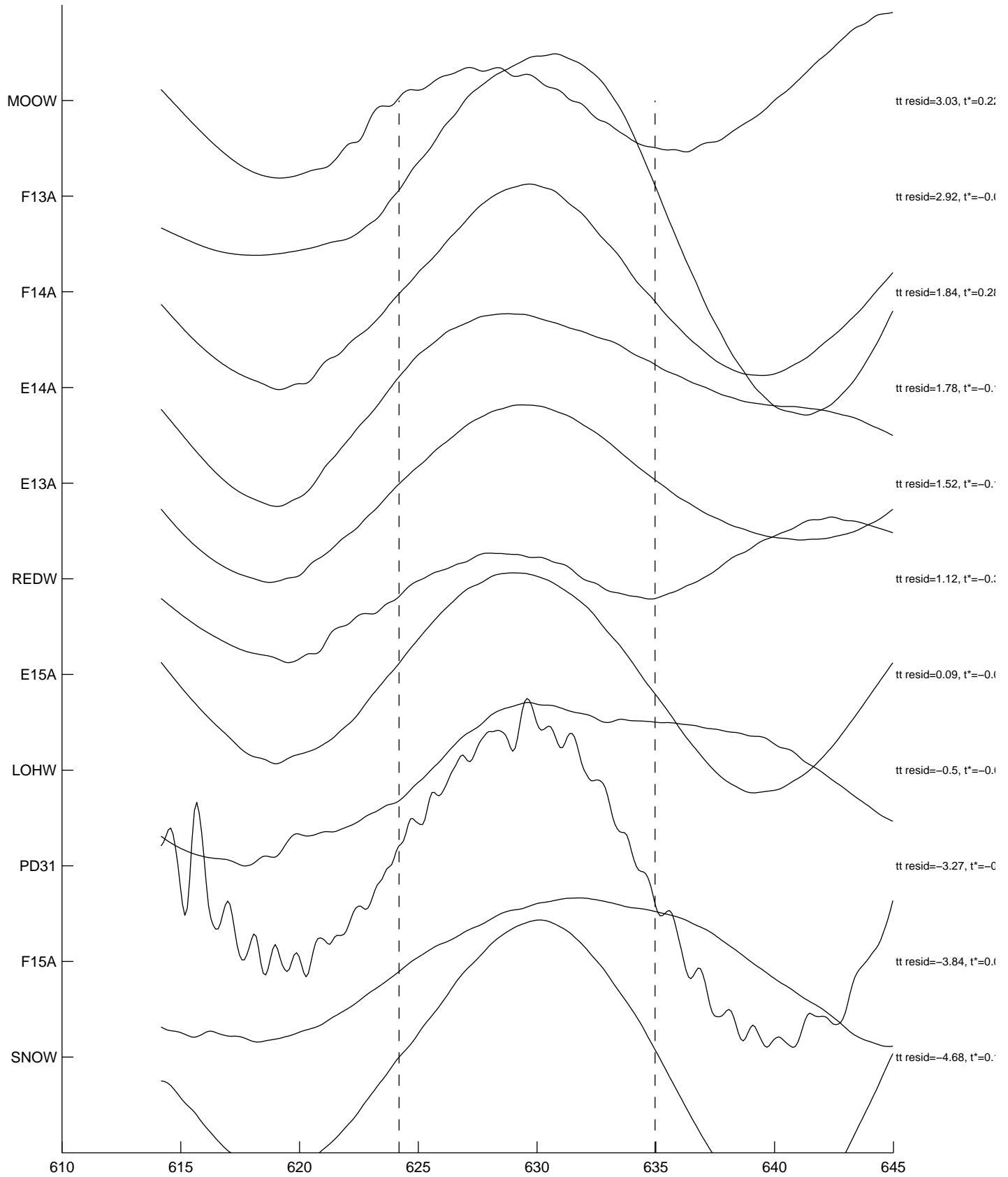
# Event\_2006\_319\_11\_40\_55



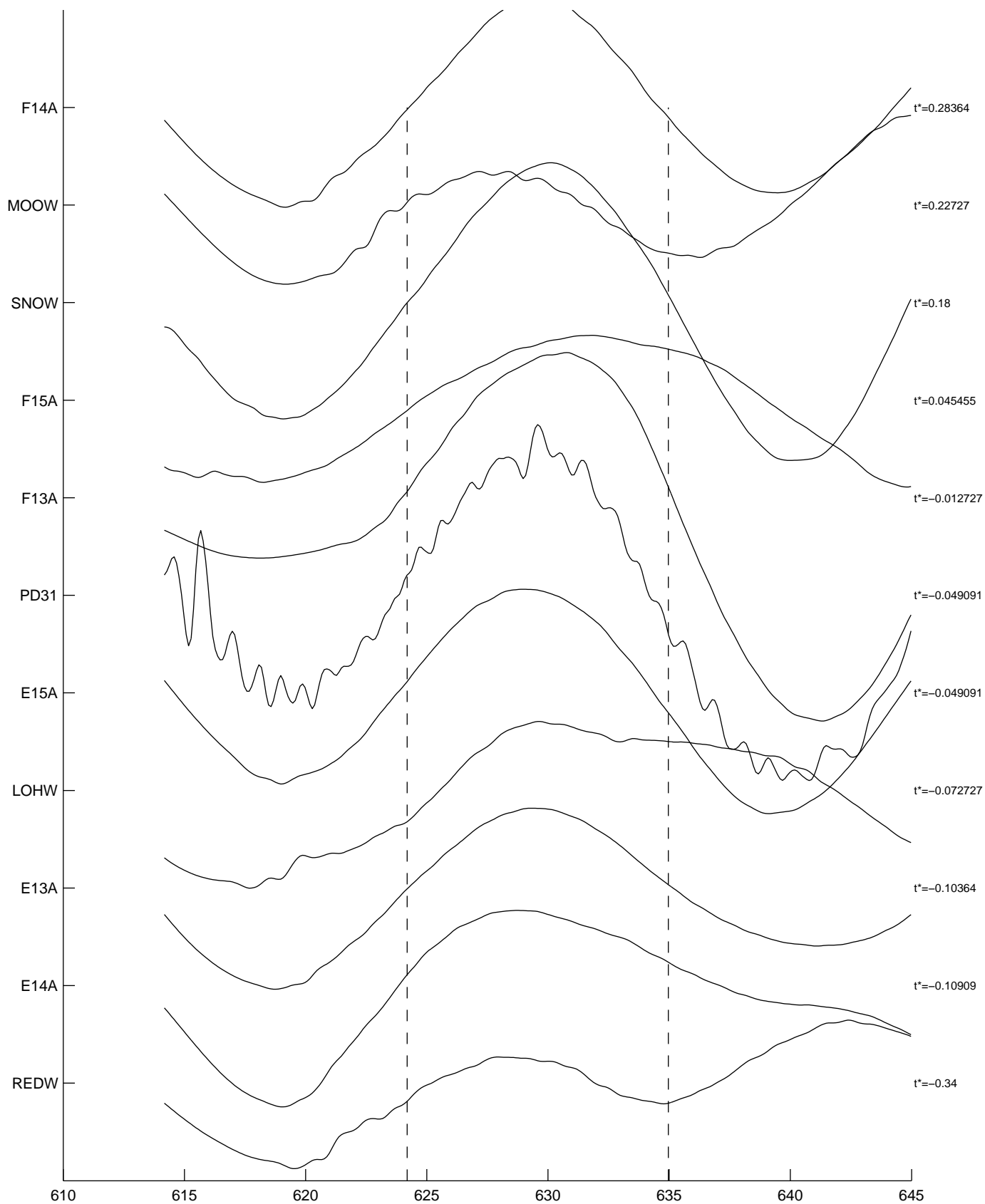
# Sorted by Delta:Event\_2006\_319\_11\_40\_55



# Sorted by travel time: Event\_2006\_319\_11\_40\_55

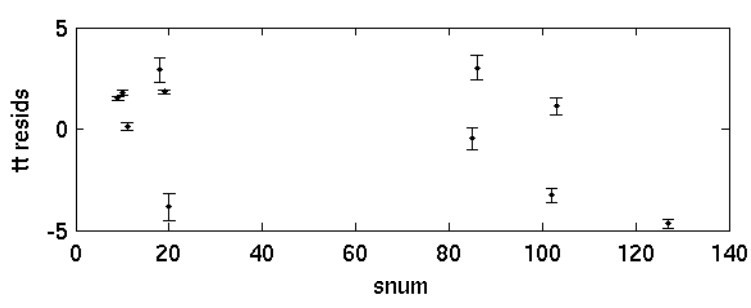
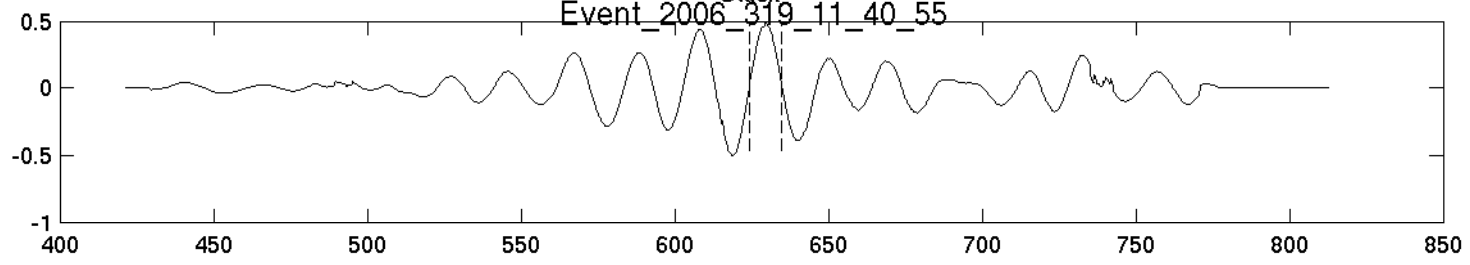


Sorted by  $t^*$ :Event\_2006\_319\_11\_40\_55

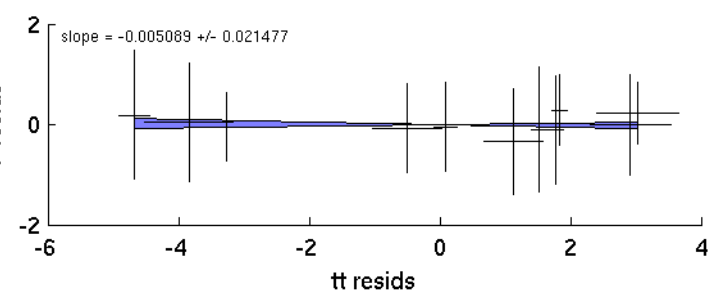
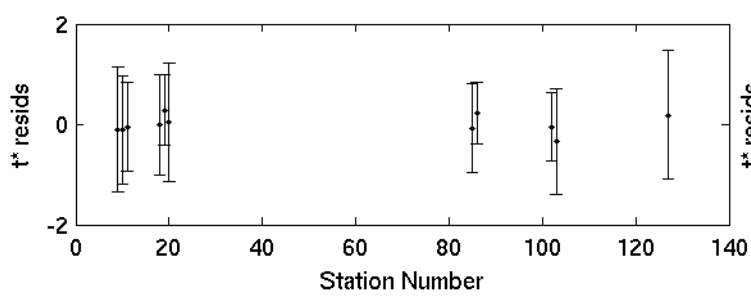


Event\_2006\_319\_11\_40\_55

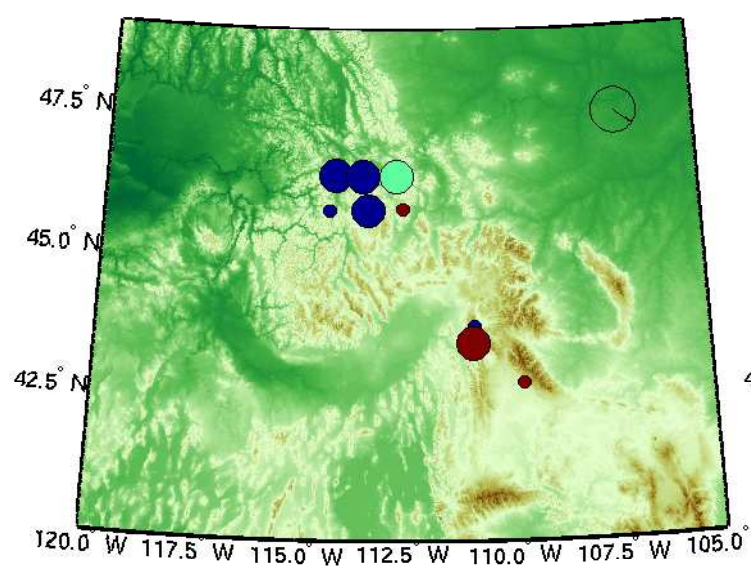
Stack



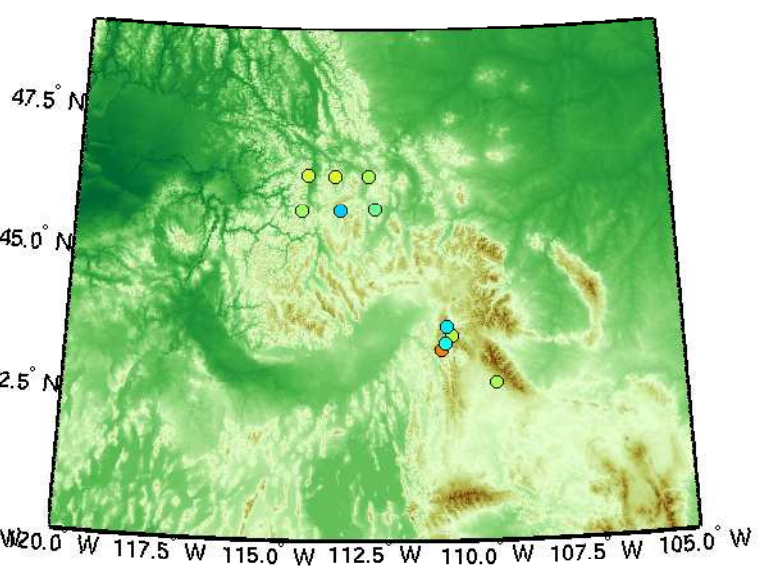
Baz = 308.2808  
Mean xcor value = 0.67182  
Range of  $t^*$  values is 0.62364  
Median  $t^*$  err is 1.0161  
Slope = -0.005089 +/- 0.021477



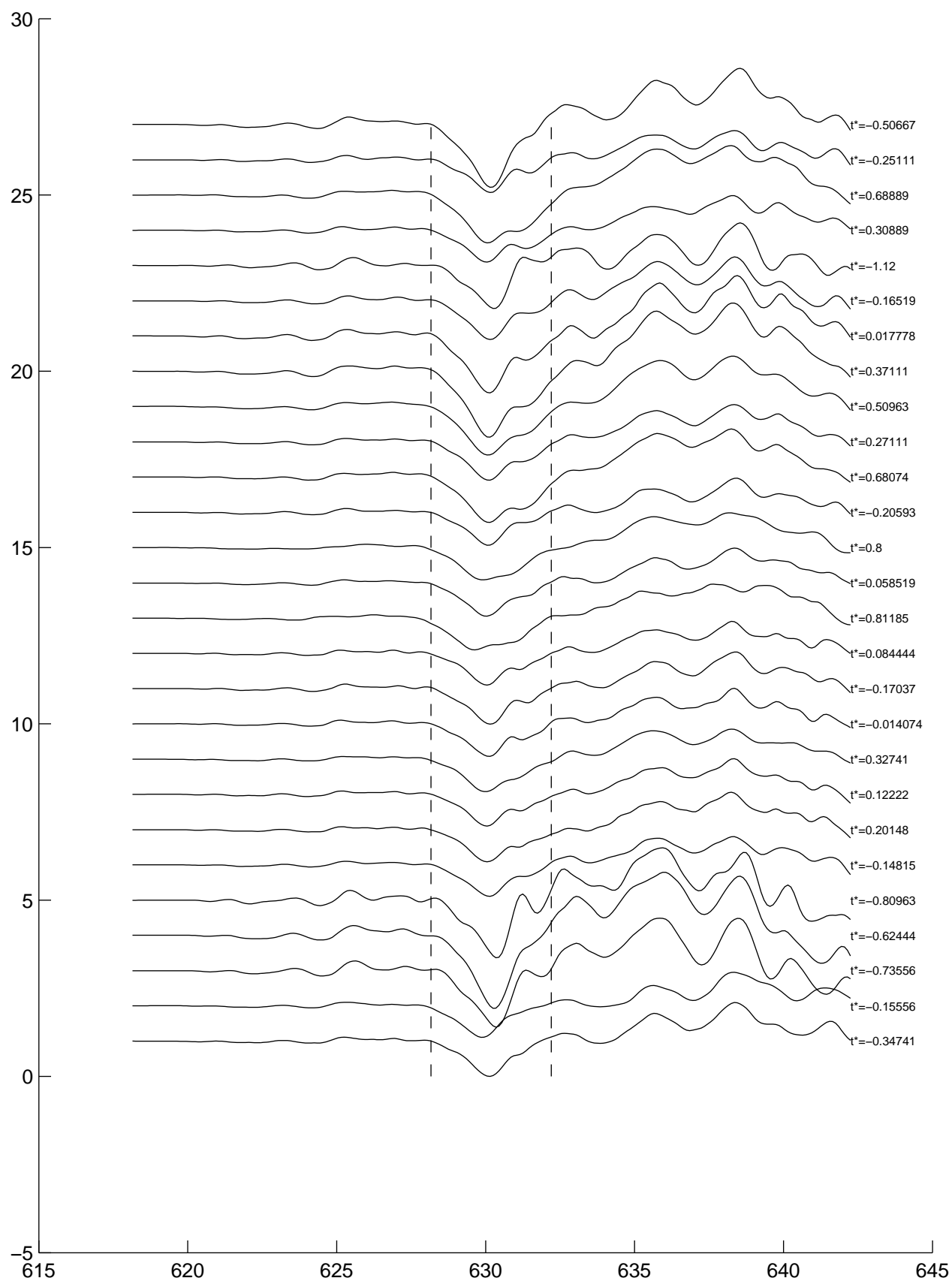
travel time residuals



$t^*$  values

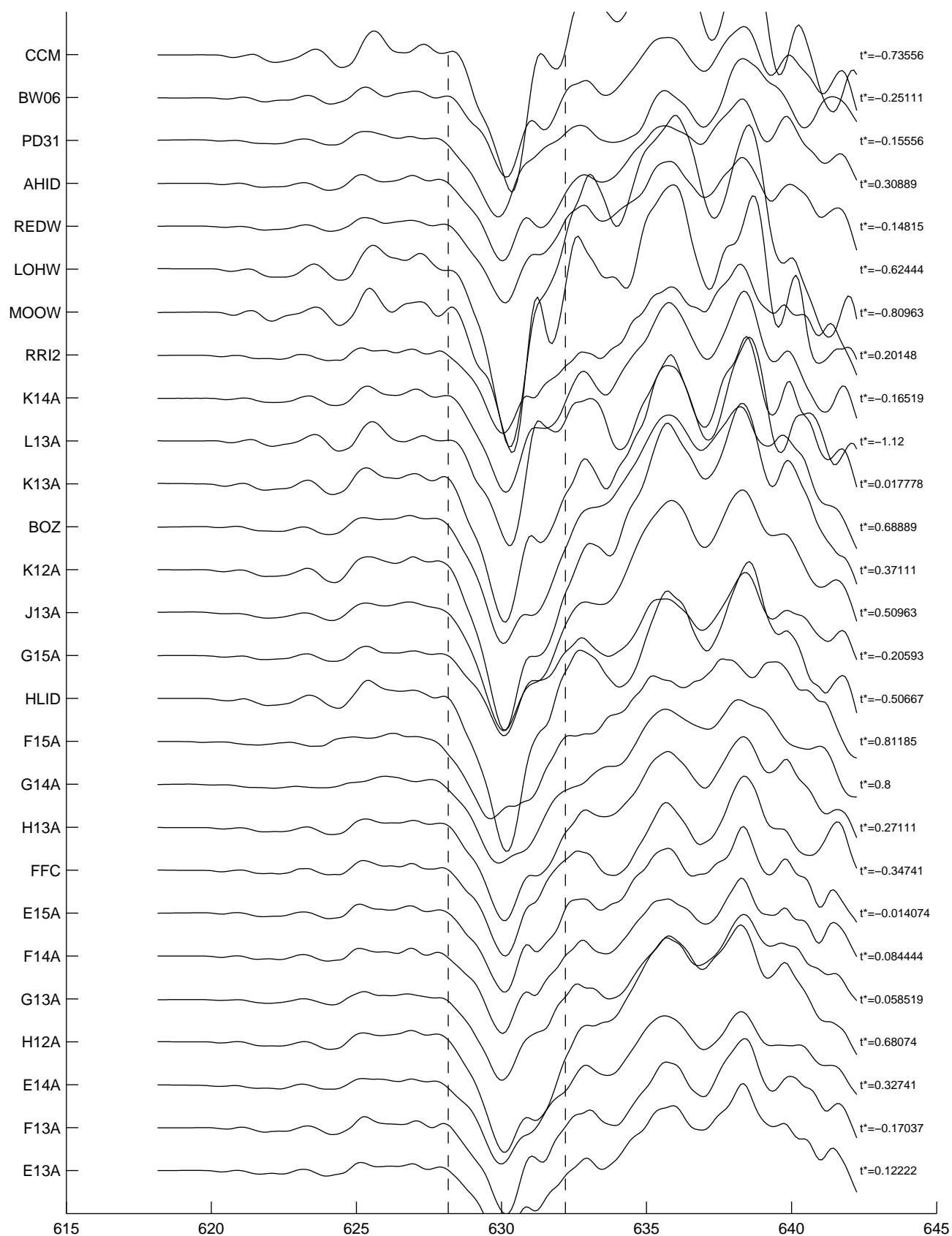


# Event\_2007\_013\_04\_23\_21

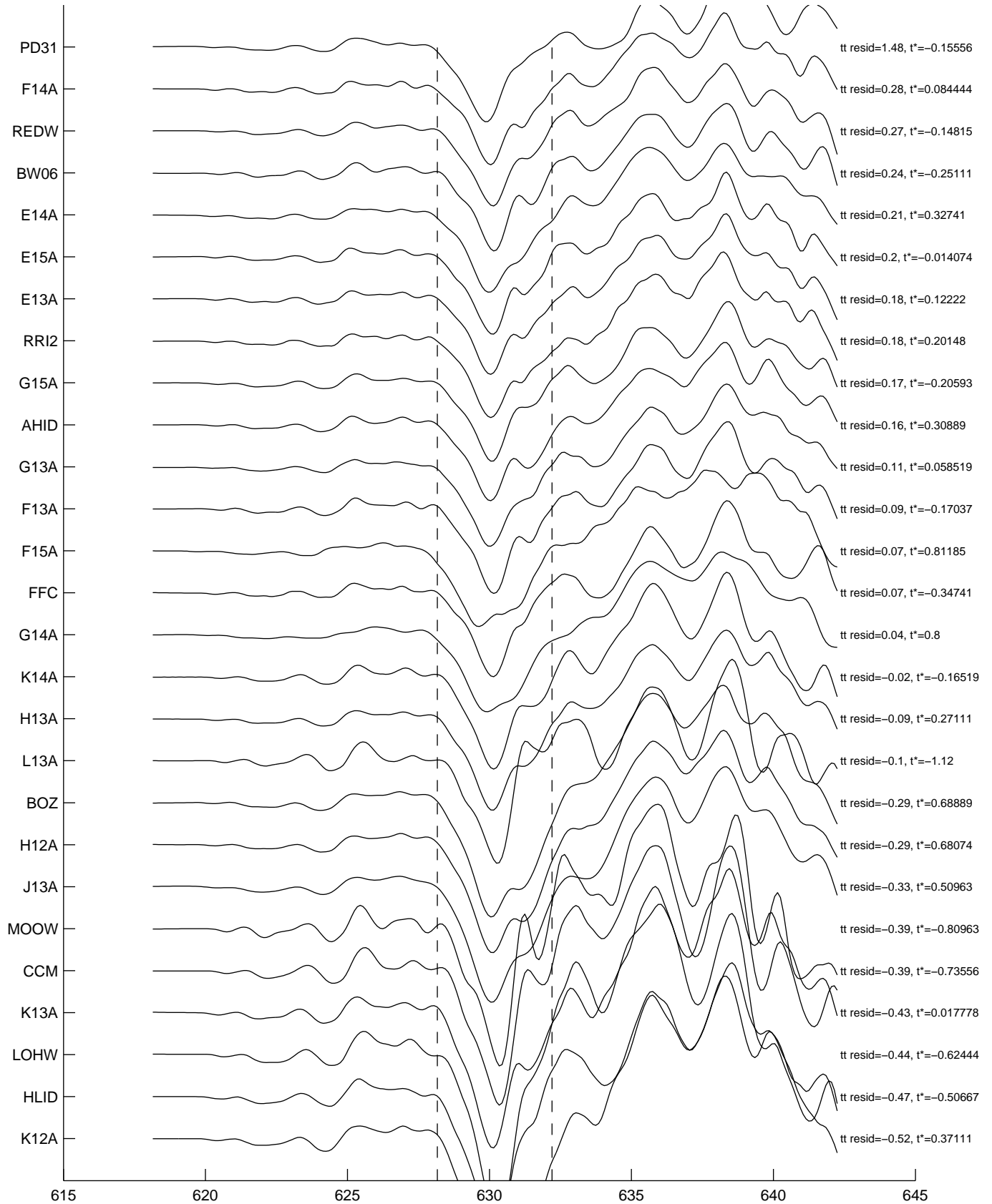




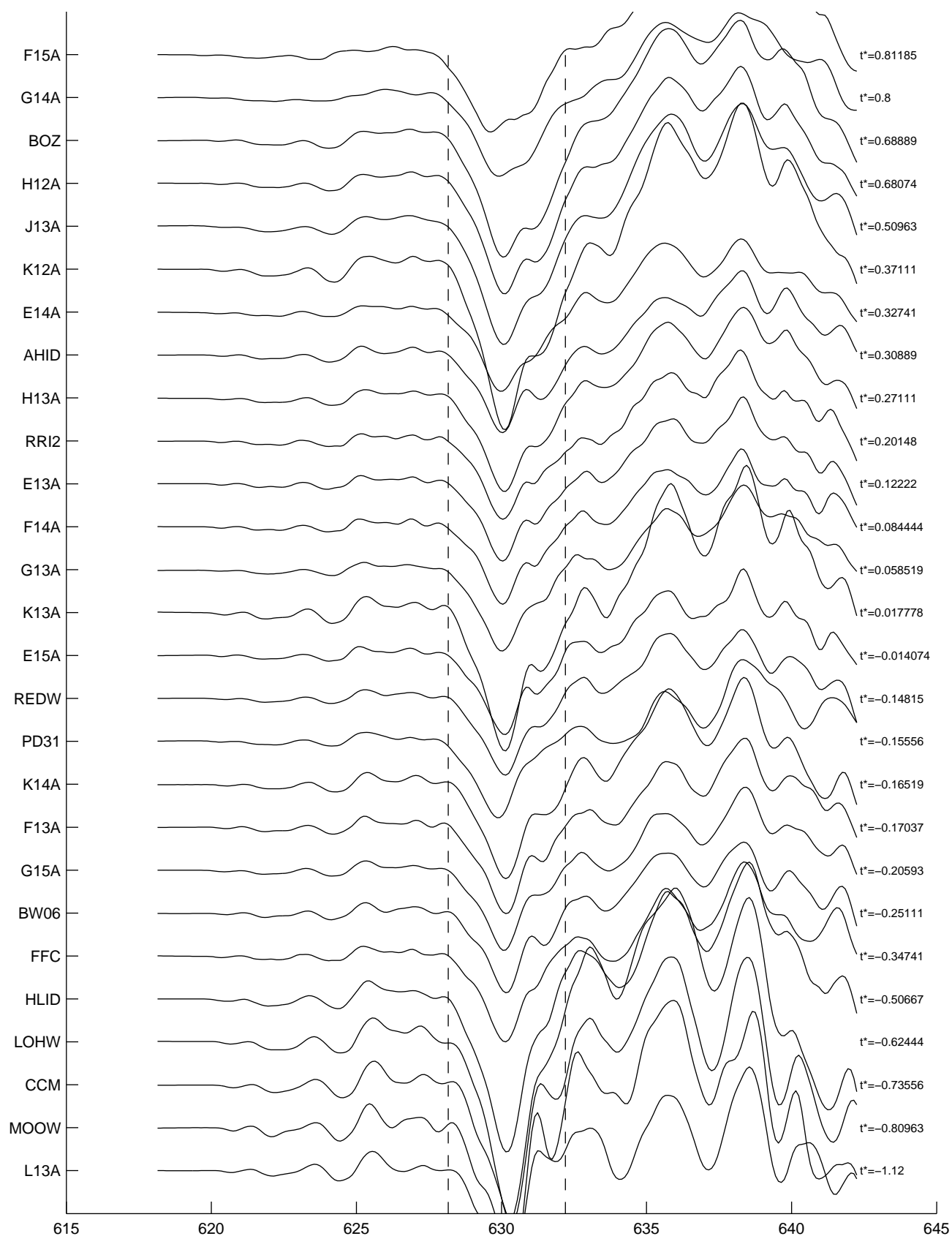
# Sorted by Delta:Event\_2007\_013\_04\_23\_21



# Sorted by travel time: Event\_2007\_013\_04\_23\_21

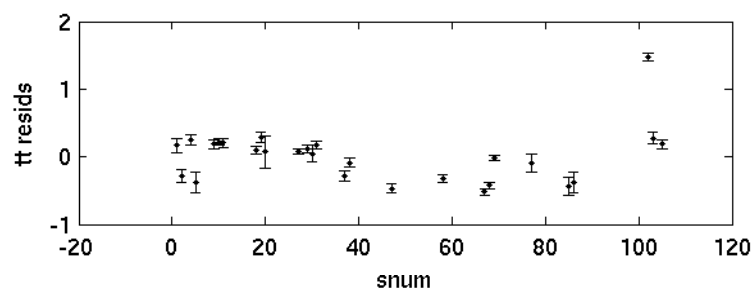
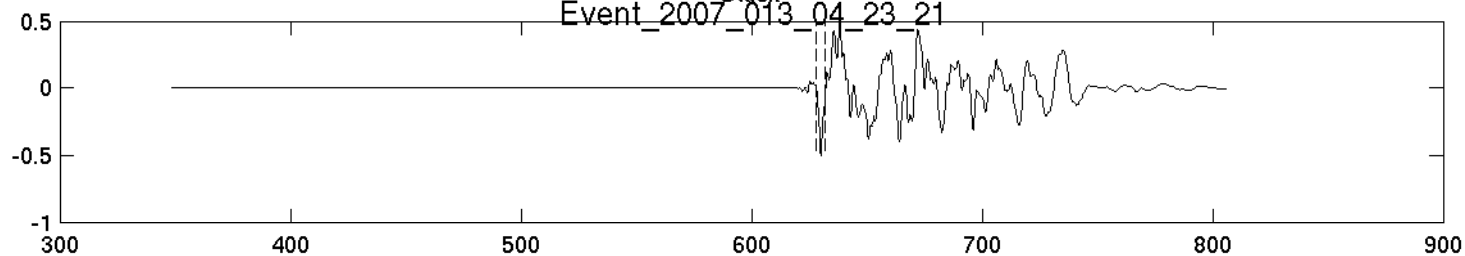


Sorted by  $t^*$ :Event\_2007\_013\_04\_23\_21

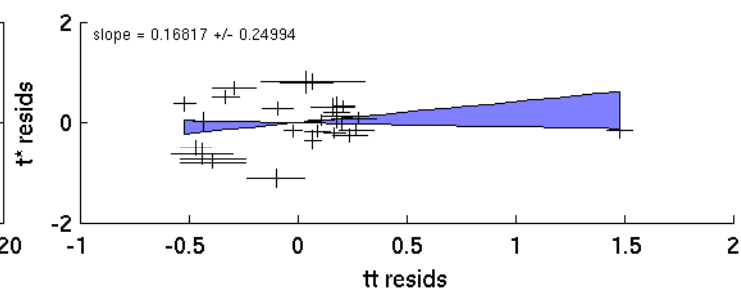
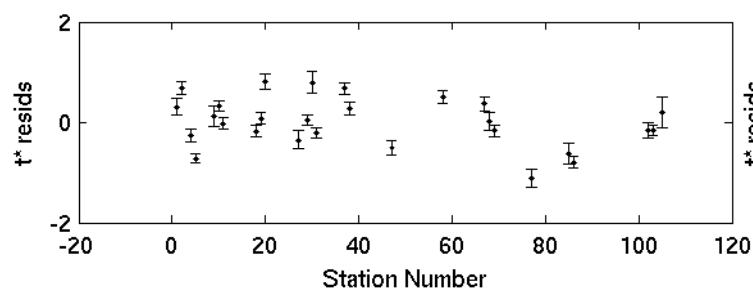


Event\_2007\_013\_04\_23\_21

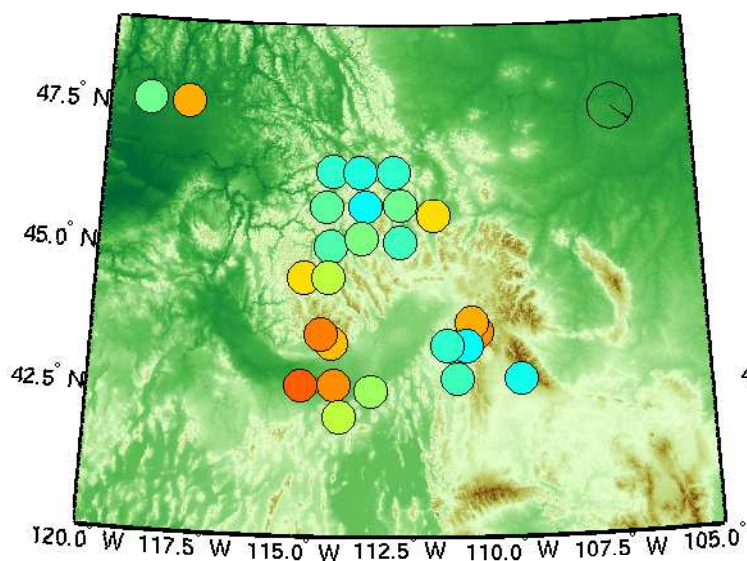
Stack



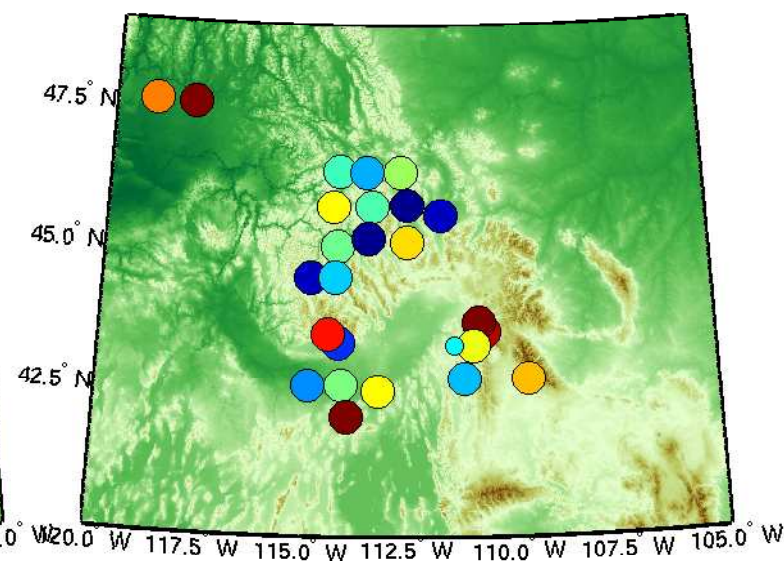
Baz = 308.4262  
Mean xcor value = 0.91222  
Range of  $t^*$  values is 1.9319  
Median  $t^*$  err is 0.13048  
Slope = 0.16817 +/- 0.24994



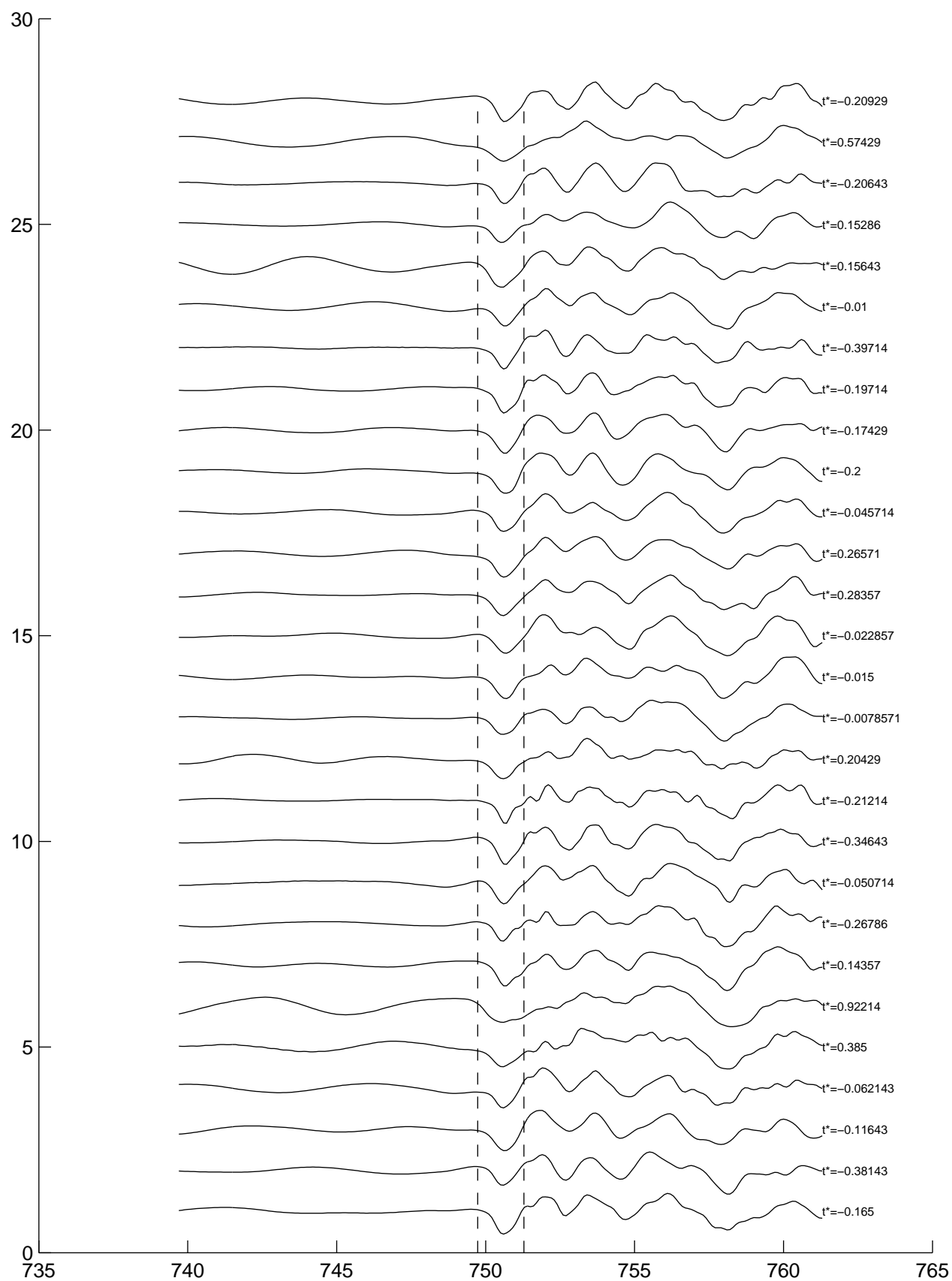
travel time residuals



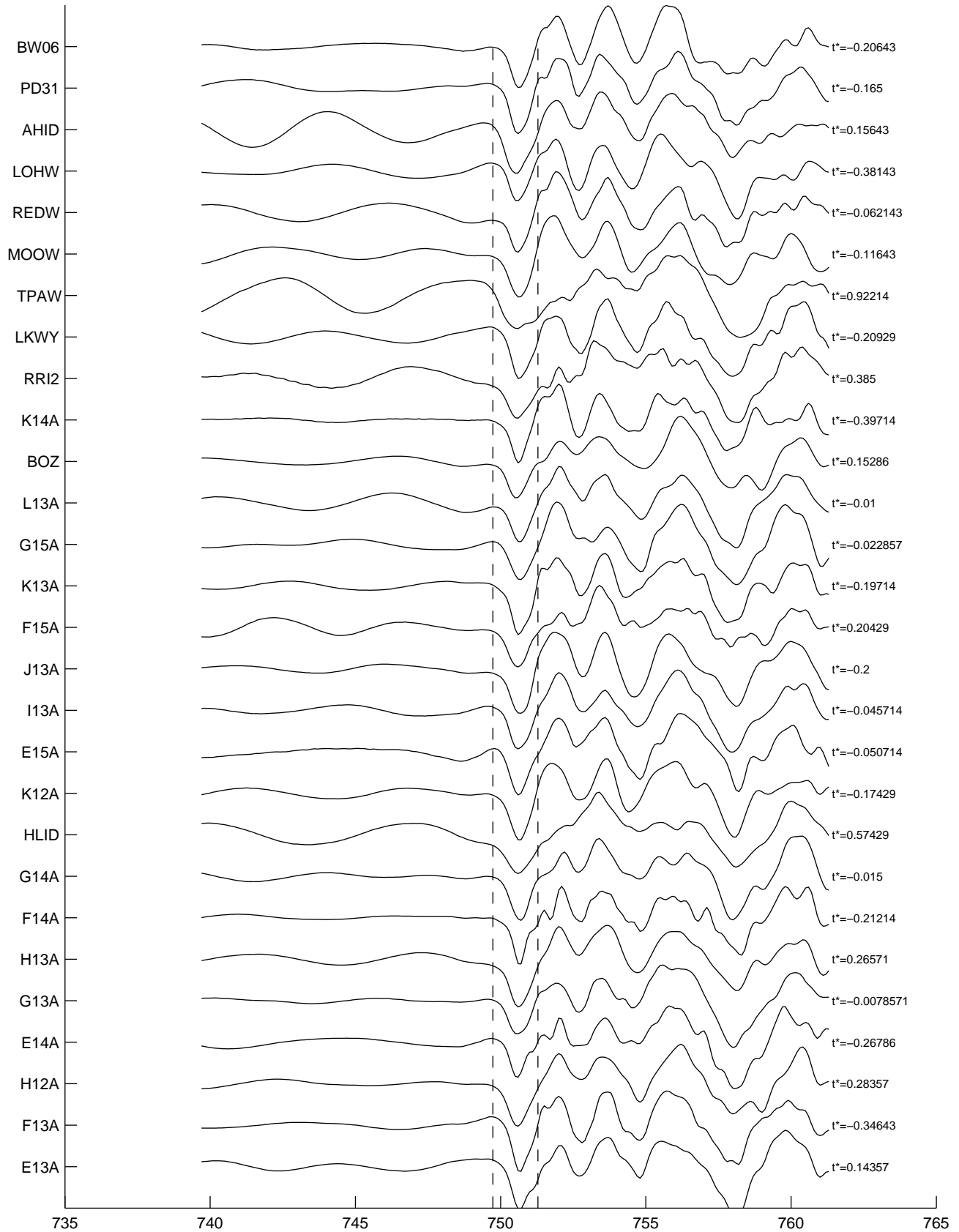
$t^*$  values



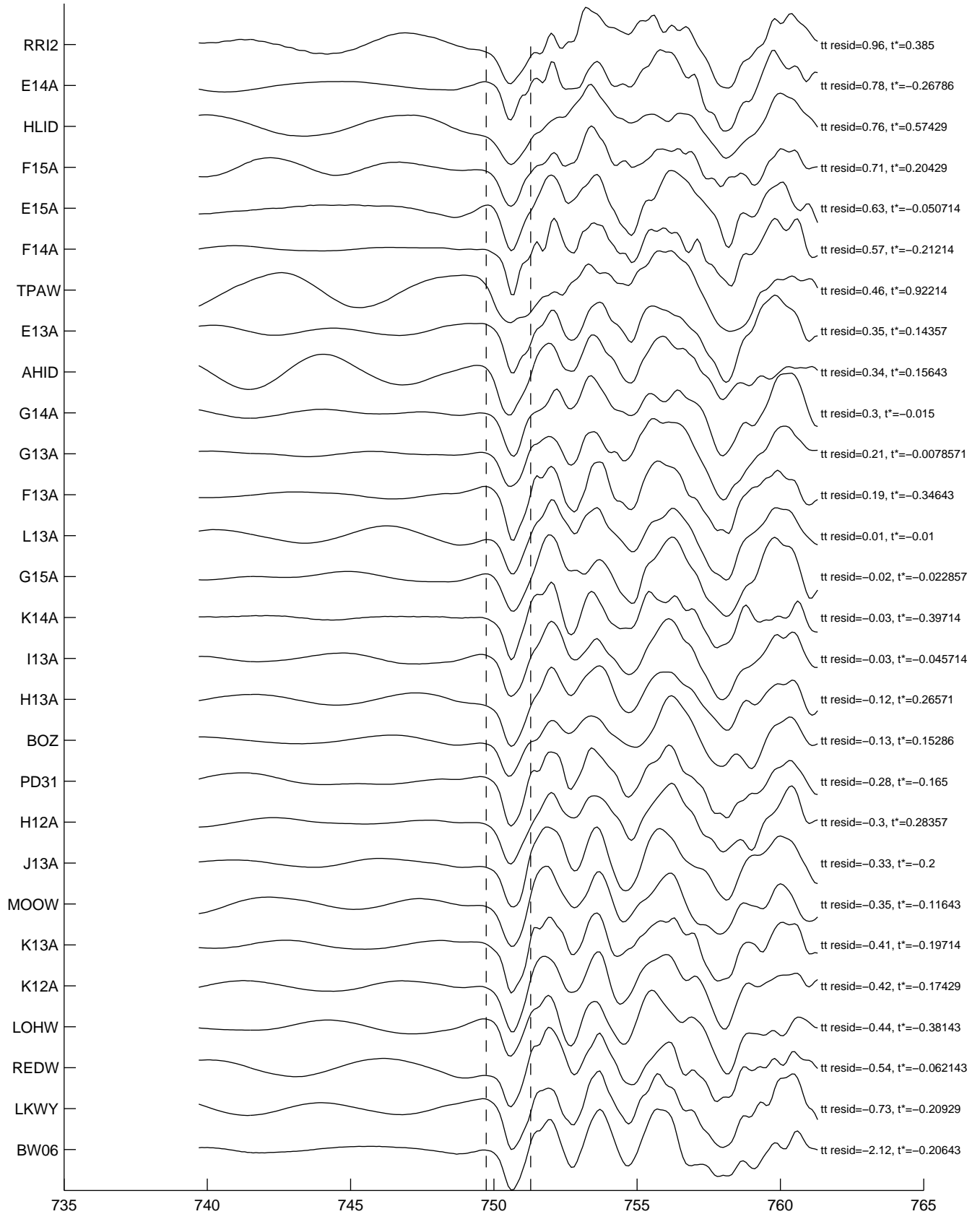
# Event\_2007\_030\_21\_37\_45



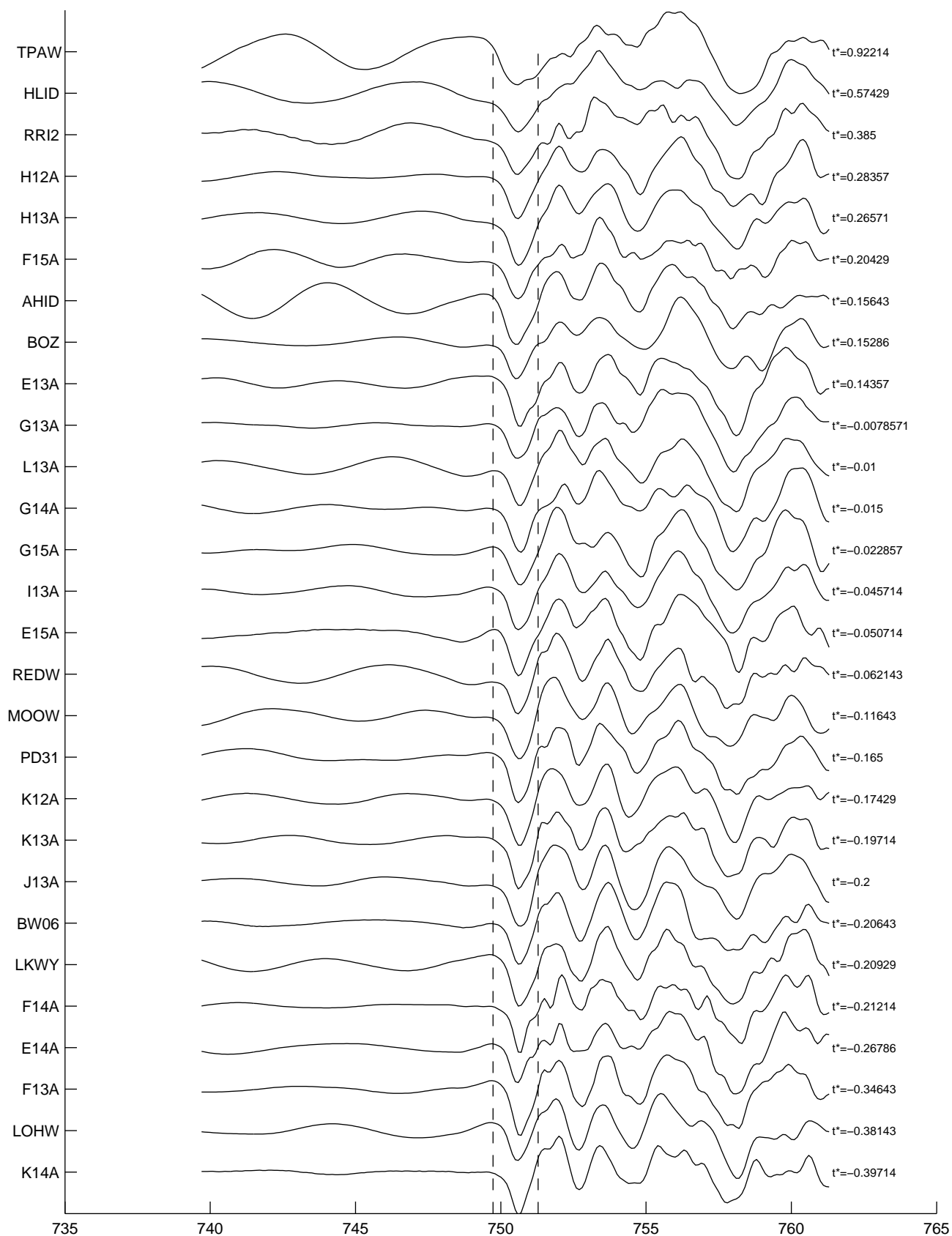
# Sorted by Delta:Event\_2007\_030\_21\_37\_45



# Sorted by travel time: Event\_2007\_030\_21\_37\_45



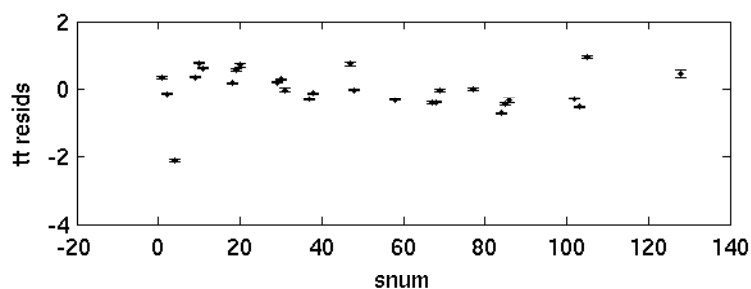
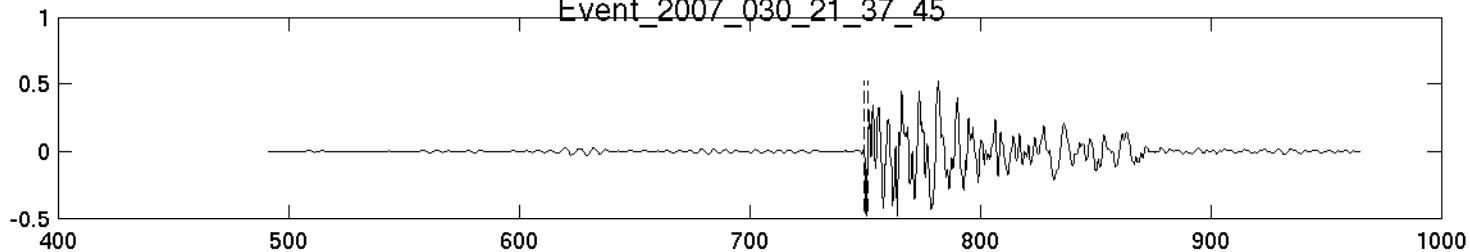
Sorted by  $t^*$ :Event\_2007\_030\_21\_37\_45



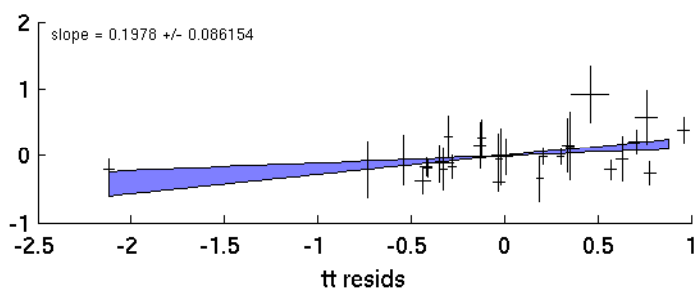
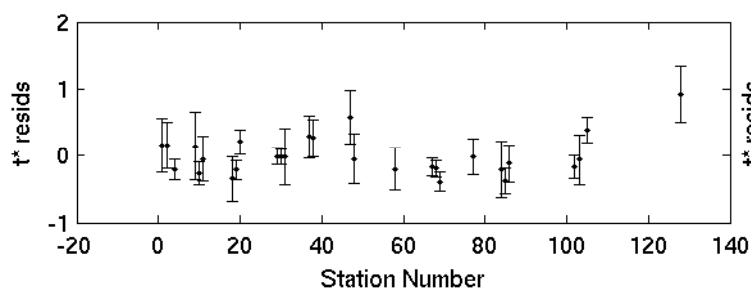


# Event\_2007\_030\_21\_37\_45

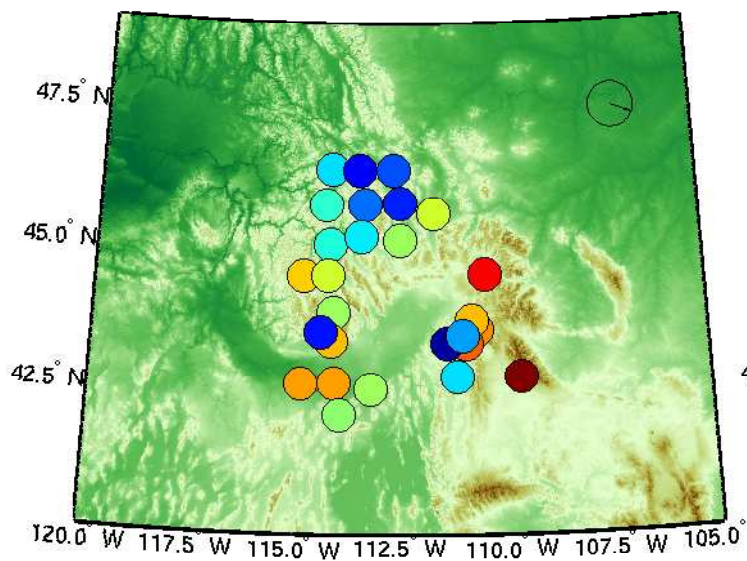
Stack



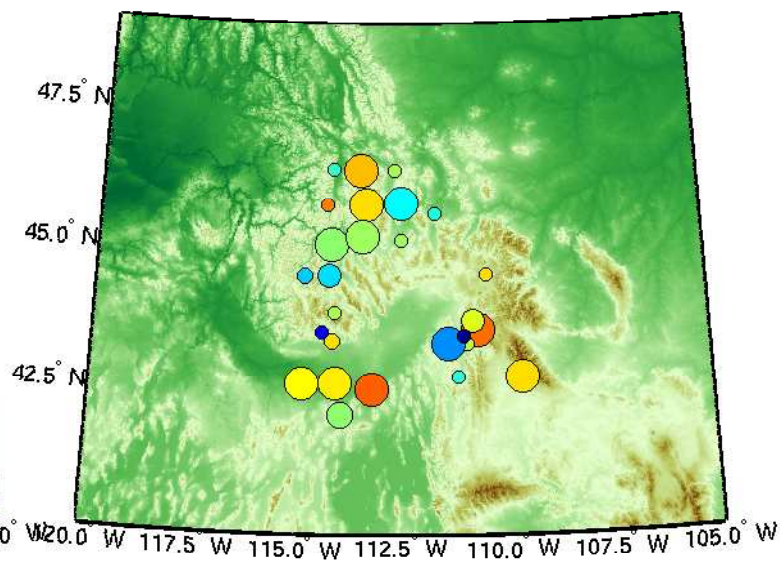
Baz = 293.6705  
Mean xcor value = 0.76  
Range of  $t^*$  values is 1.3193  
Median  $t^*$  err is 0.27829  
Slope = 0.1978 +/- 0.086154



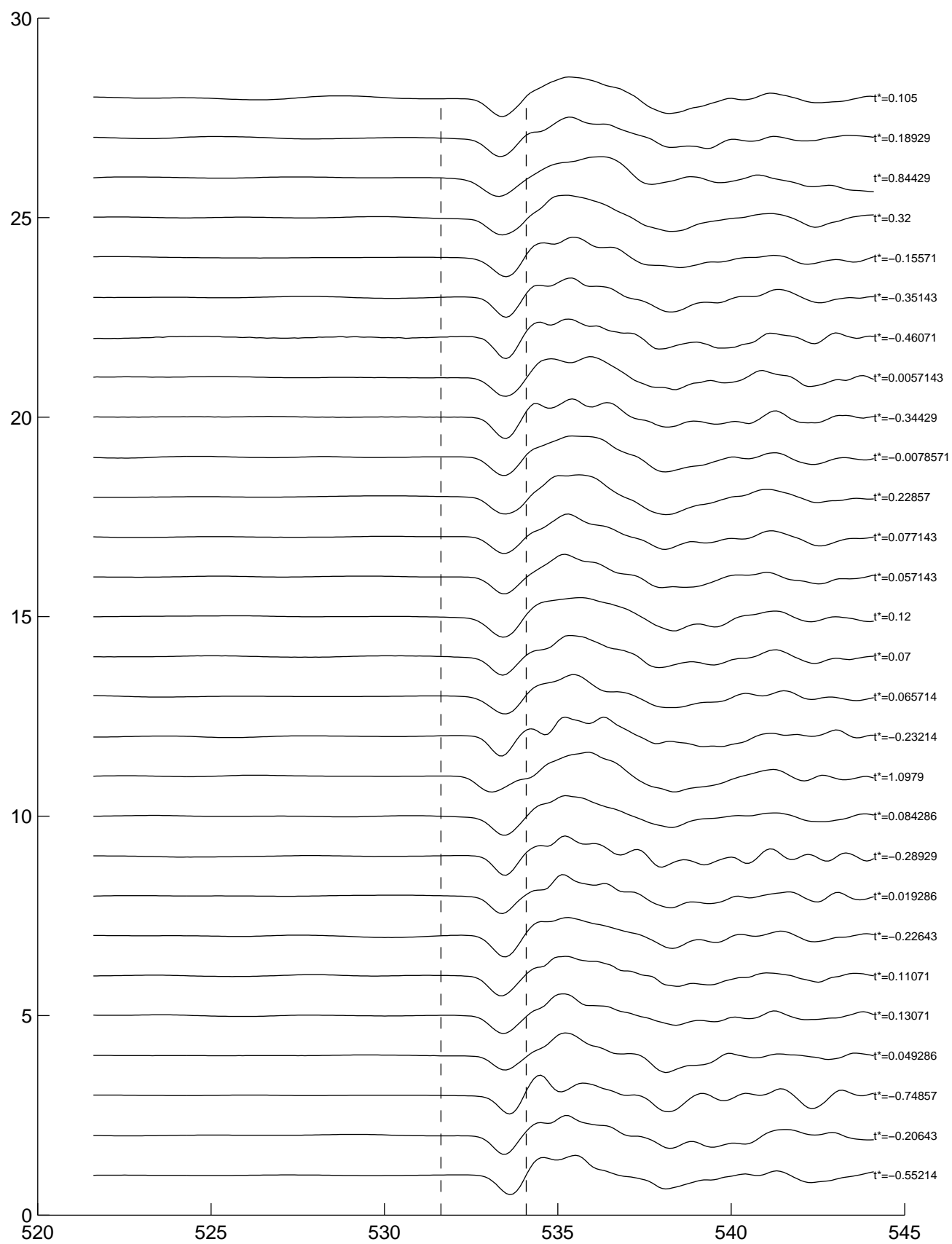
travel time residuals



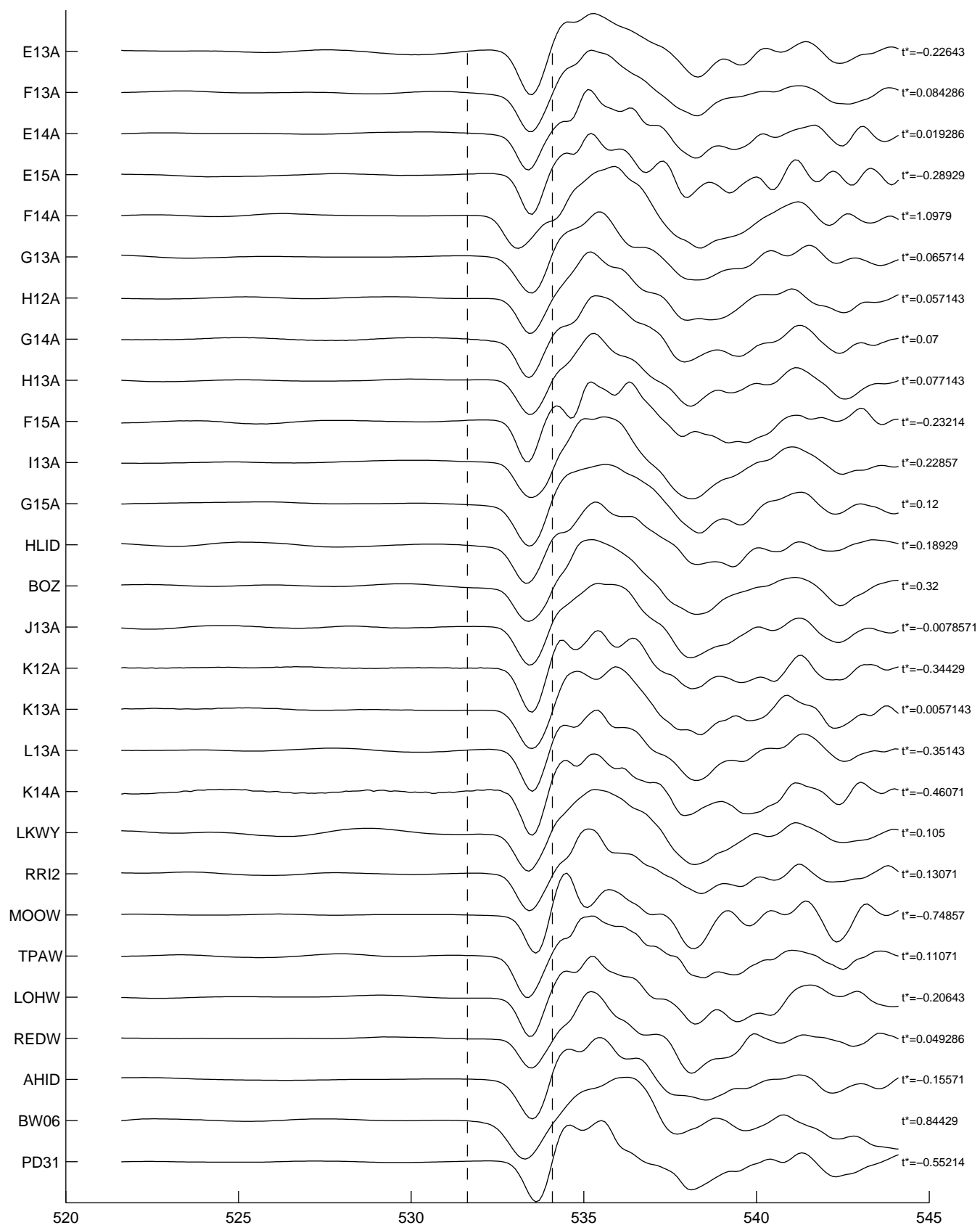
$t^*$  values



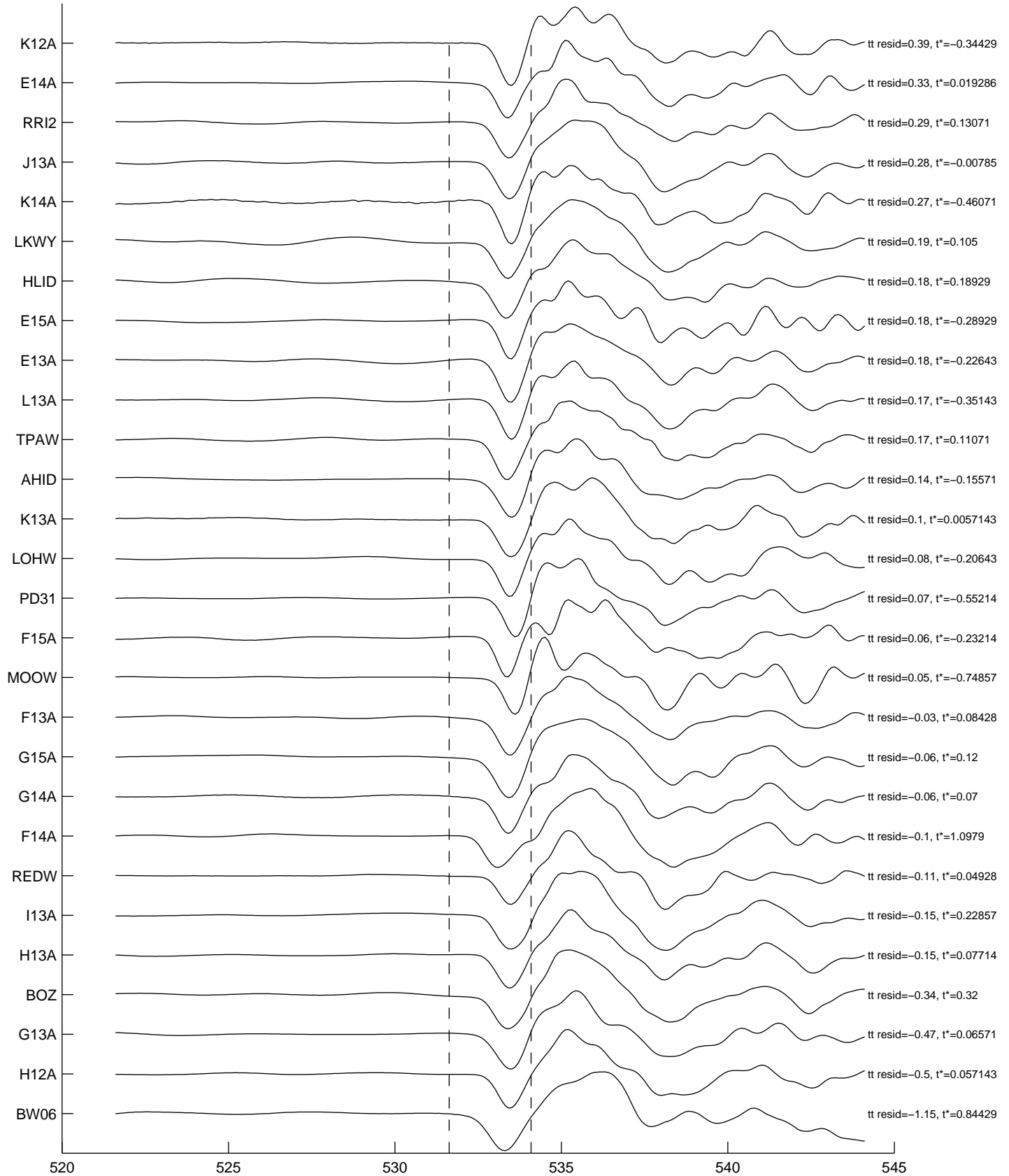
# Event\_2007\_077\_02\_11\_05



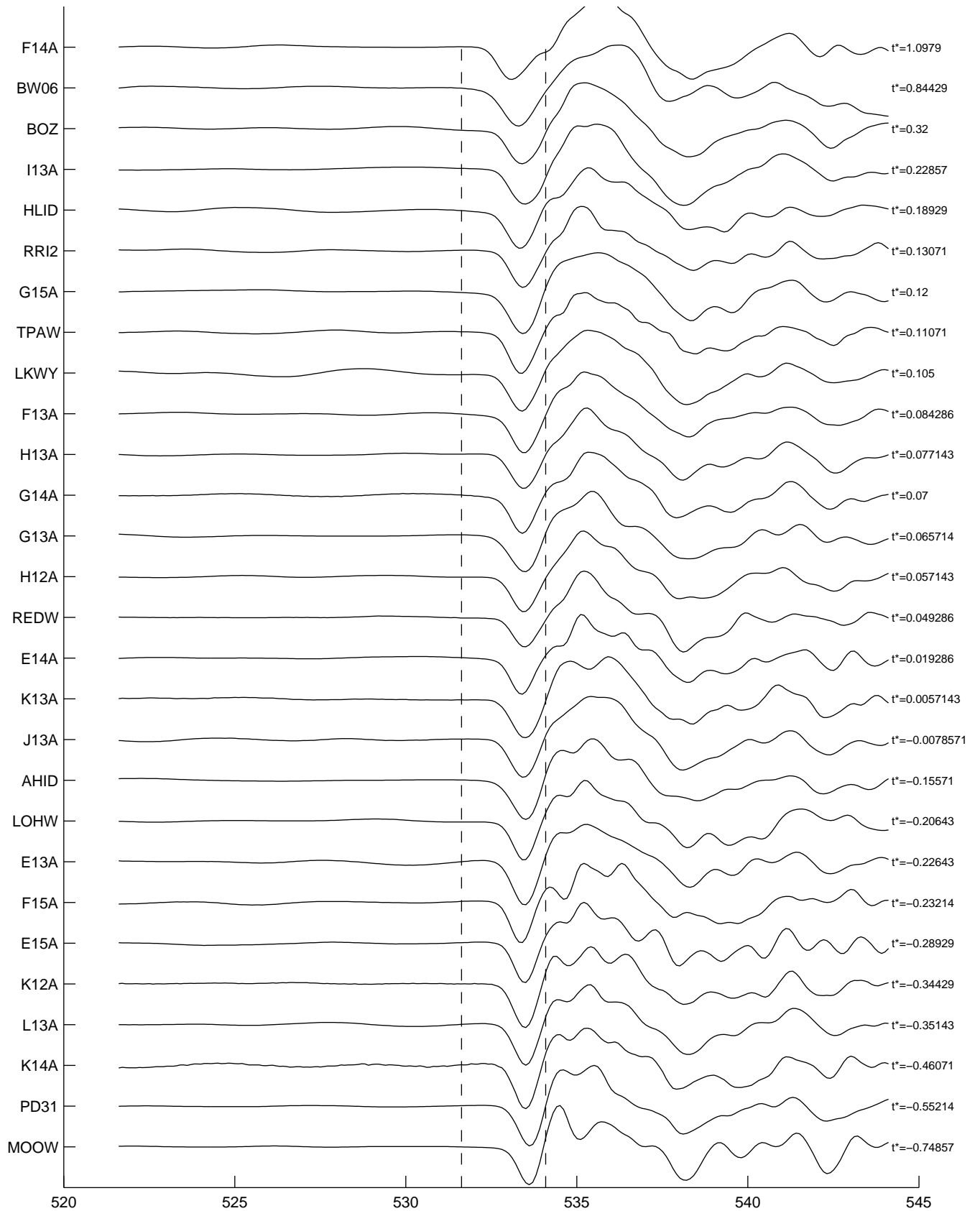
# Sorted by Delta:Event\_2007\_077\_02\_11\_05



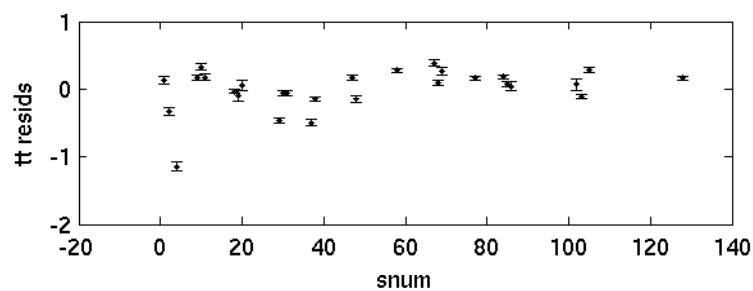
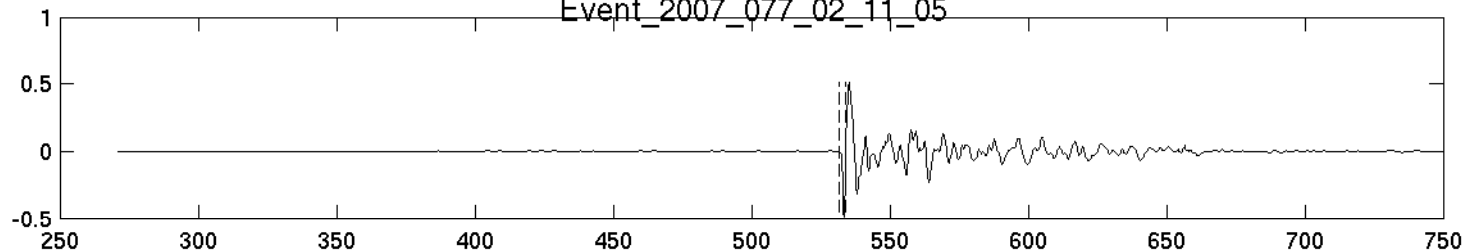
# Sorted by travel time:Event\_2007\_077\_02\_11\_05



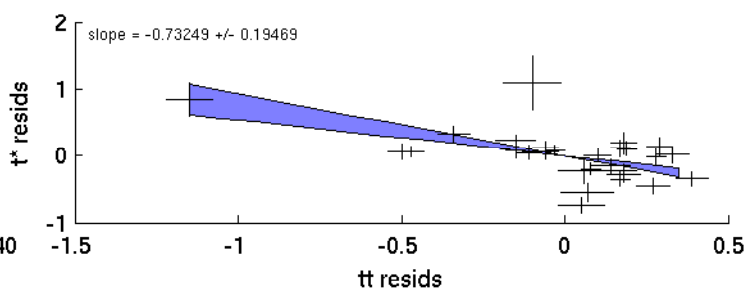
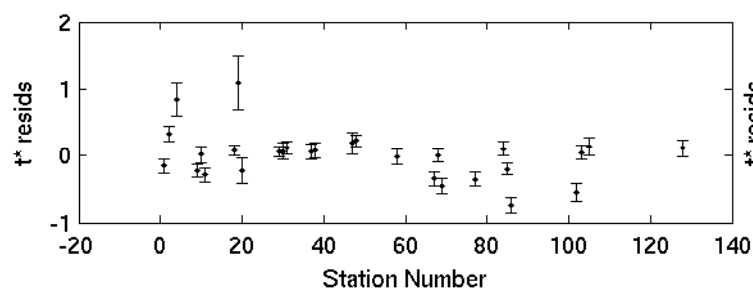
# Sorted by $t^*$ :Event\_2007\_077\_02\_11\_05



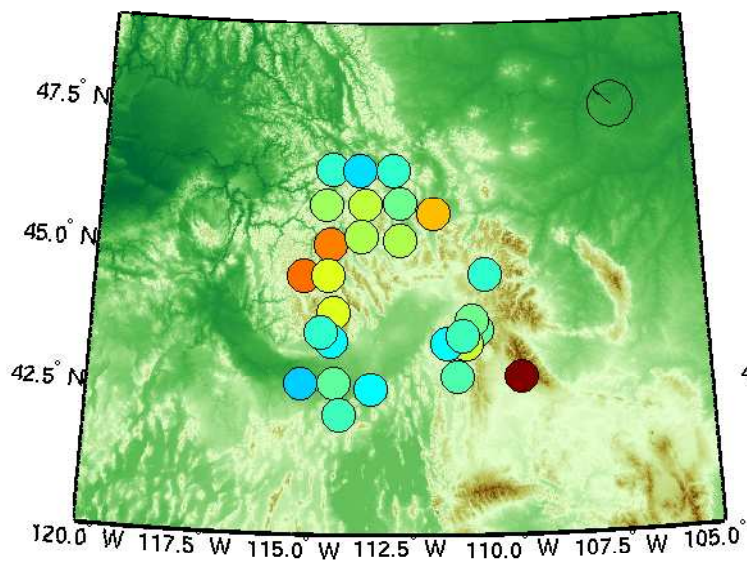
Stack  
Event\_2007\_077\_02\_11\_05



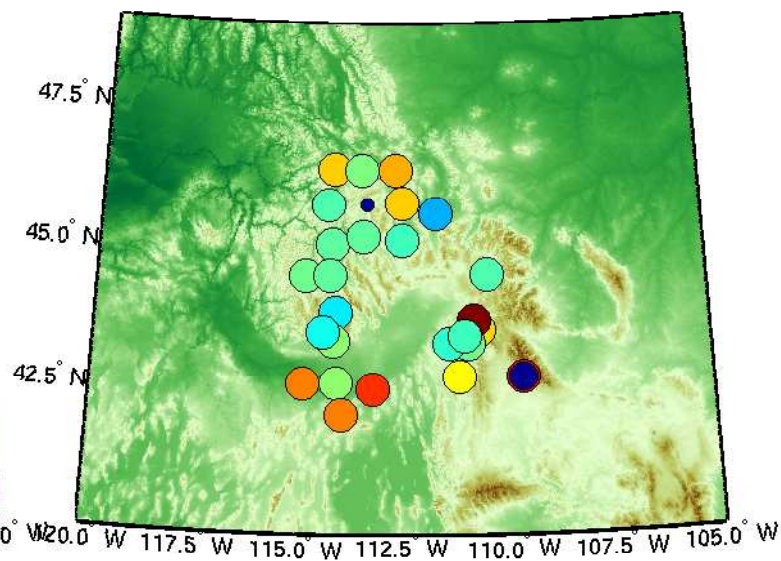
Baz = 132.9086  
Mean xcor value = 0.84143  
Range of  $t^*$  values is 1.8464  
Median  $t^*$  err is 0.11129  
Slope = -0.73249 +/- 0.19469



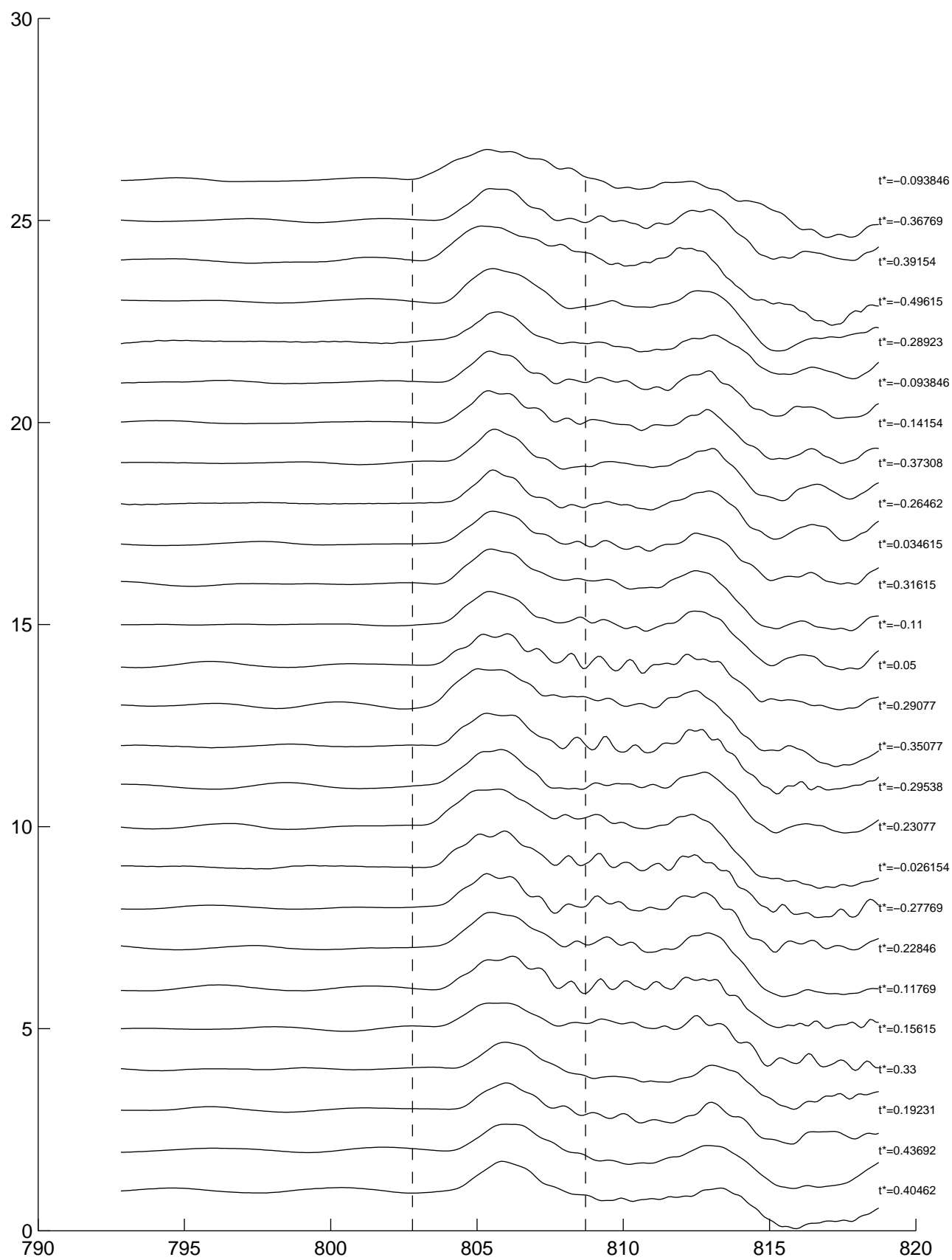
travel time residuals



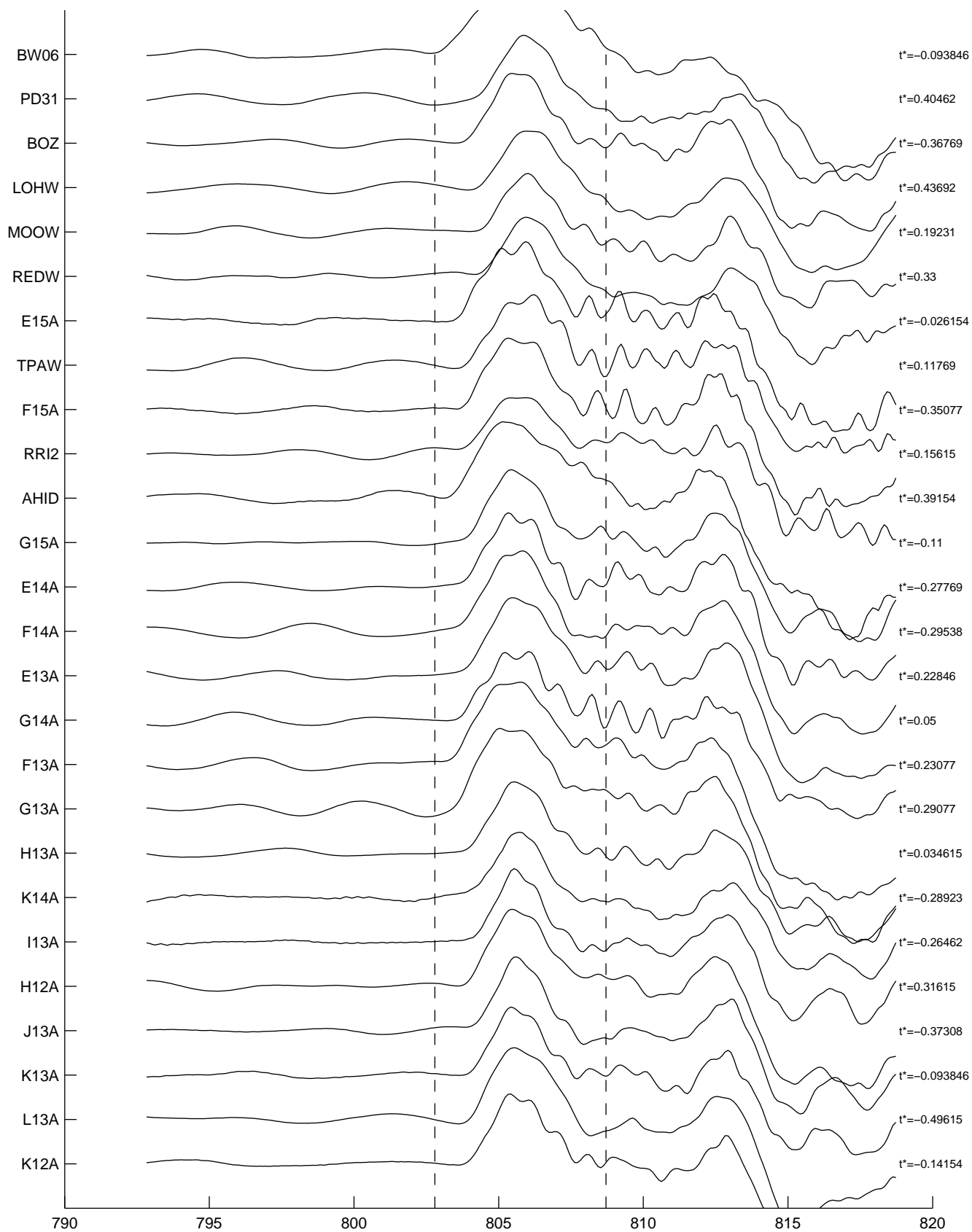
$t^*$  values



# Event\_2007\_084\_00\_40\_01

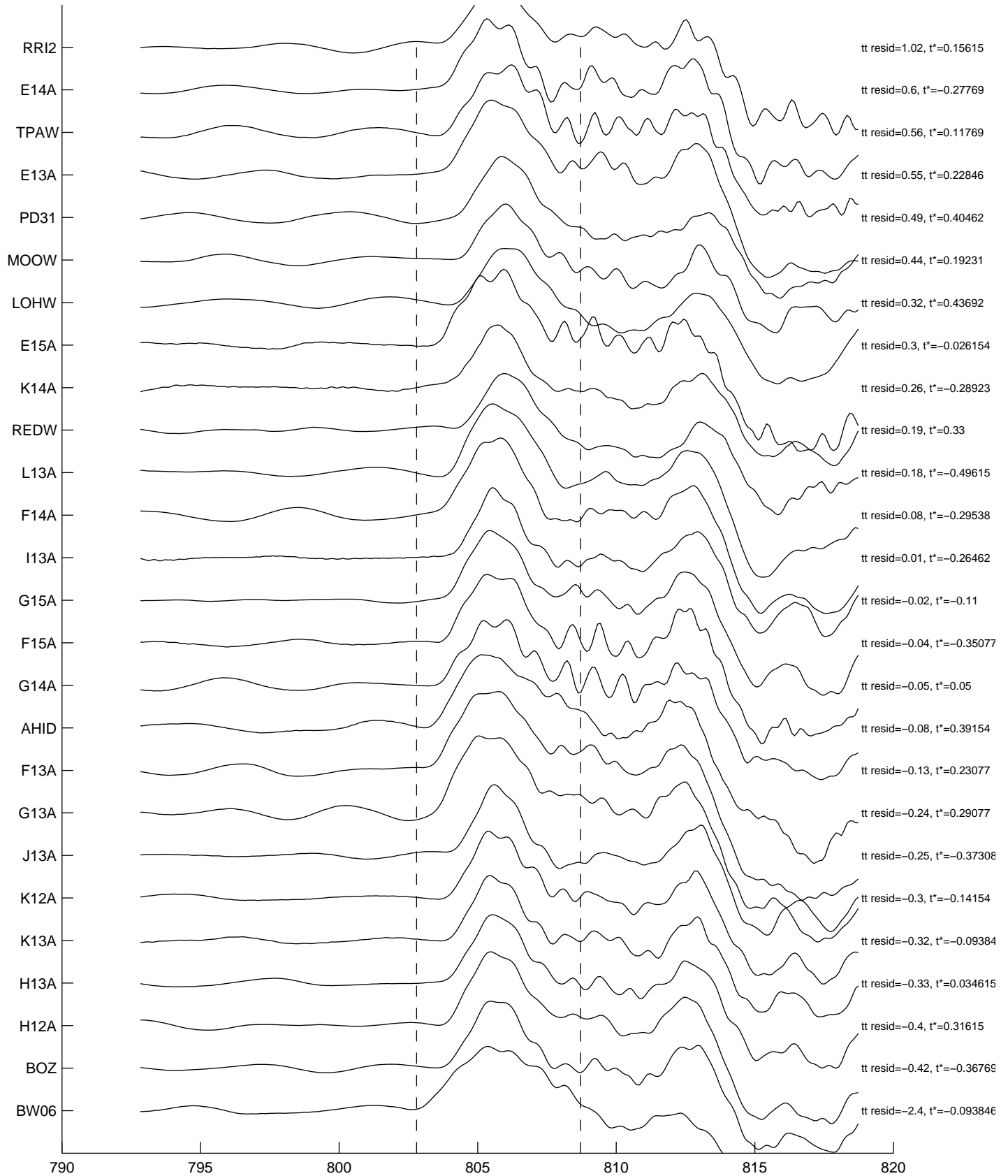


# Sorted by Delta:Event\_2007\_084\_00\_40\_01

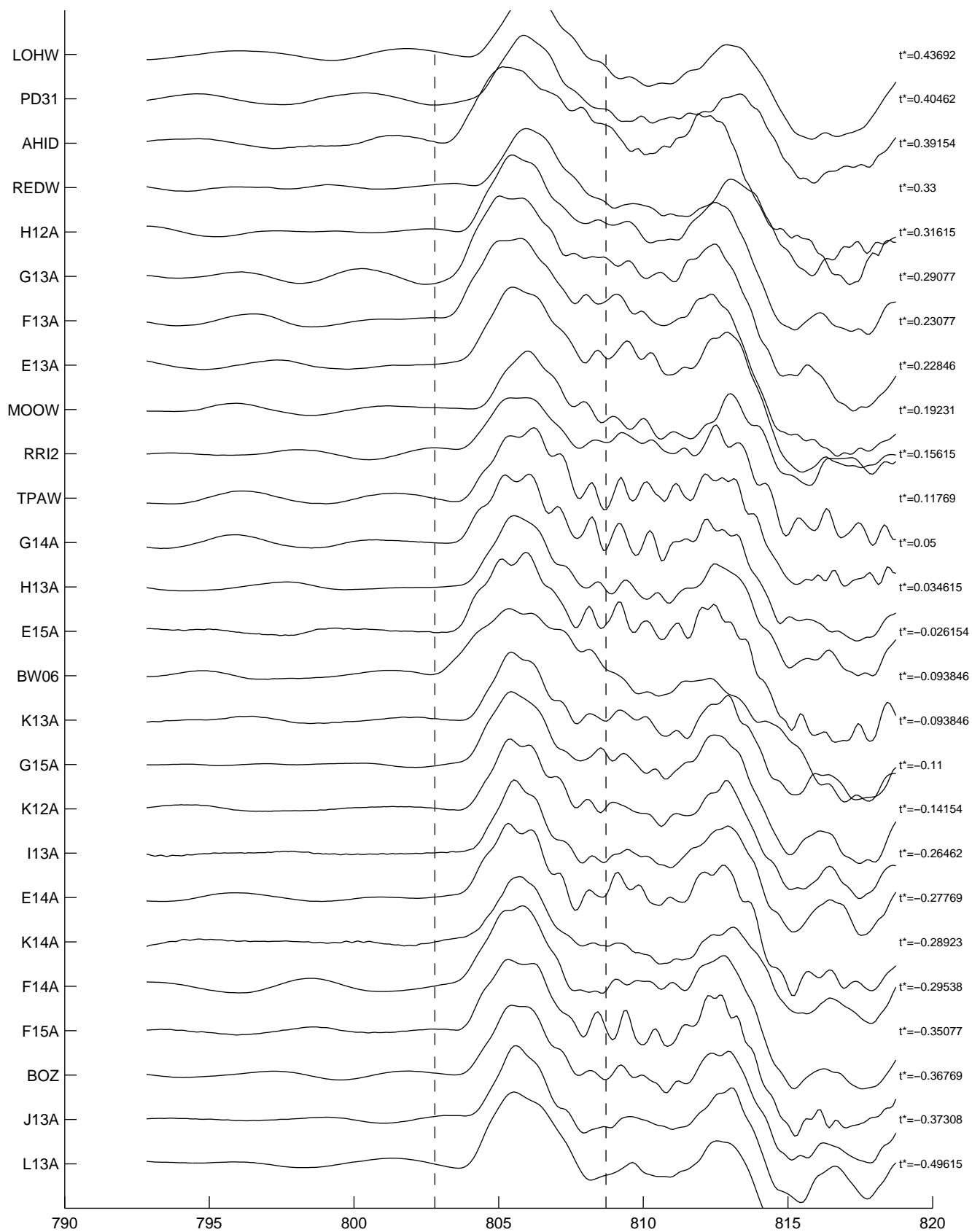




# Sorted by travel time: Event\_2007\_084\_00\_40\_01

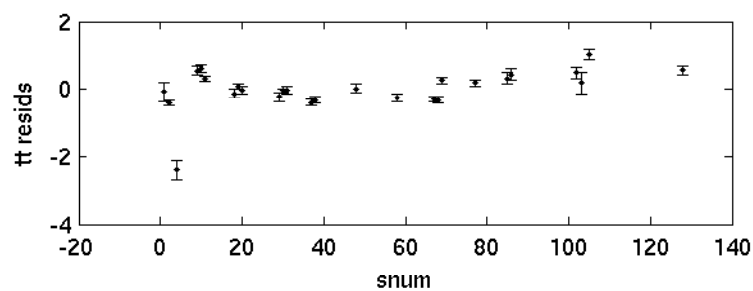
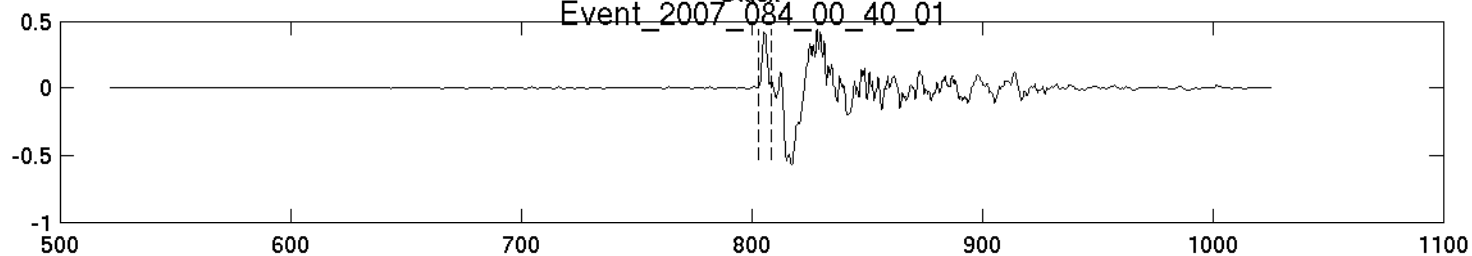


# Sorted by $t^*$ :Event\_2007\_084\_00\_40\_01

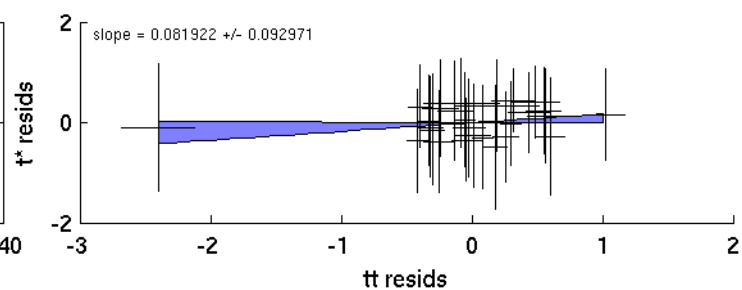
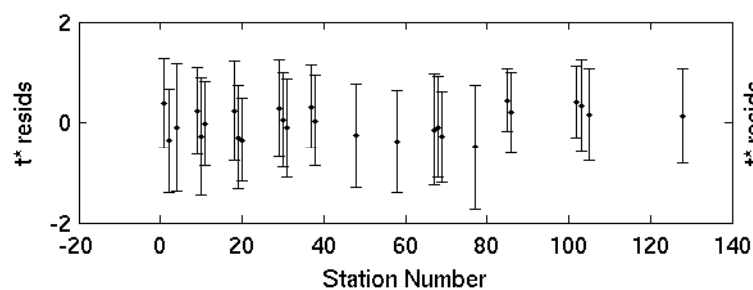


Event\_2007\_084\_00\_40\_01

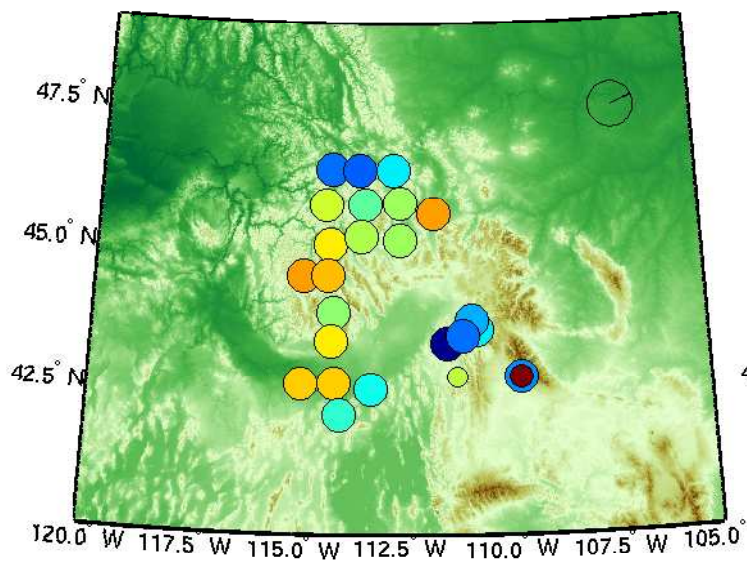
Stack



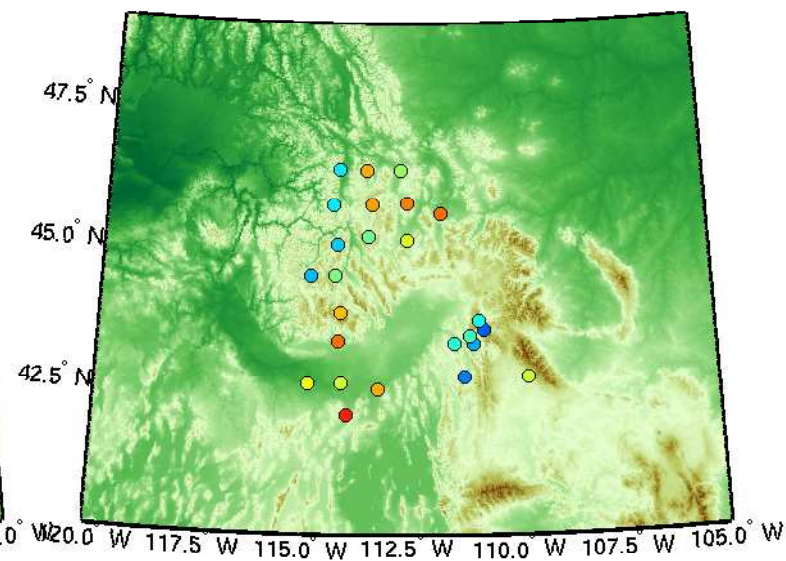
Baz = 246.973  
Mean xcor value = 0.85077  
Range of  $t^*$  values is 0.93308  
Median  $t^*$  err is 0.94797  
Slope = 0.081922 +/- 0.092971



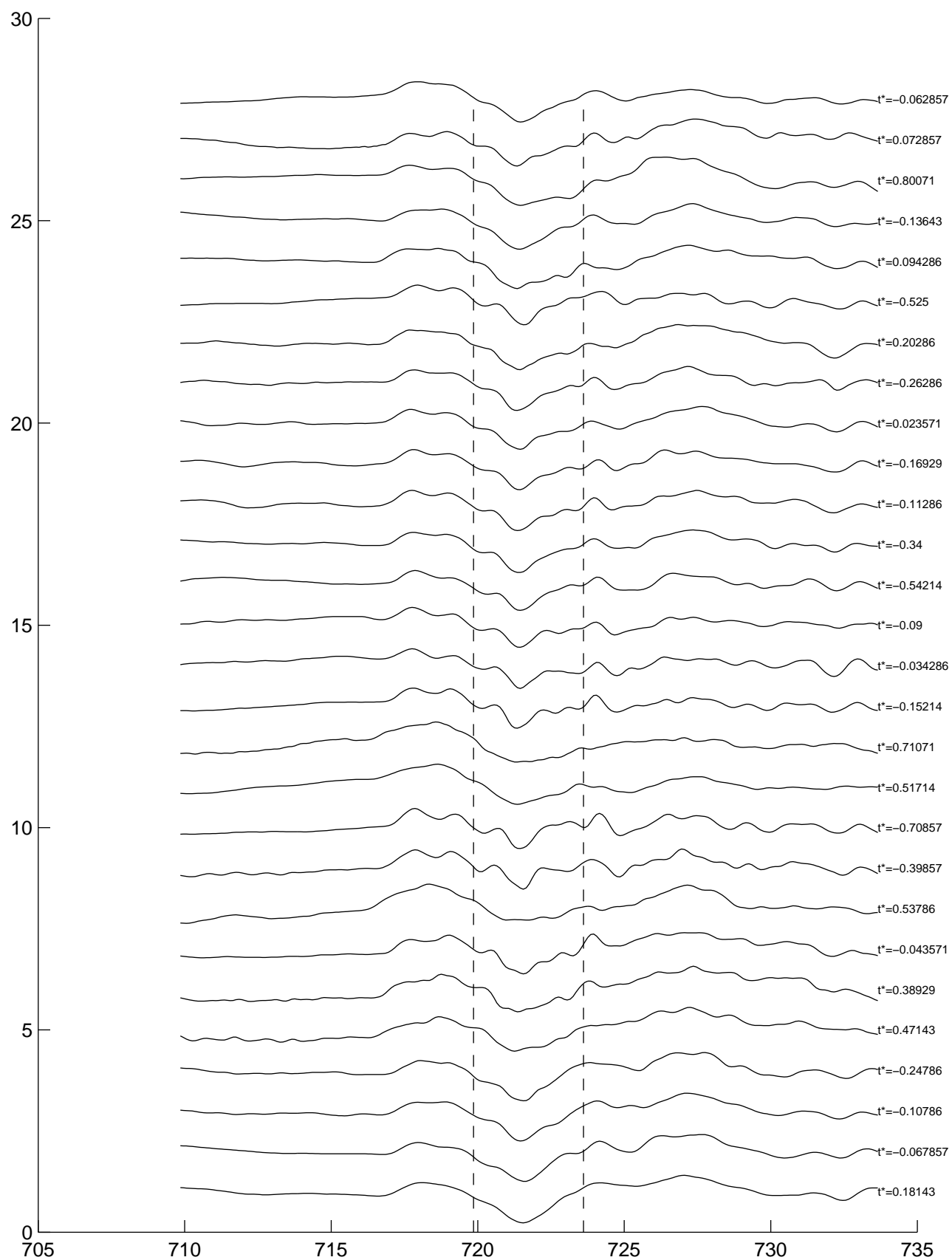
travel time residuals



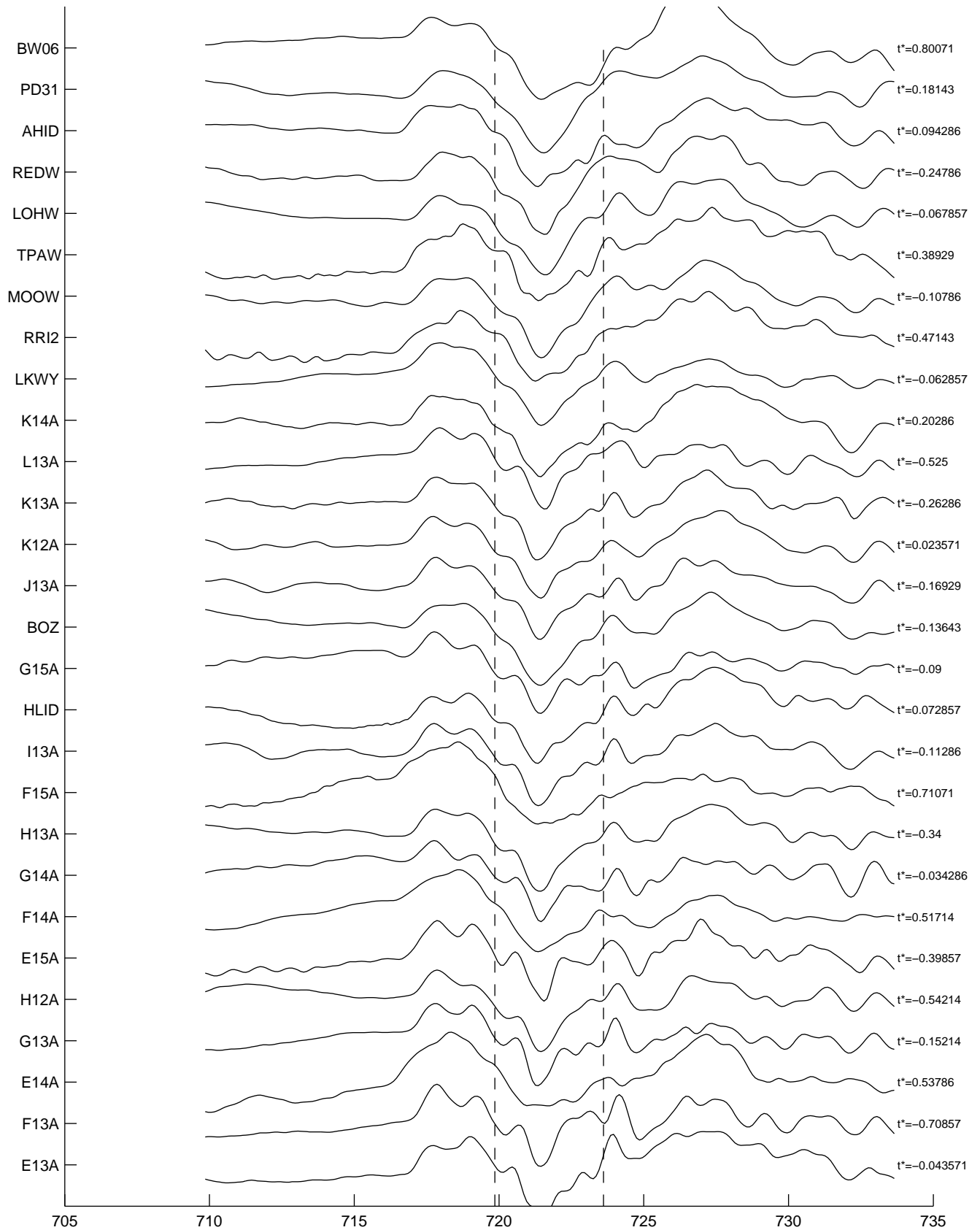
$t^*$  values



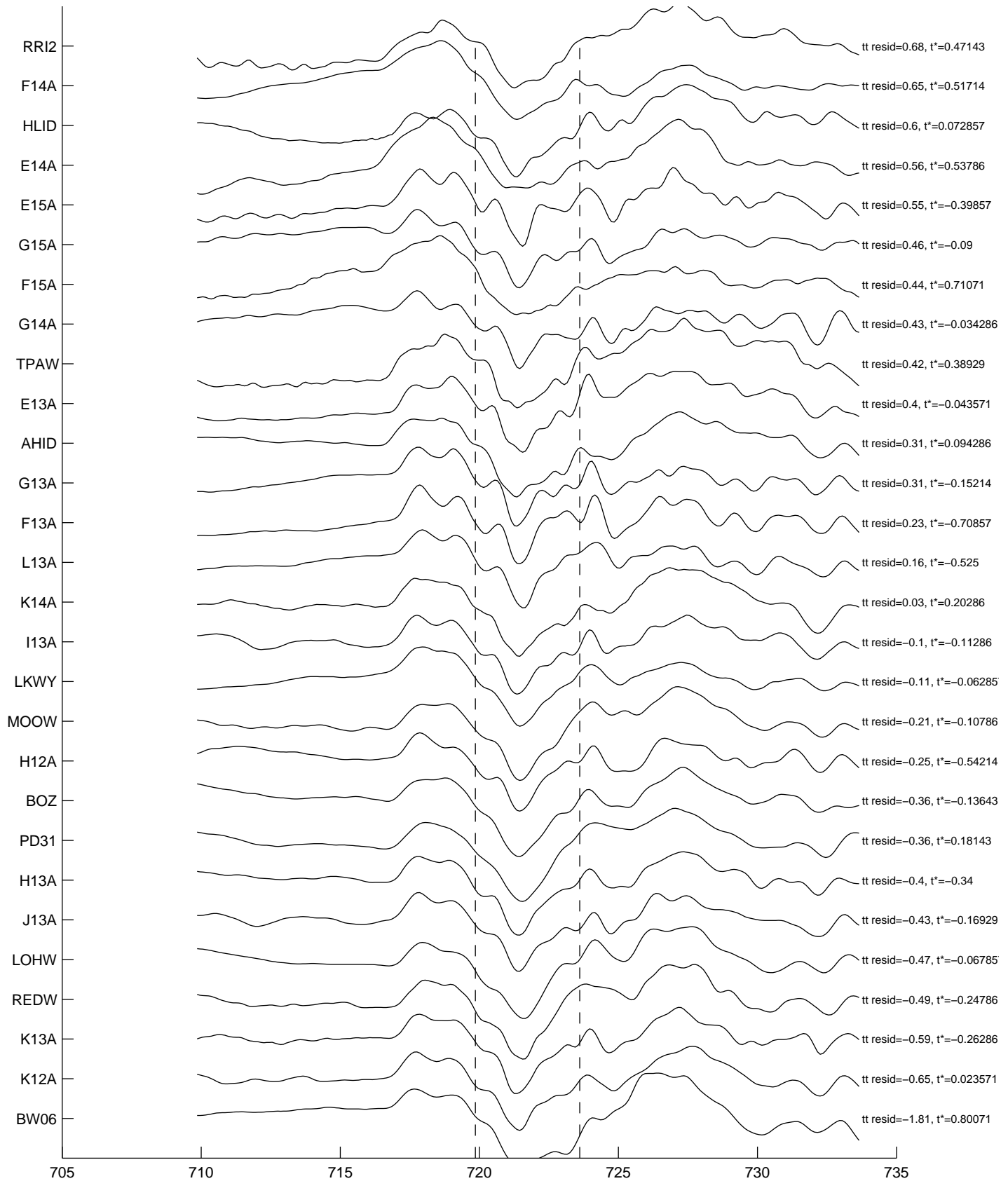
# Event\_2007\_084\_00\_41\_57



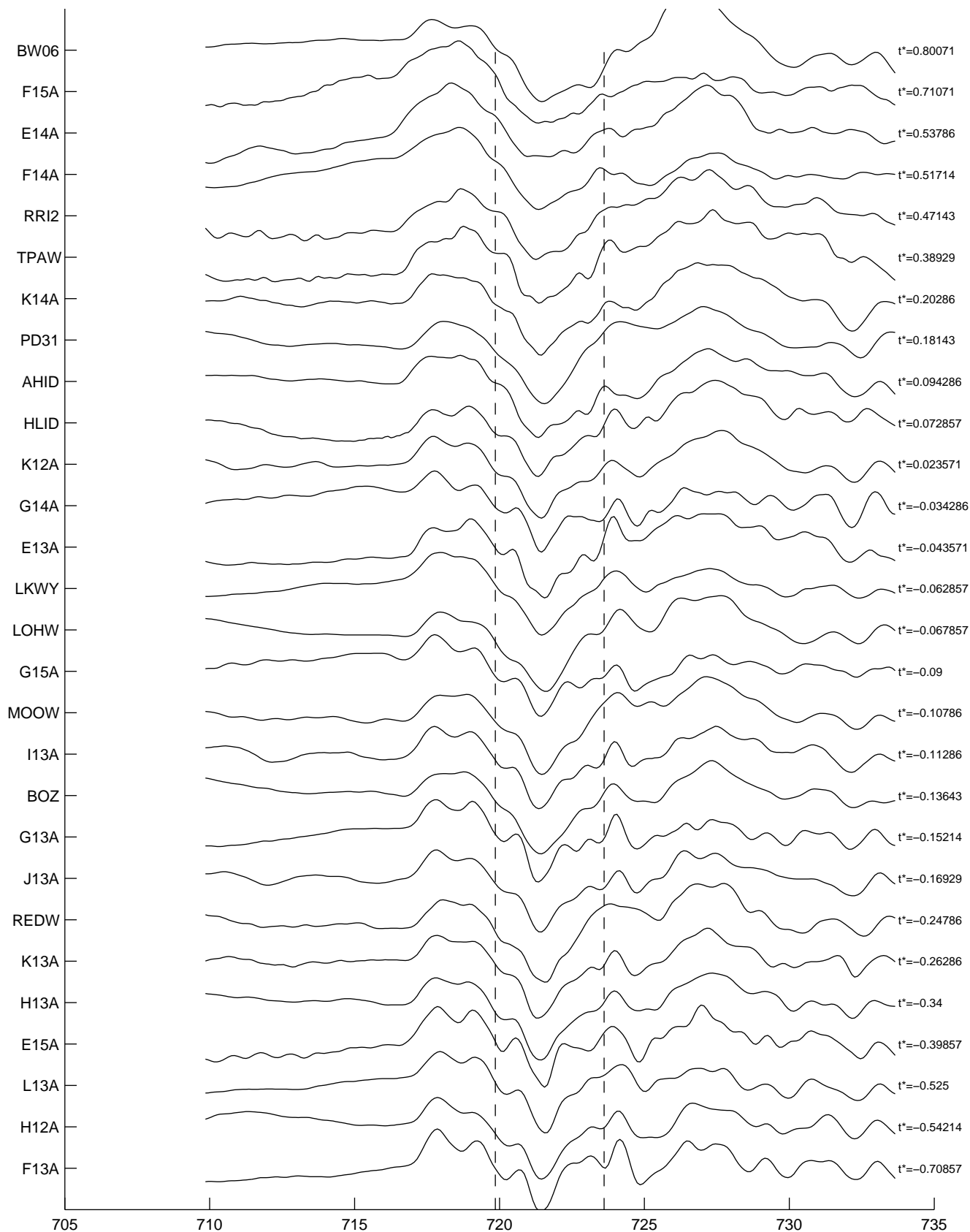
# Sorted by Delta:Event\_2007\_084\_00\_41\_57



# Sorted by travel time:Event\_2007\_084\_00\_41\_57

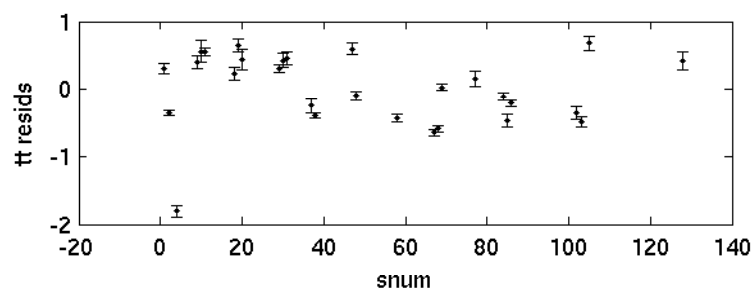
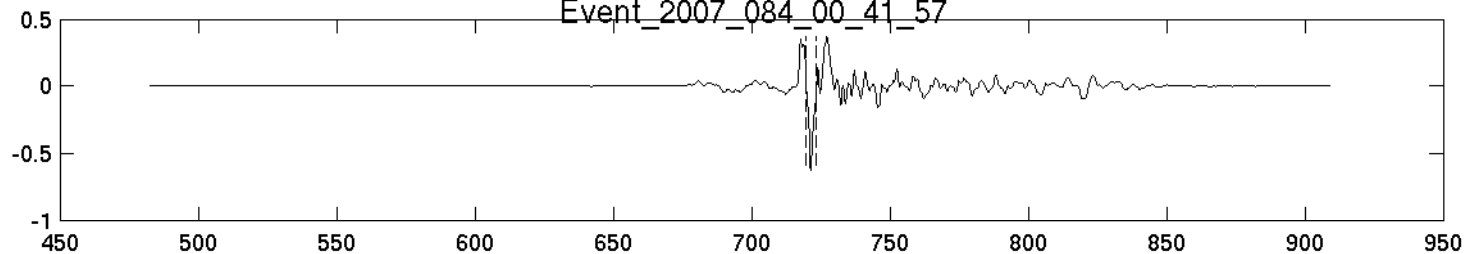


Sorted by  $t^*$ :Event\_2007\_084\_00\_41\_57

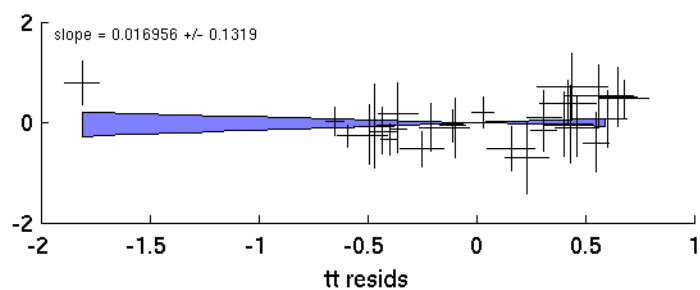
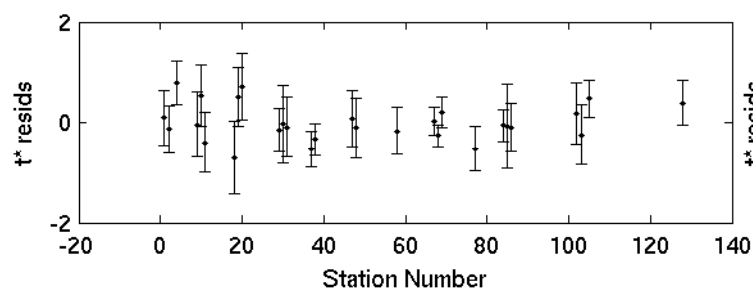


Event\_2007\_084\_00\_41\_57

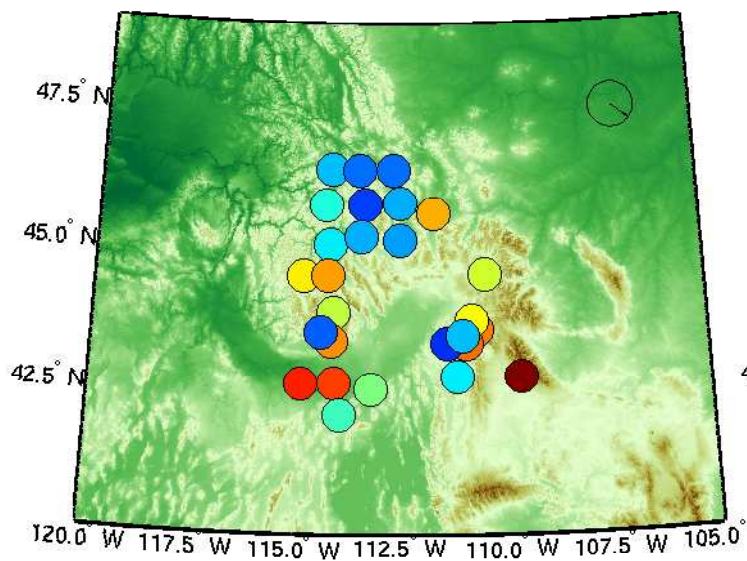
Stack



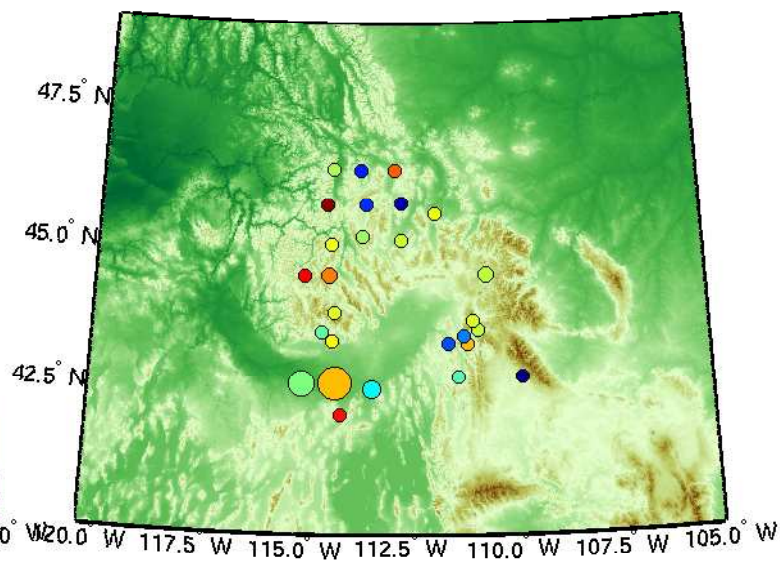
Baz = 310.3219  
Mean xcor value = 0.75107  
Range of  $t^*$  values is 1.5093  
Median  $t^*$  err is 0.51554  
Slope = 0.016956 +/- 0.1319



travel time residuals

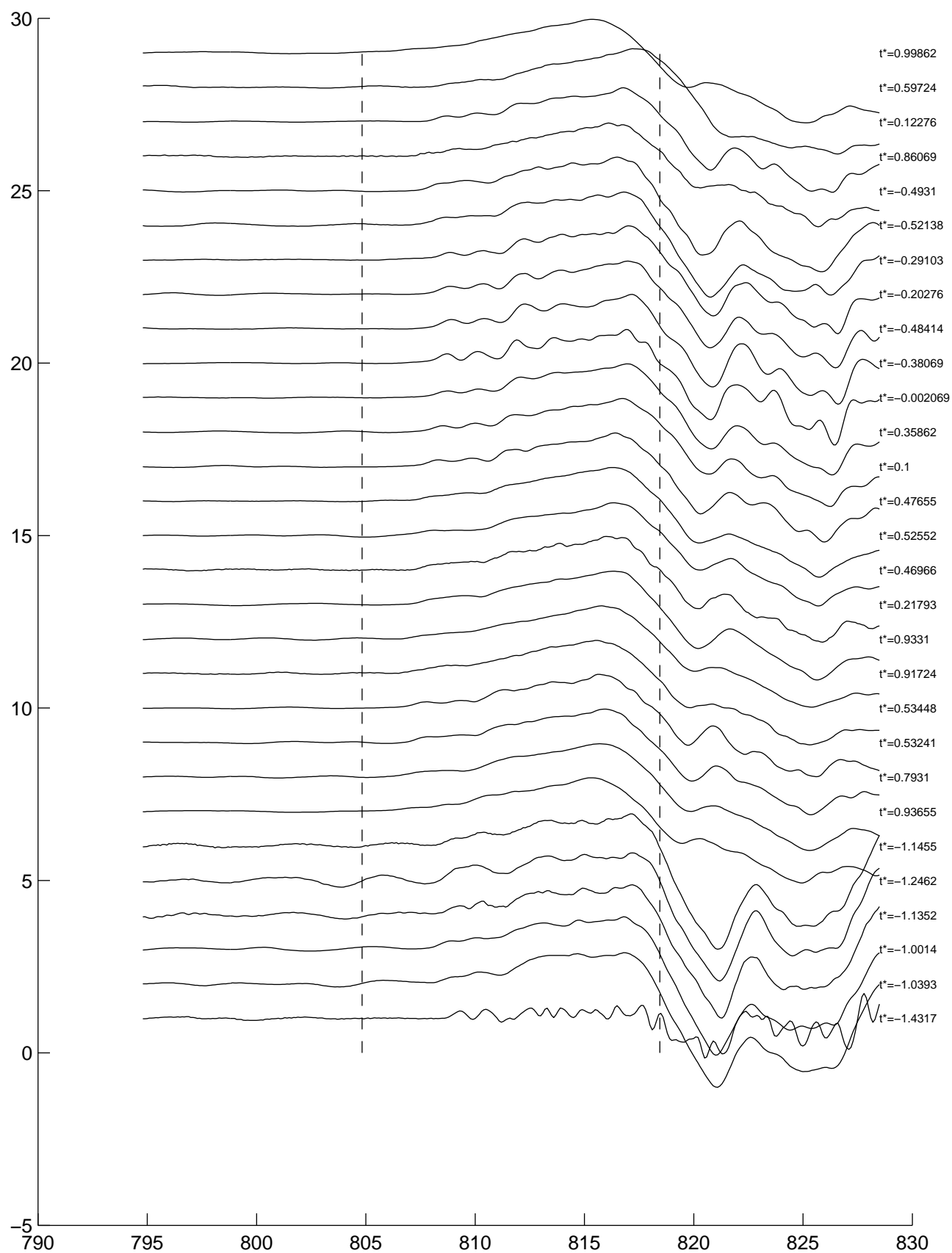


$t^*$  values

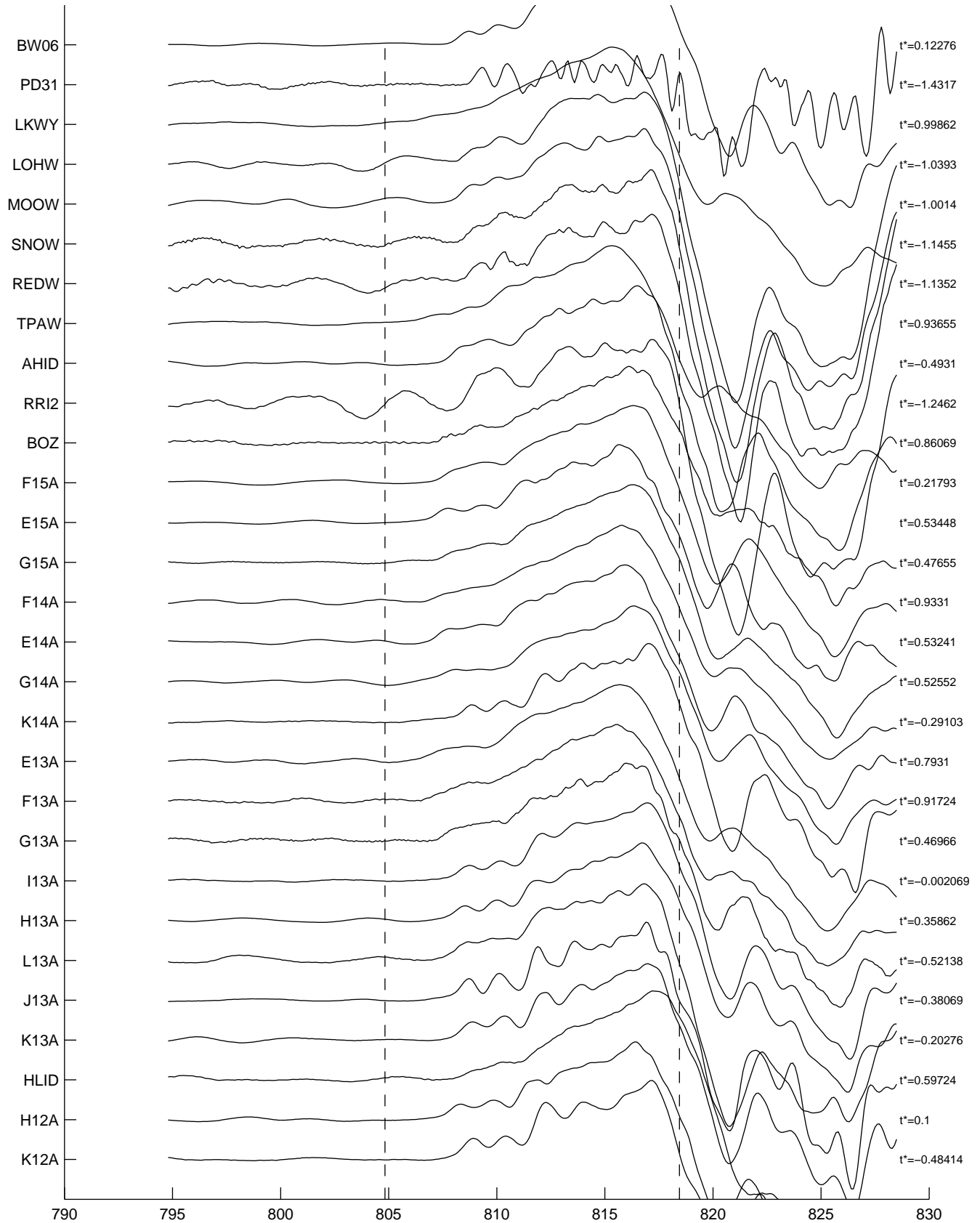




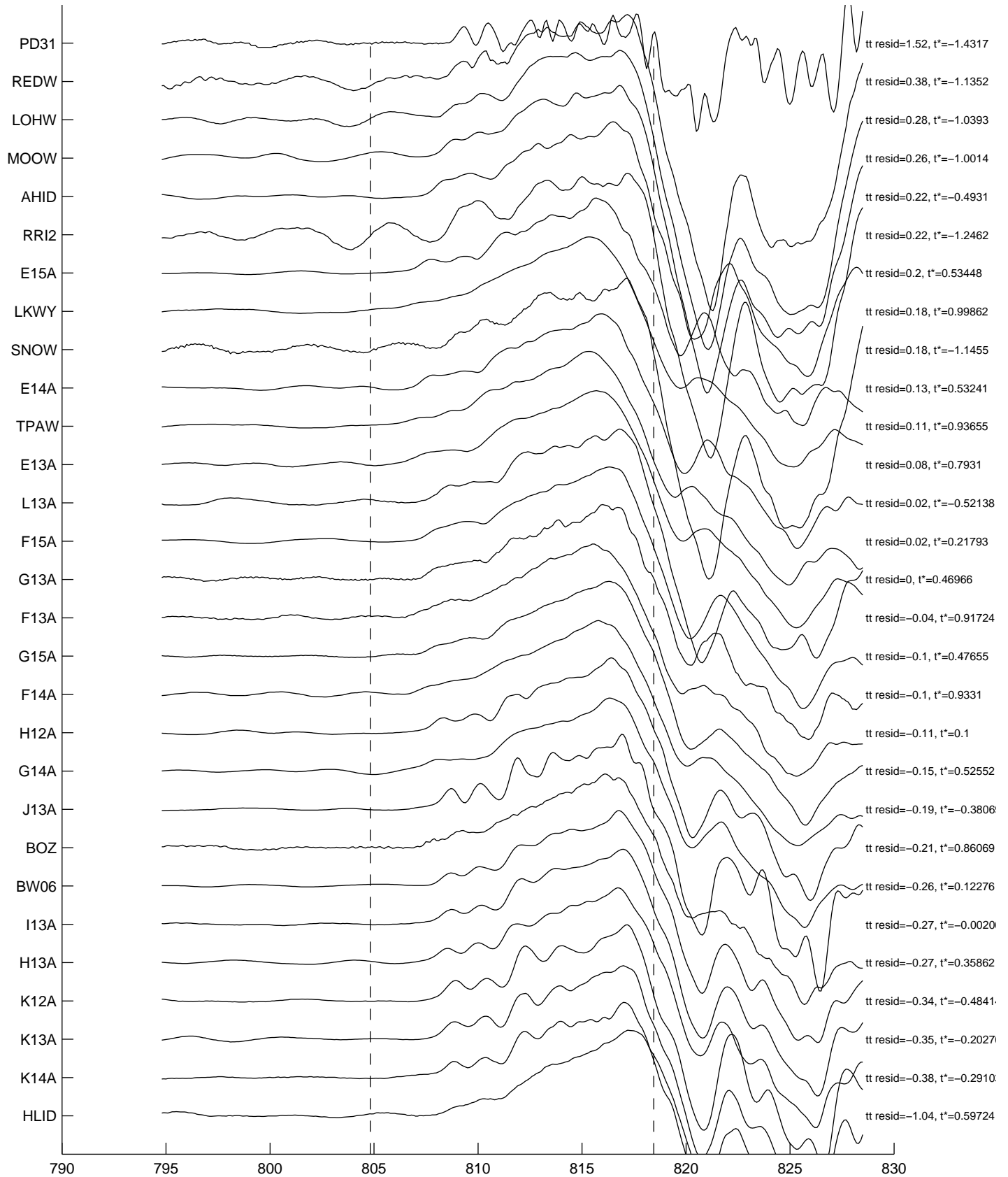
# Event\_2007\_091\_20\_39\_56



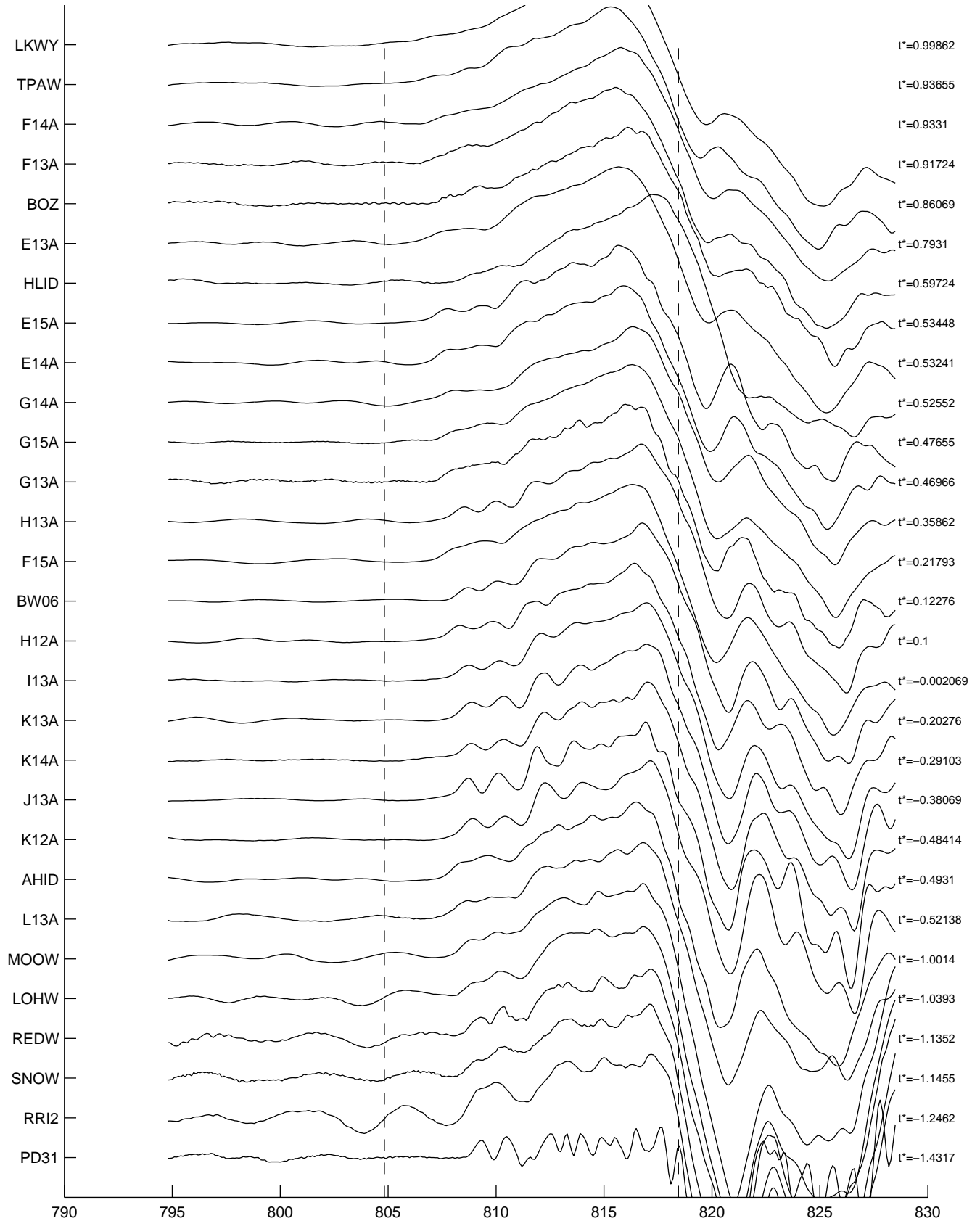
# Sorted by Delta:Event\_2007\_091\_20\_39\_56



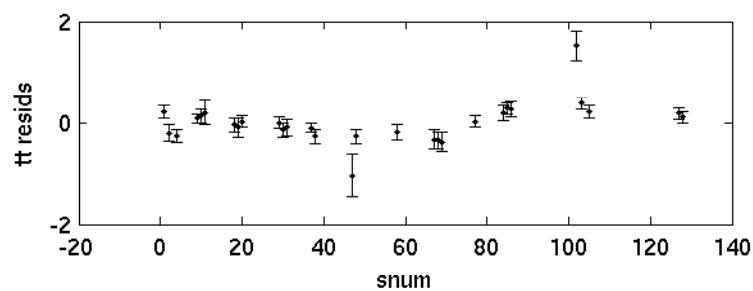
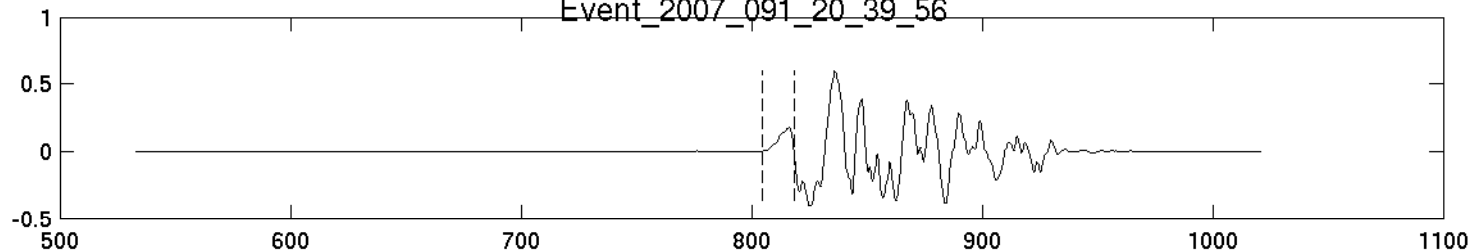
# Sorted by travel time:Event\_2007\_091\_20\_39\_56



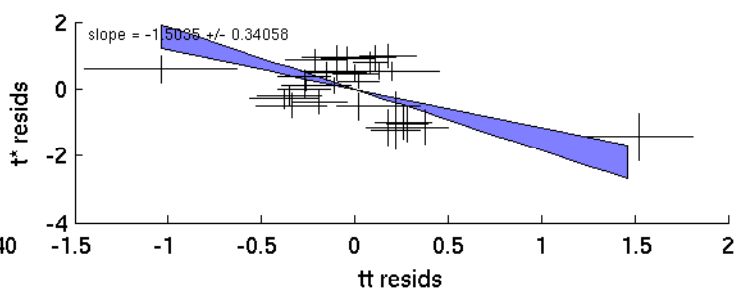
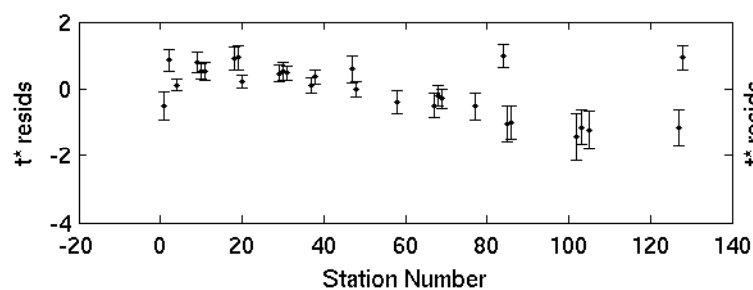
# Sorted by t\*:Event\_2007\_091\_20\_39\_56



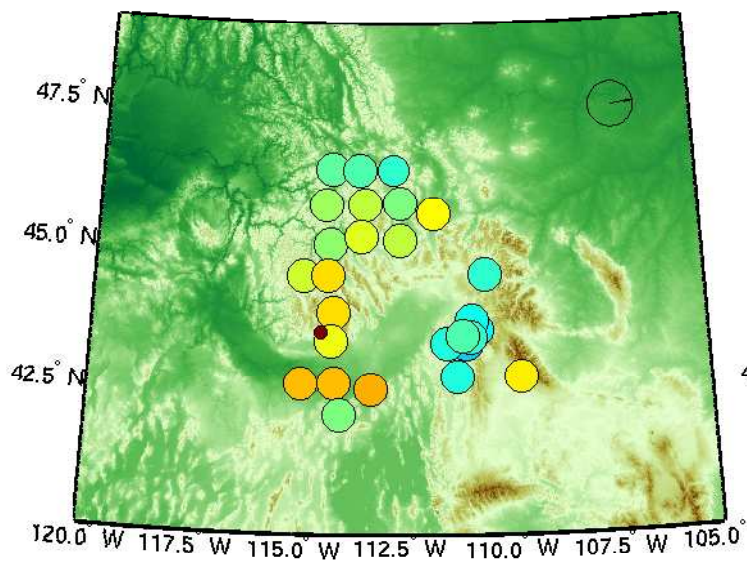
Event\_2007\_091\_20\_39\_56



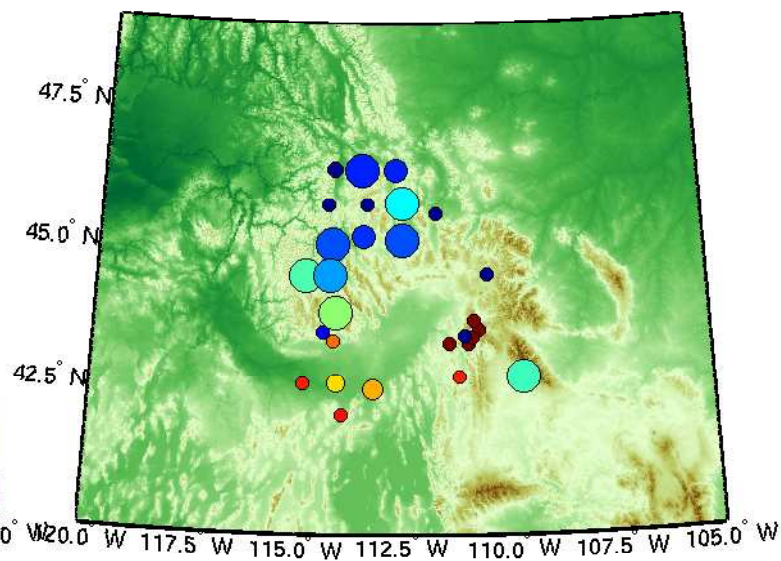
Baz = 264.1145  
Mean xcor value = 0.90724  
Range of  $t^*$  values is 2.4303  
Median  $t^*$  err is 0.33983  
Slope =  $-1.5035 \pm 0.34058$



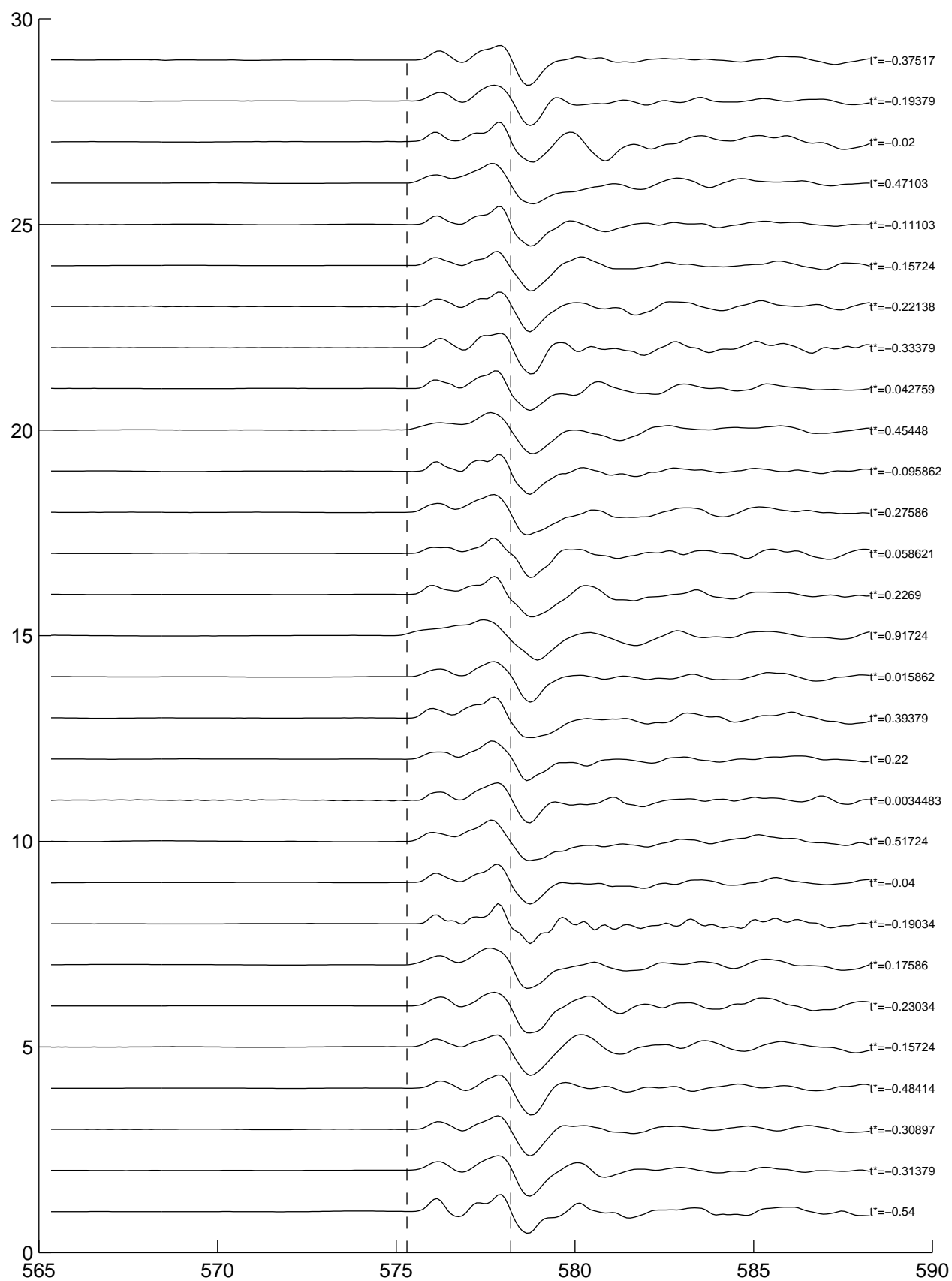
travel time residuals



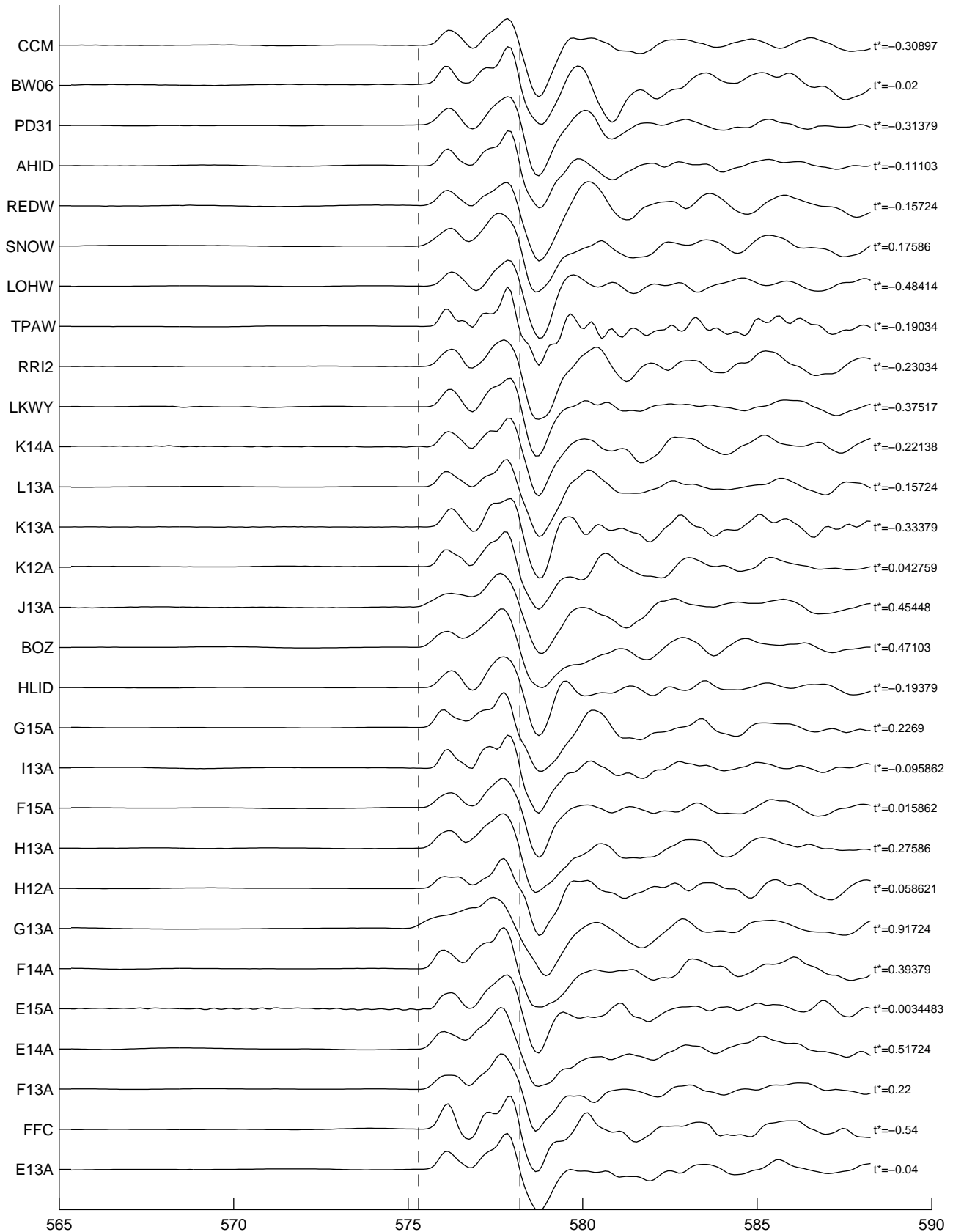
$t^*$  values



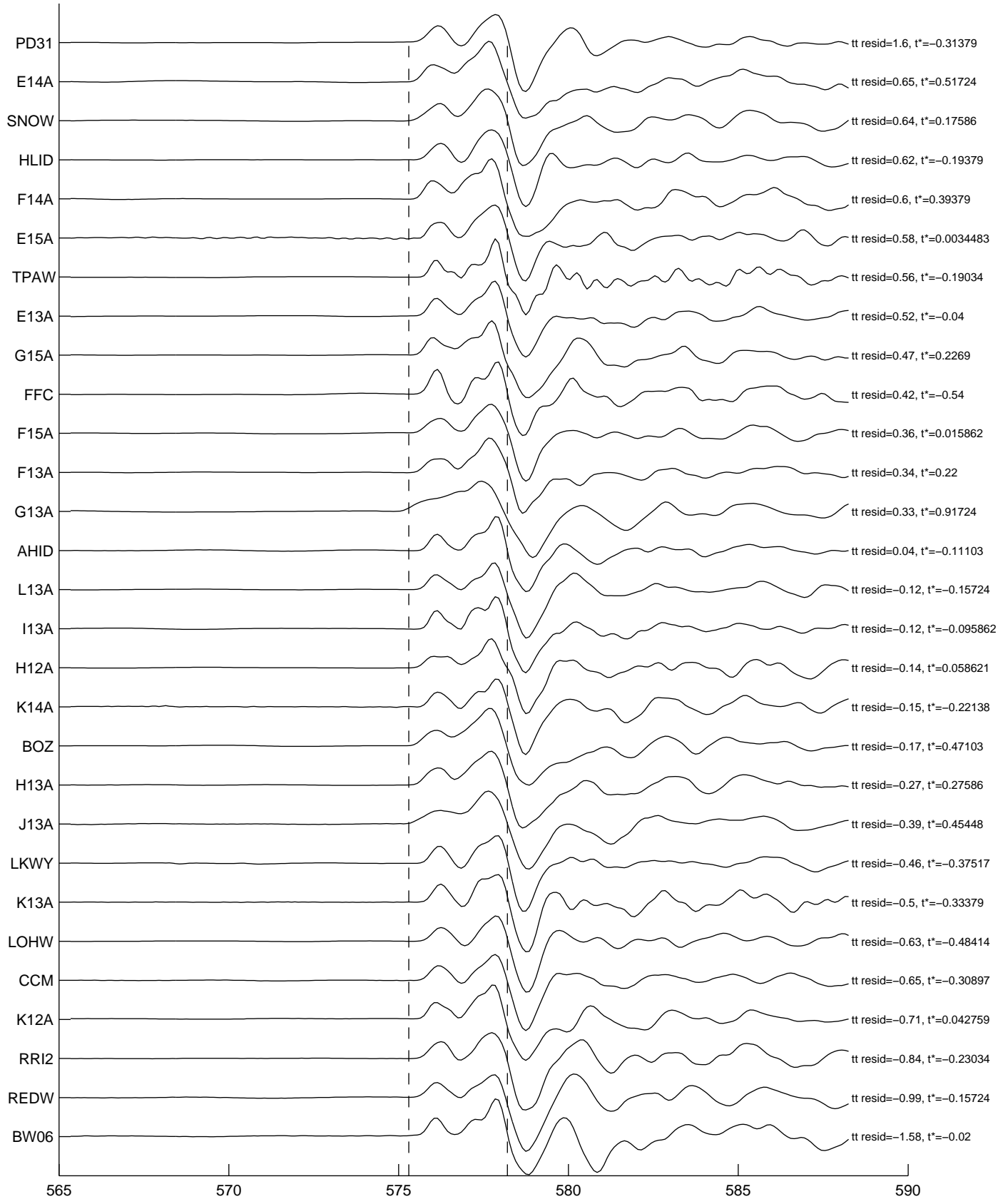
# Event\_2007\_150\_20\_22\_12



# Sorted by Delta:Event\_2007\_150\_20\_22\_12

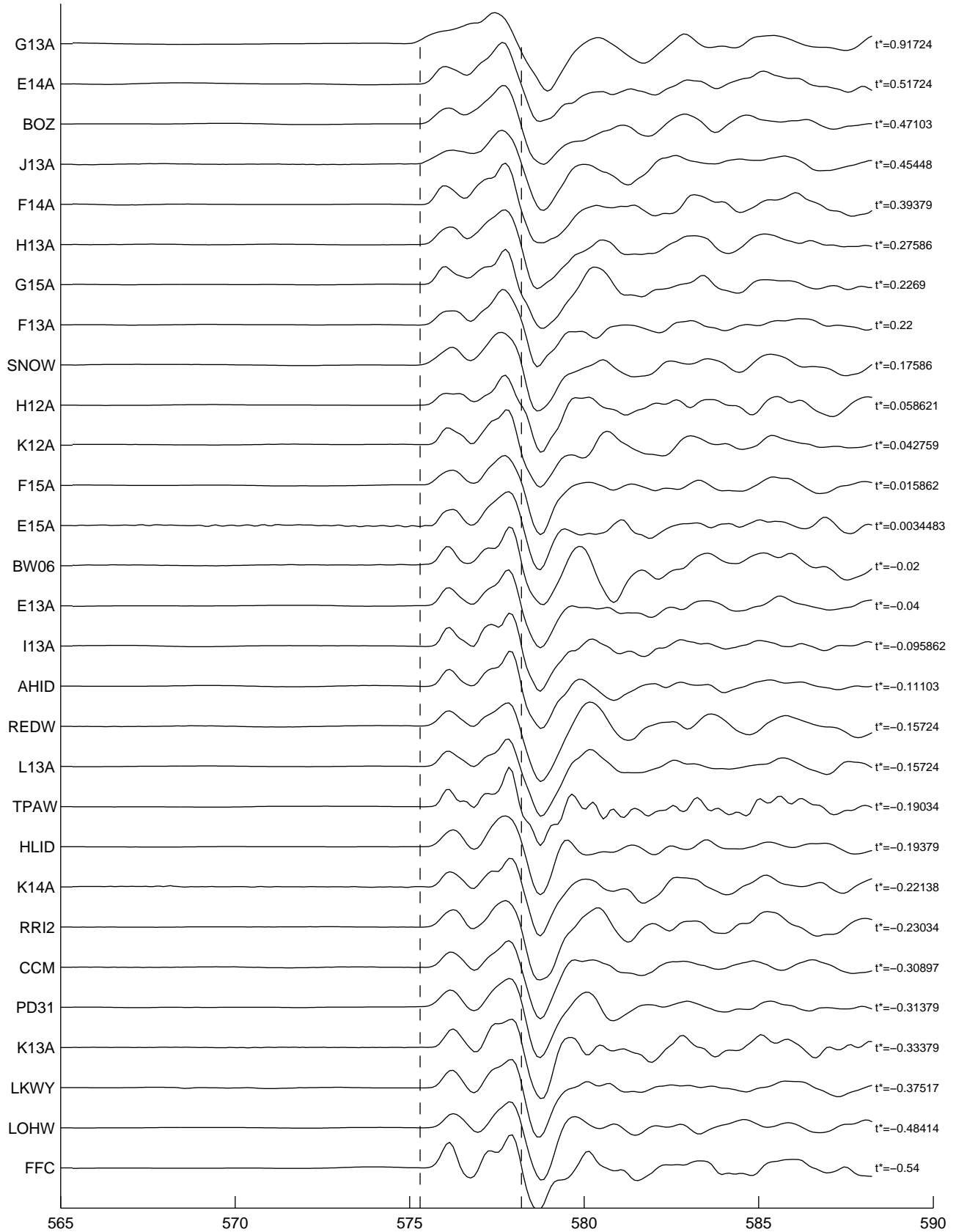


# Sorted by travel time: Event\_2007\_150\_20\_22\_12

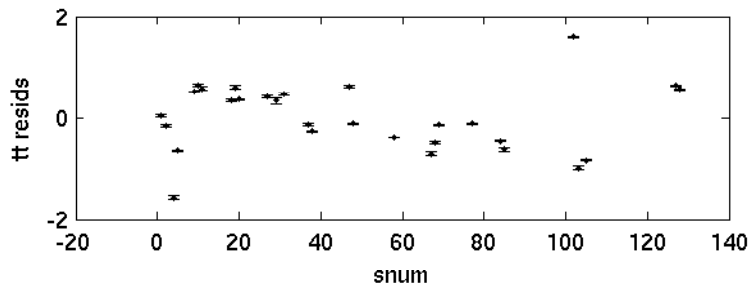
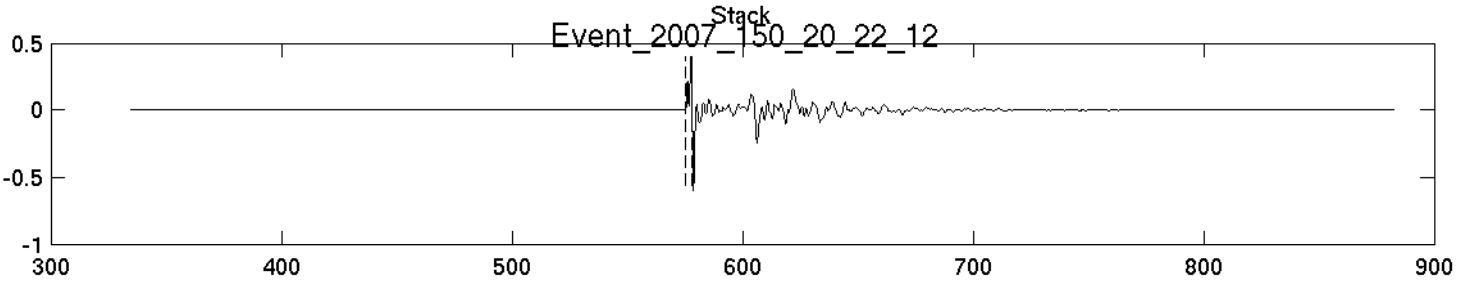




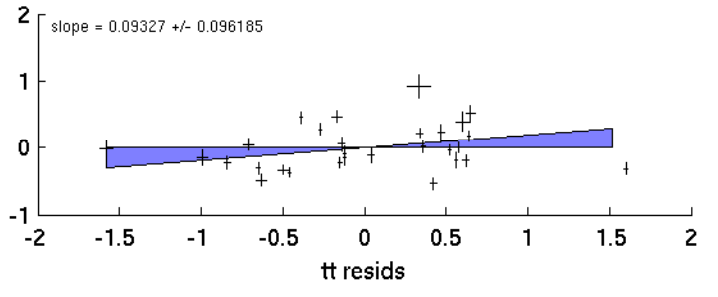
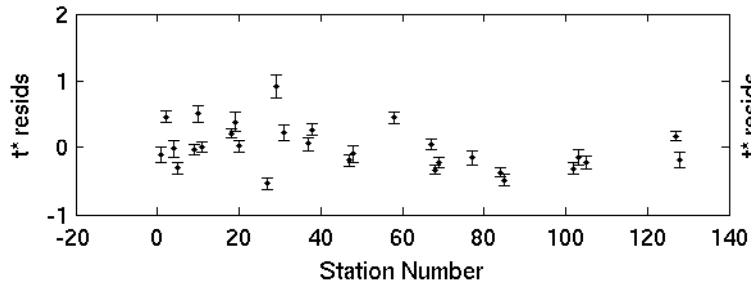
# Sorted by $t^*$ :Event\_2007\_150\_20\_22\_12



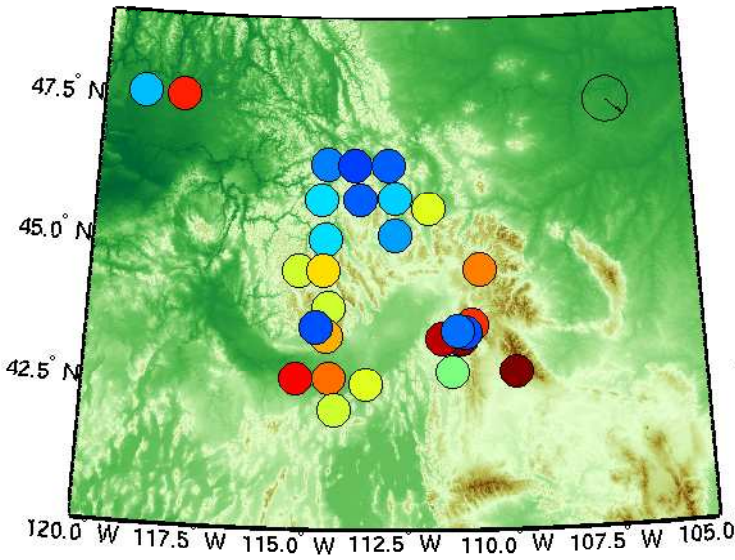
Event\_2007\_150\_20\_22\_12



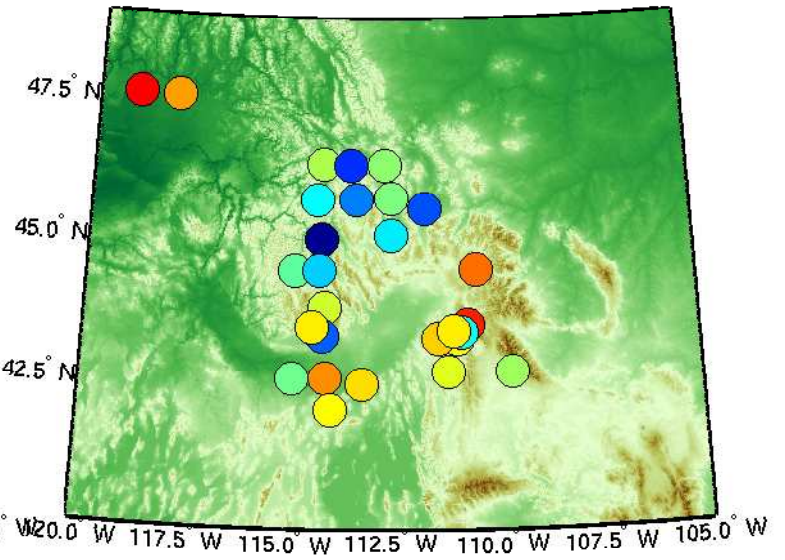
Baz = 312.9864  
Mean xcor value = 0.79276  
Range of t\* values is 1.4572  
Median t\* err is 0.090472  
Slope = 0.09327 +/- 0.096185



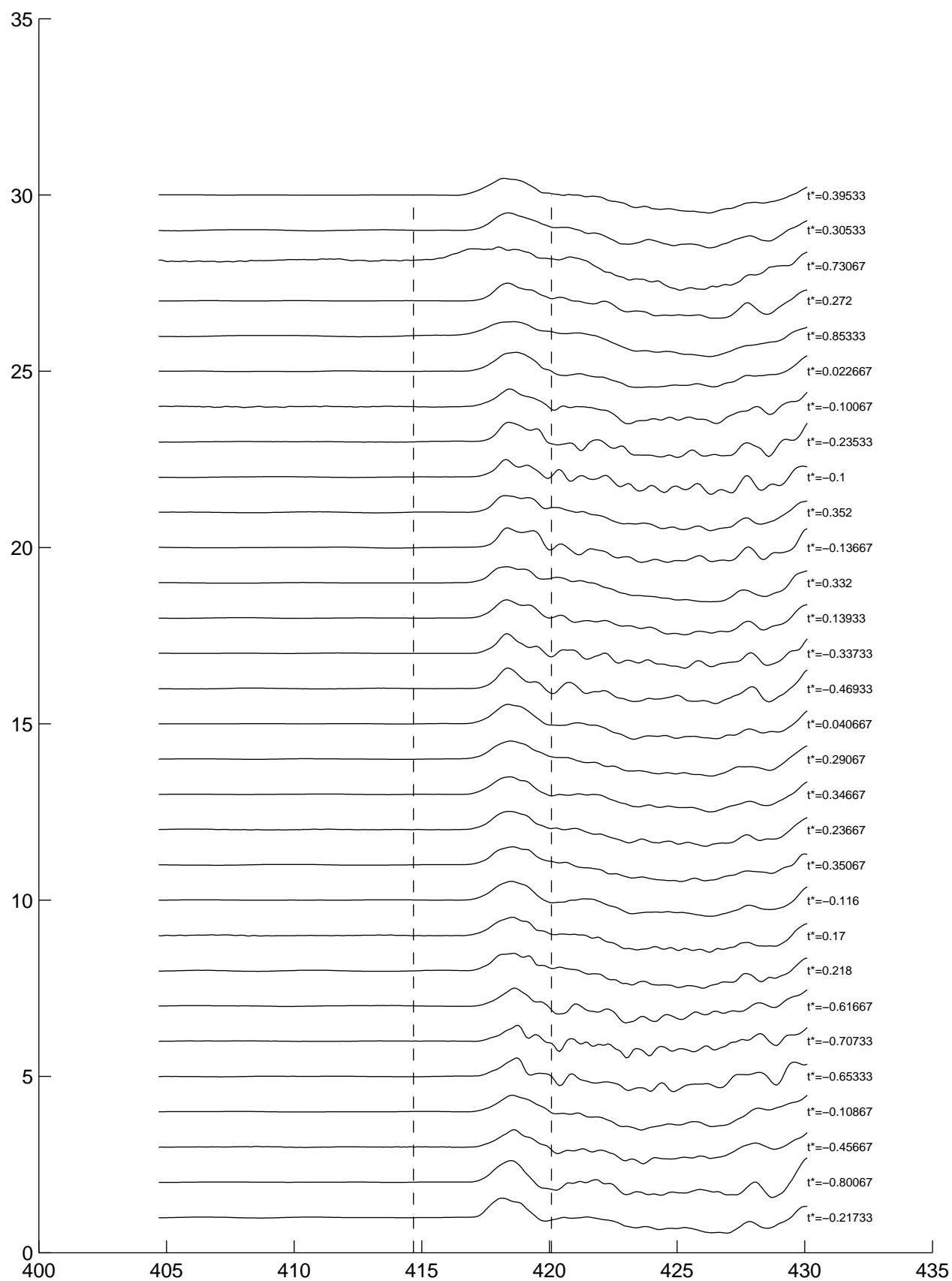
travel time residuals



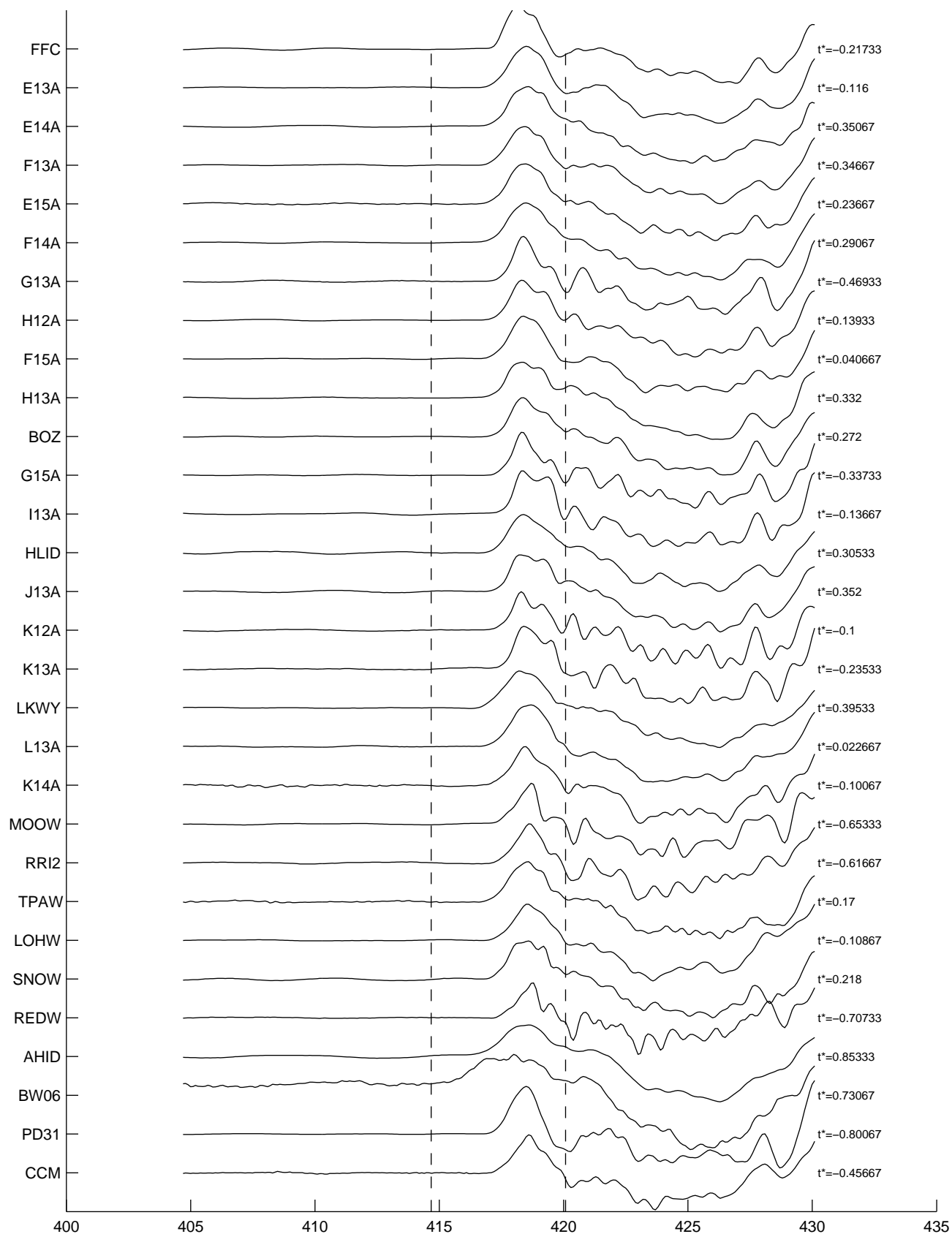
t\* values



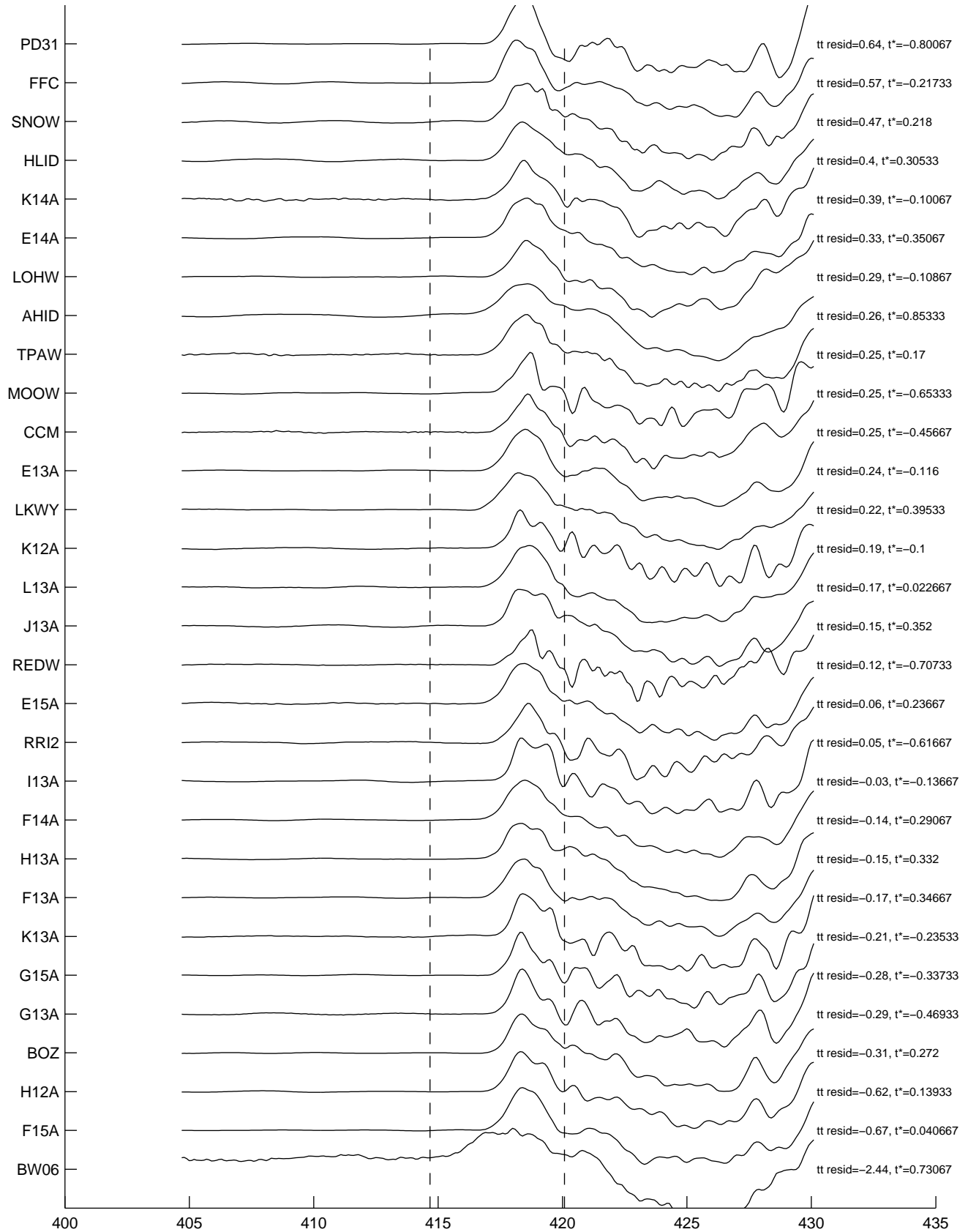
# Event\_2007\_164\_19\_29\_40



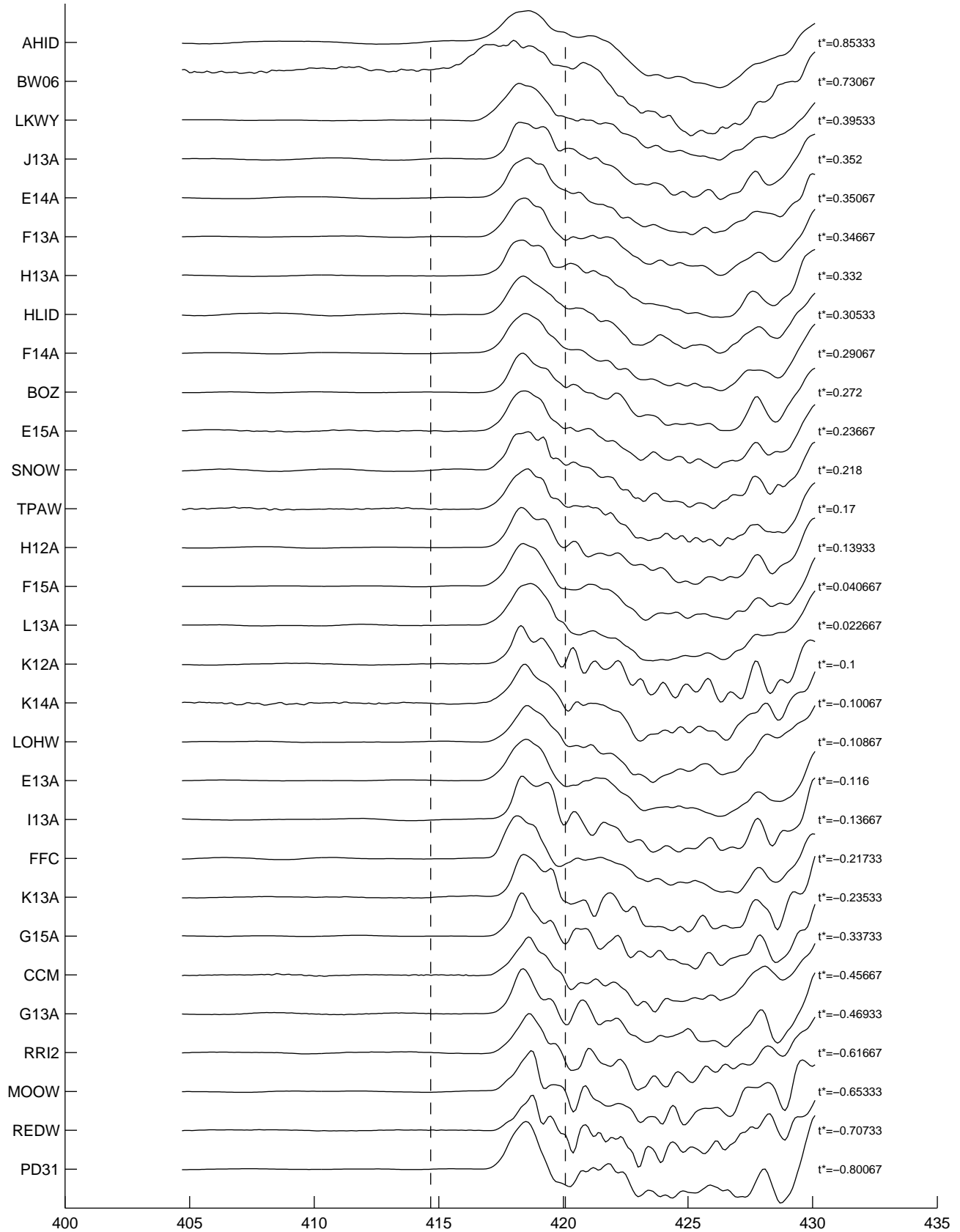
# Sorted by Delta:Event\_2007\_164\_19\_29\_40



# Sorted by travel time:Event\_2007\_164\_19\_29\_40

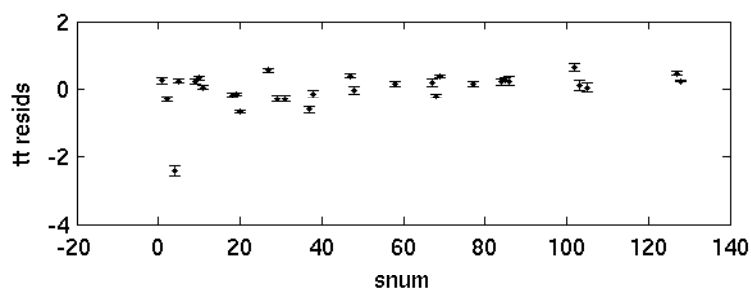
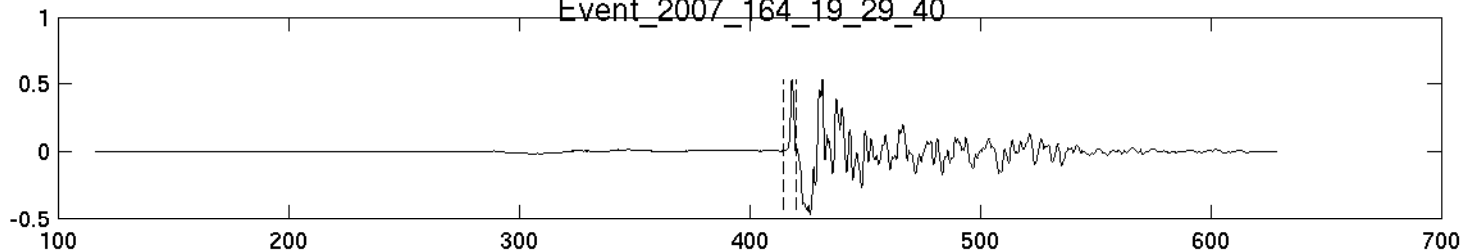


Sorted by  $t^*$ :Event\_2007\_164\_19\_29\_40

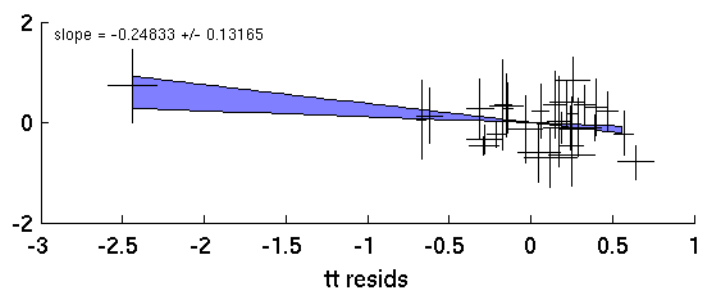
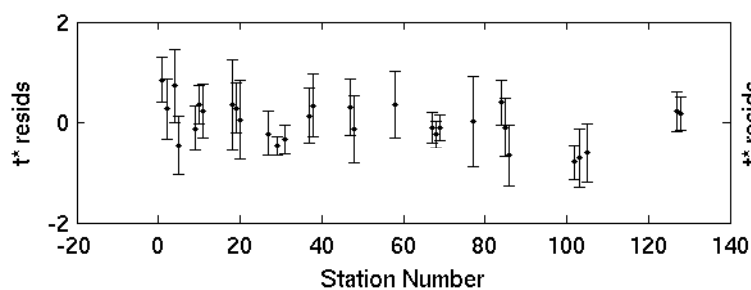


Event\_2007\_164\_19\_29\_40

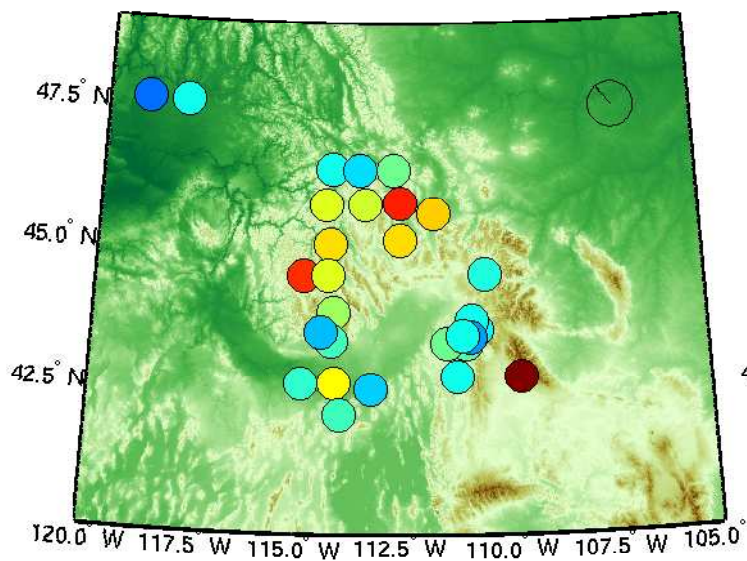
Stack



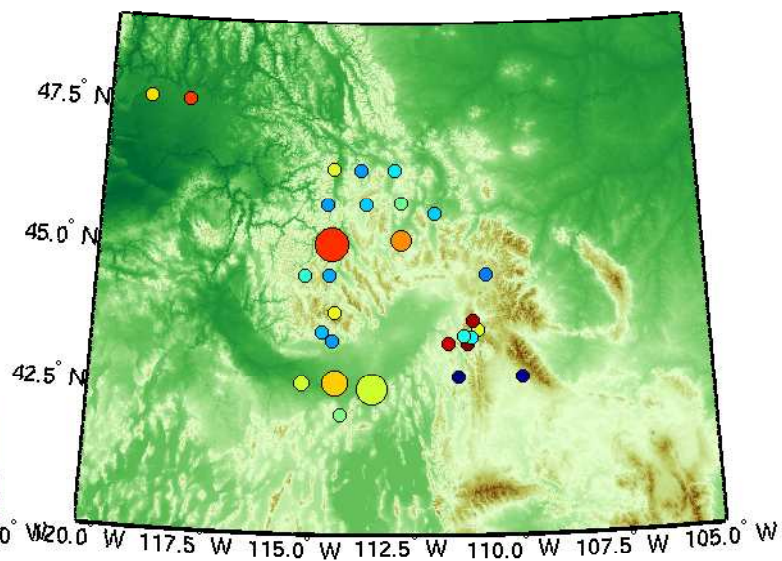
Baz = 143.6885  
Mean xcor value = 0.84633  
Range of  $t^*$  values is 1.654  
Median  $t^*$  err is 0.54145  
Slope = -0.24833 +/- 0.13165



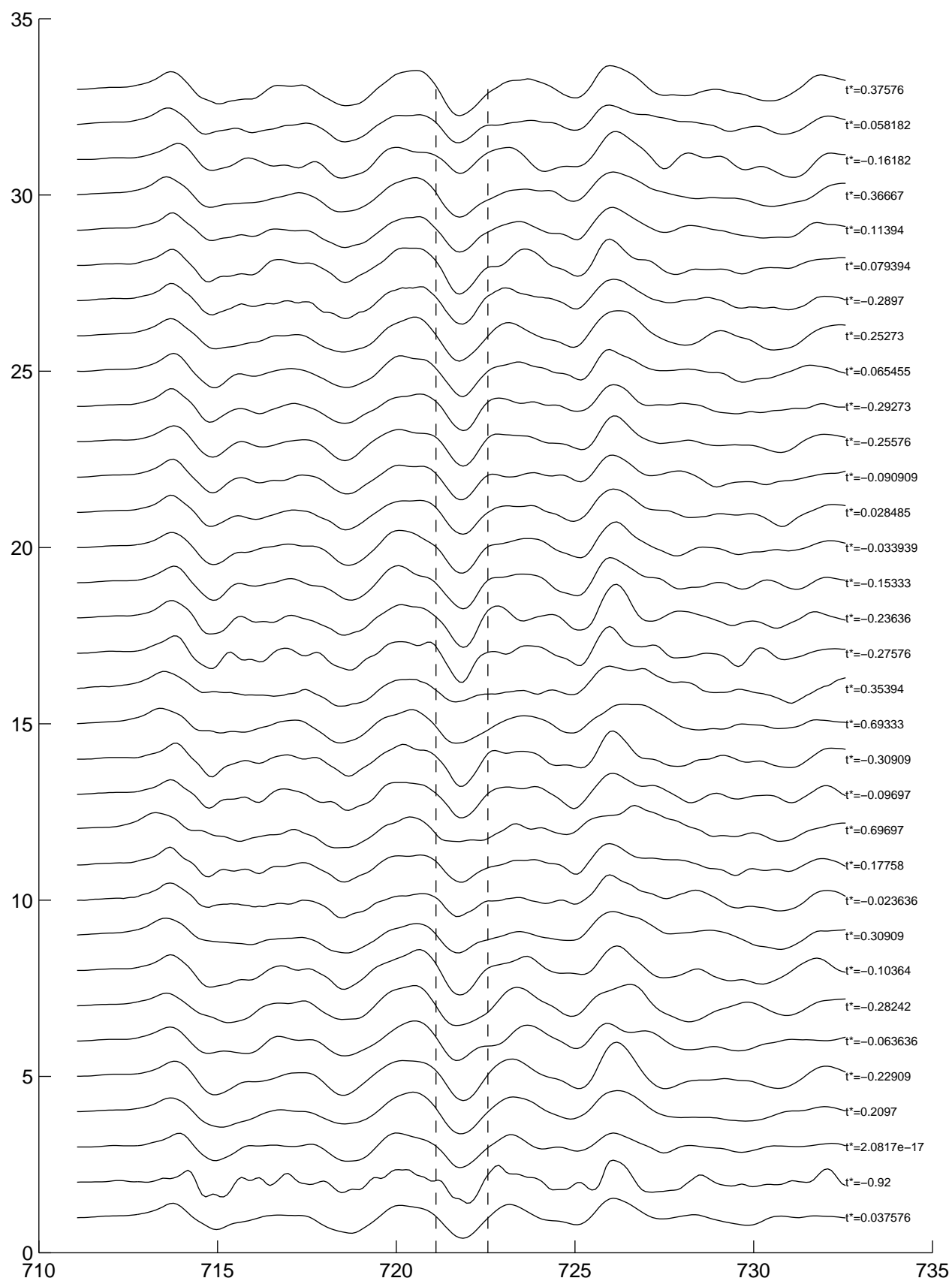
travel time residuals



$t^*$  values

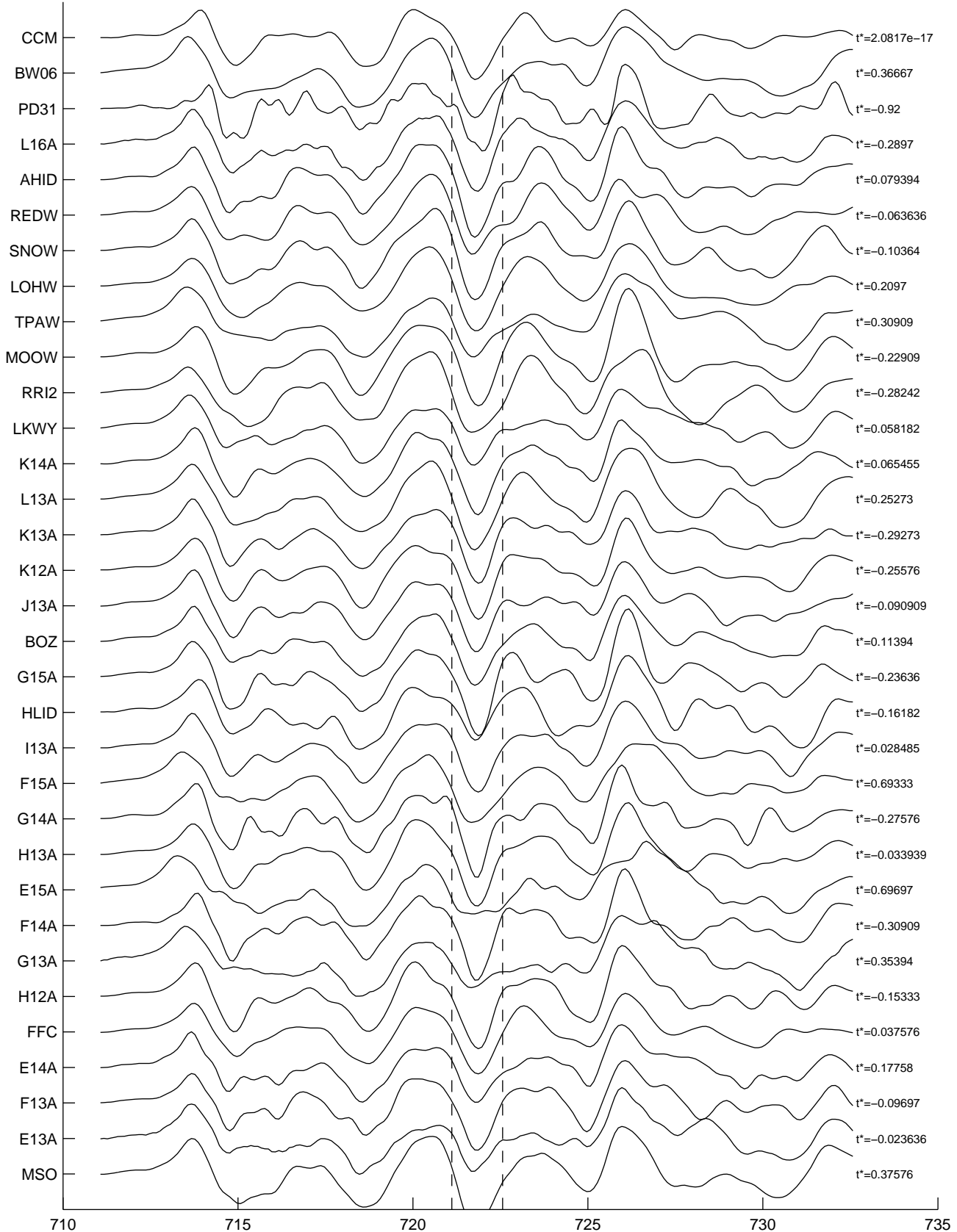


# Event\_2007\_197\_01\_13\_22

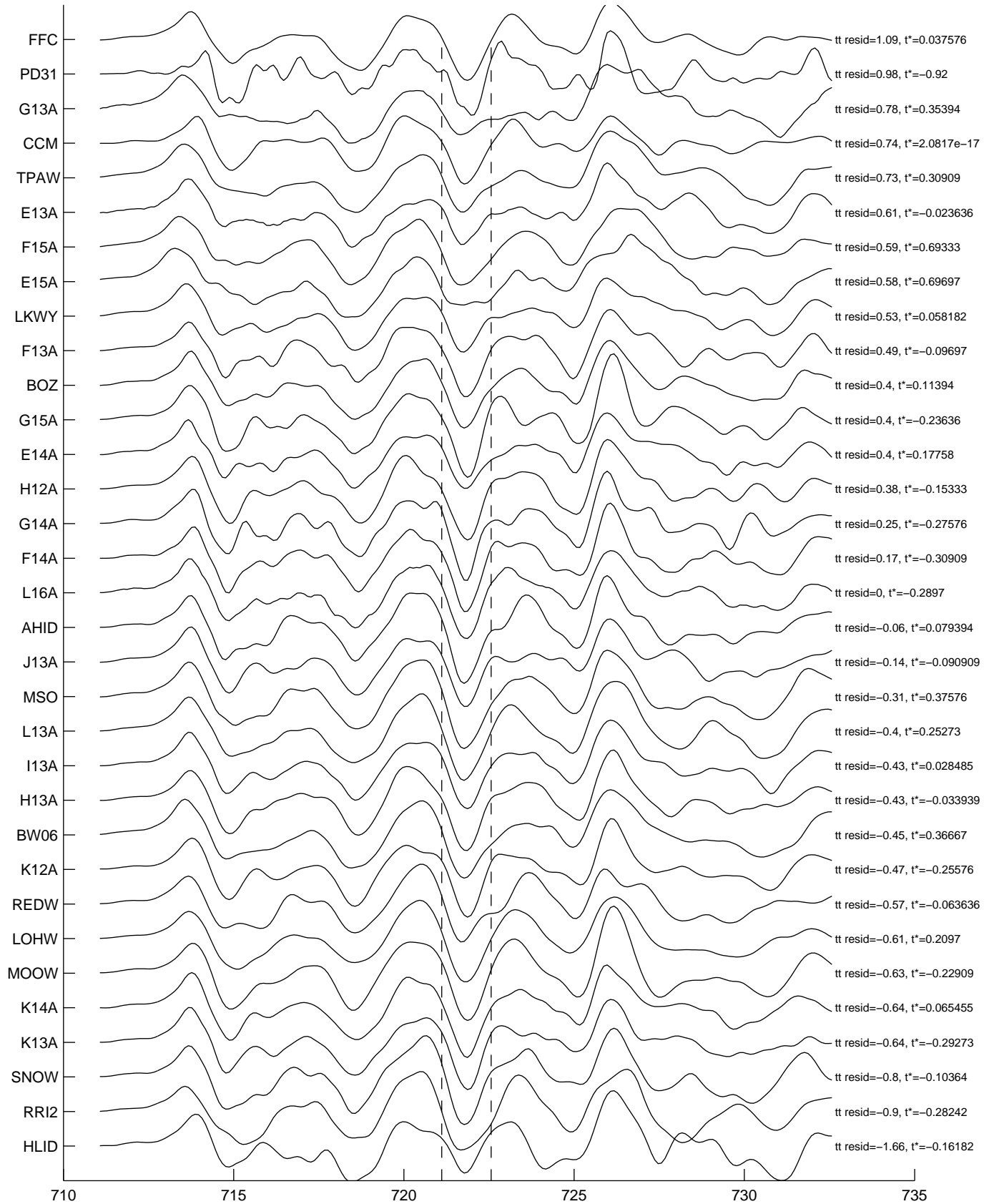




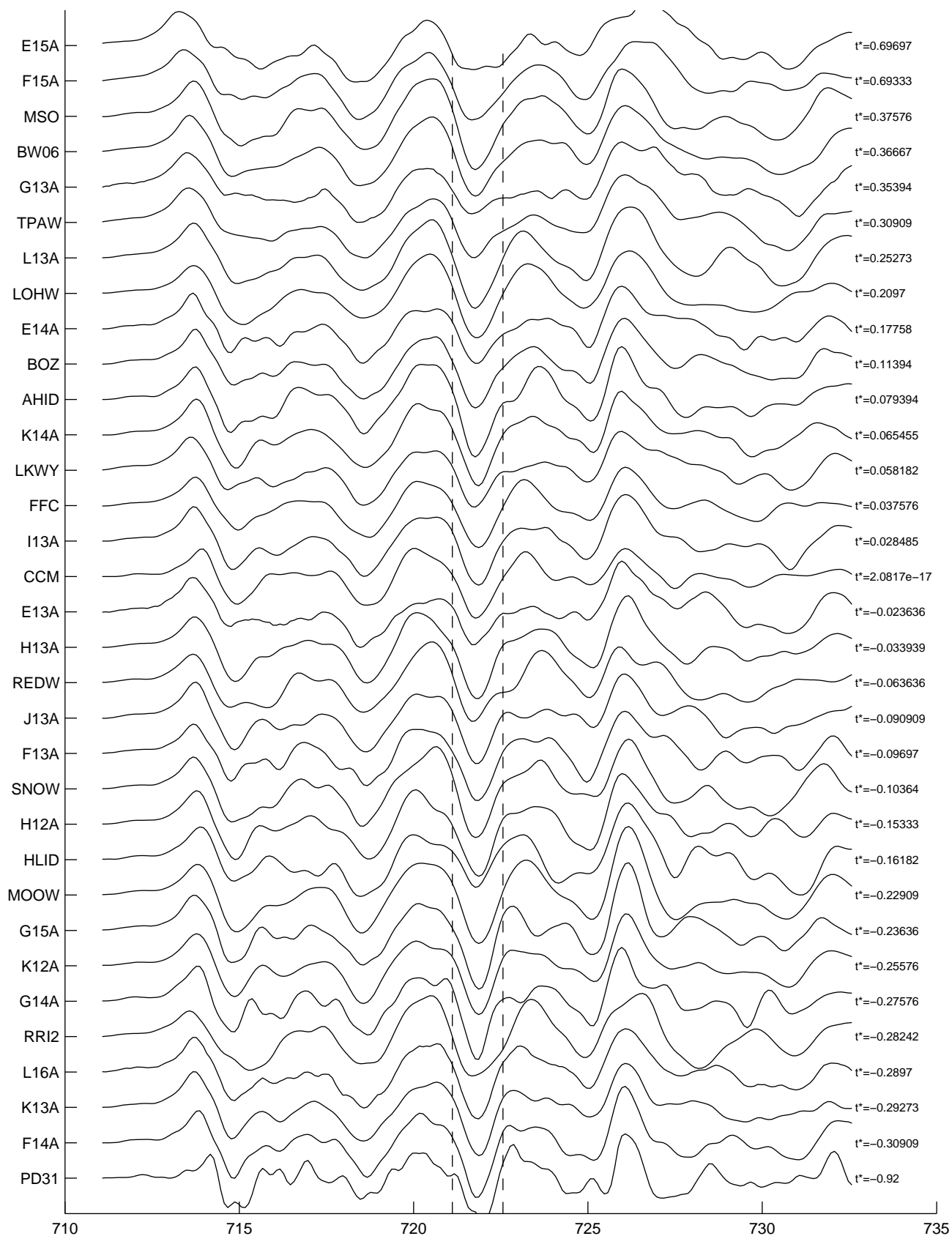
Sorted by Delta:Event\_2007\_197\_01\_13\_22



# Sorted by travel time: Event\_2007\_197\_01\_13\_22

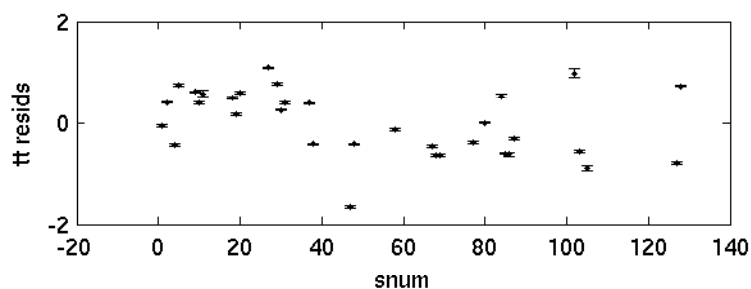
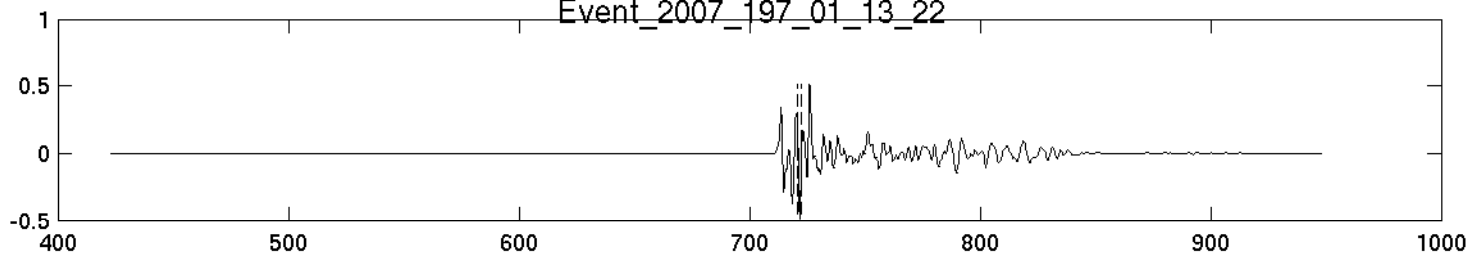


# Sorted by $t^*$ :Event\_2007\_197\_01\_13\_22

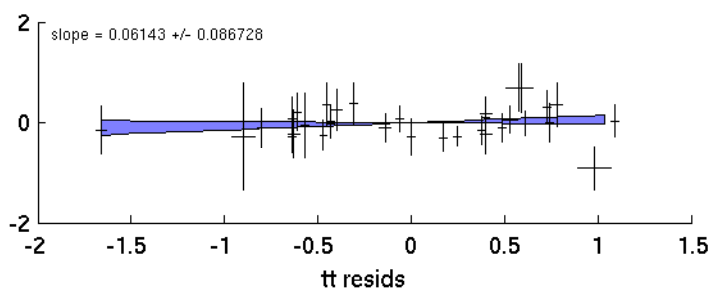
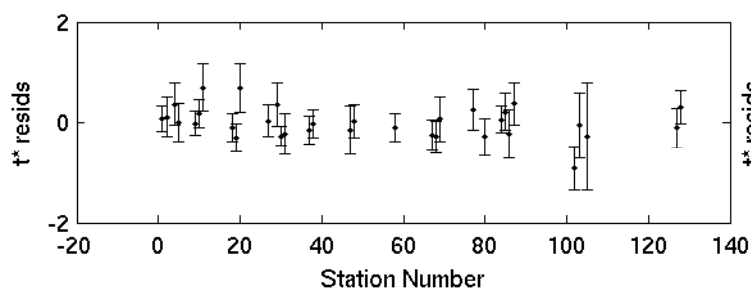


Event\_2007\_10\_13\_22

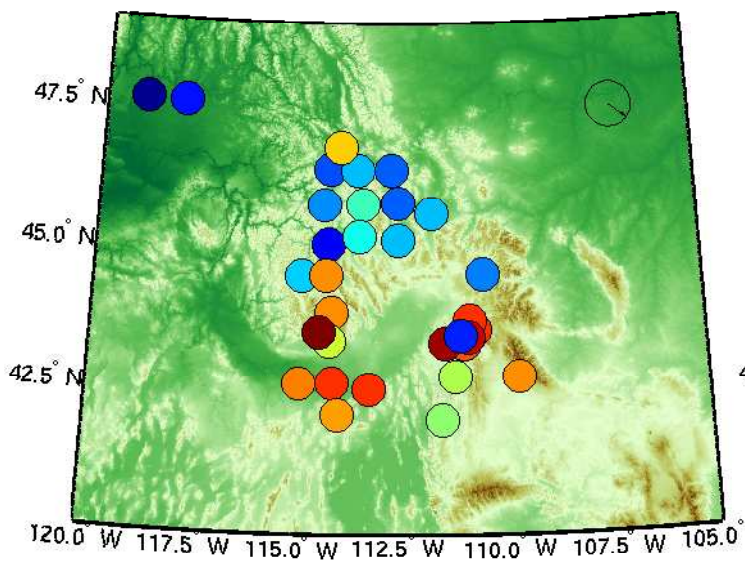
Stack



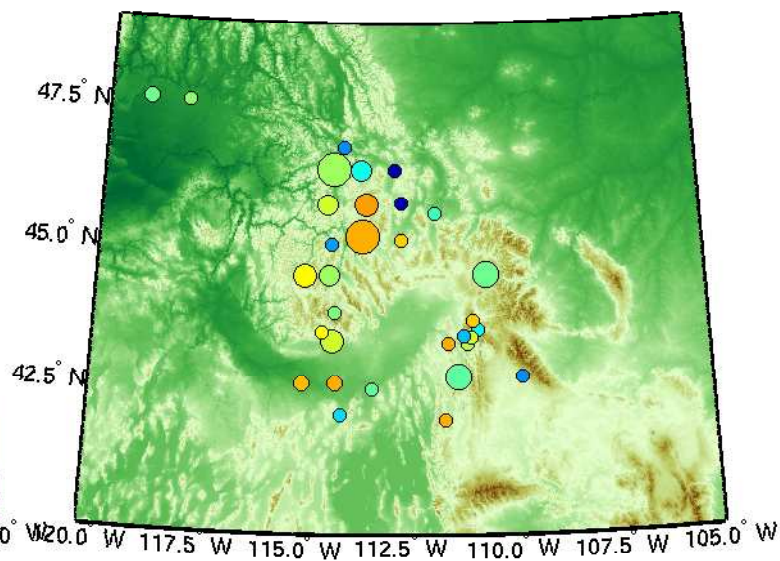
Baz = 309.974  
Mean xcor value = 0.84727  
Range of  $t^*$  values is 1.617  
Median  $t^*$  err is 0.3769  
Slope = 0.06143 +/- 0.086728



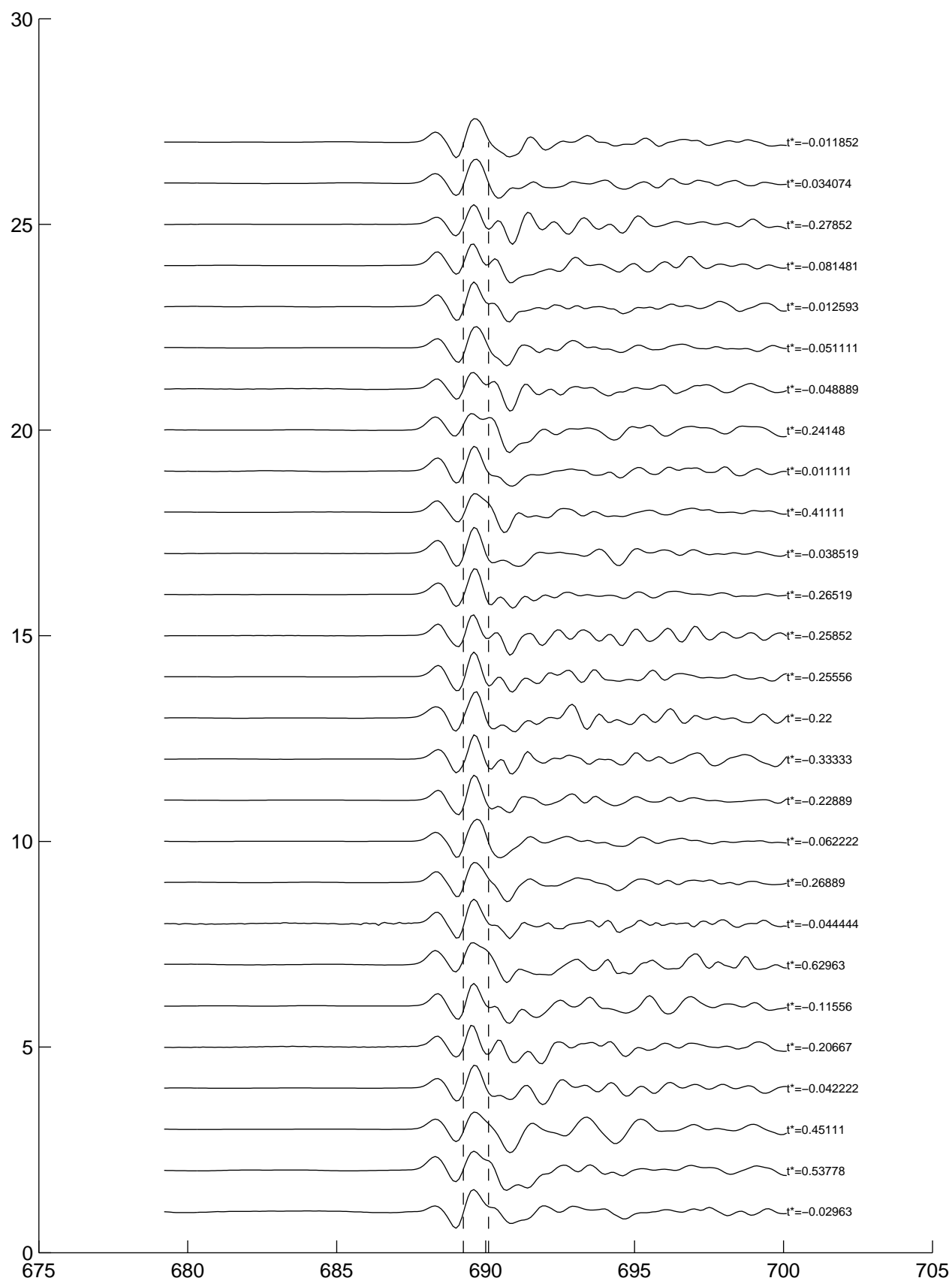
travel time residuals



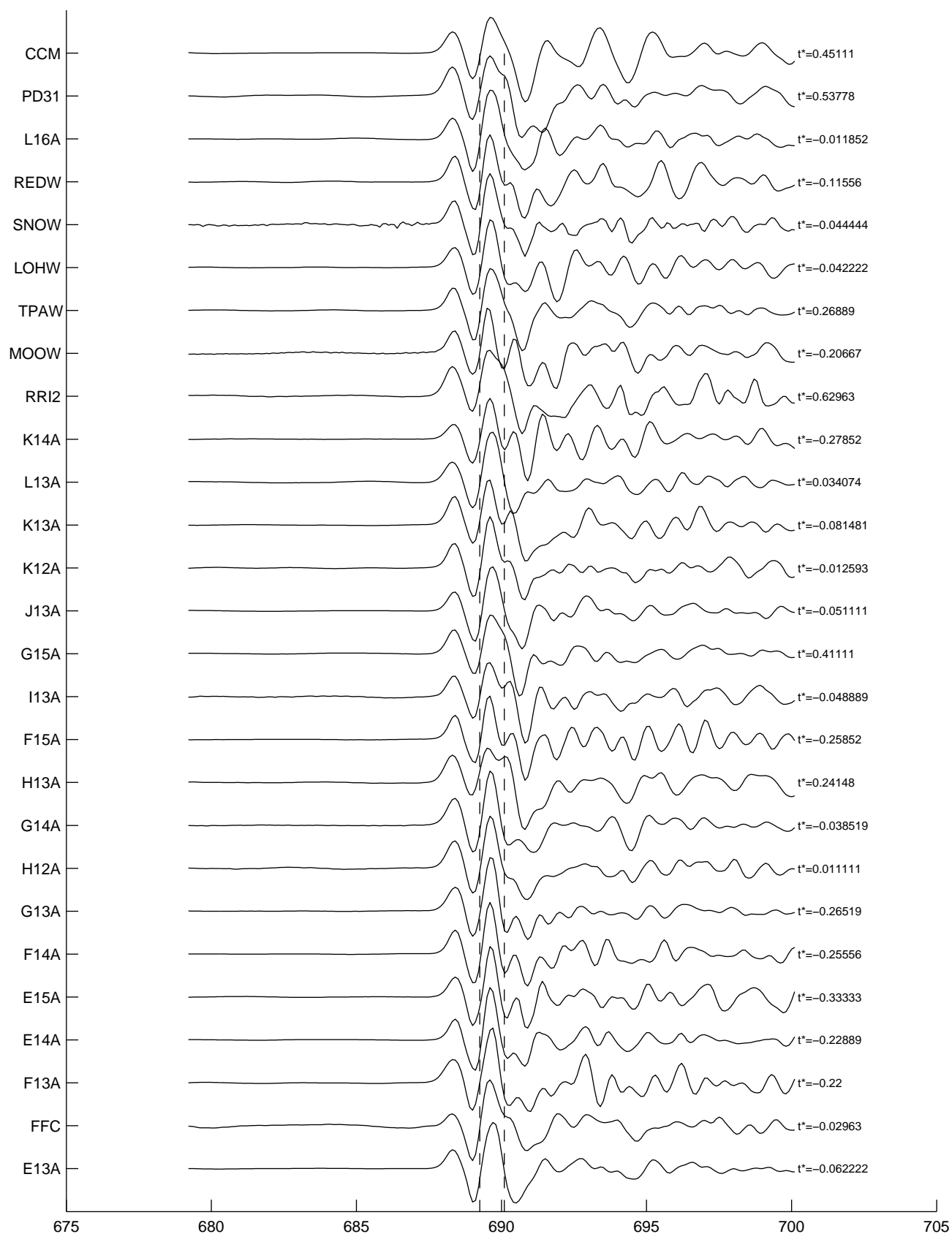
$t^*$  values



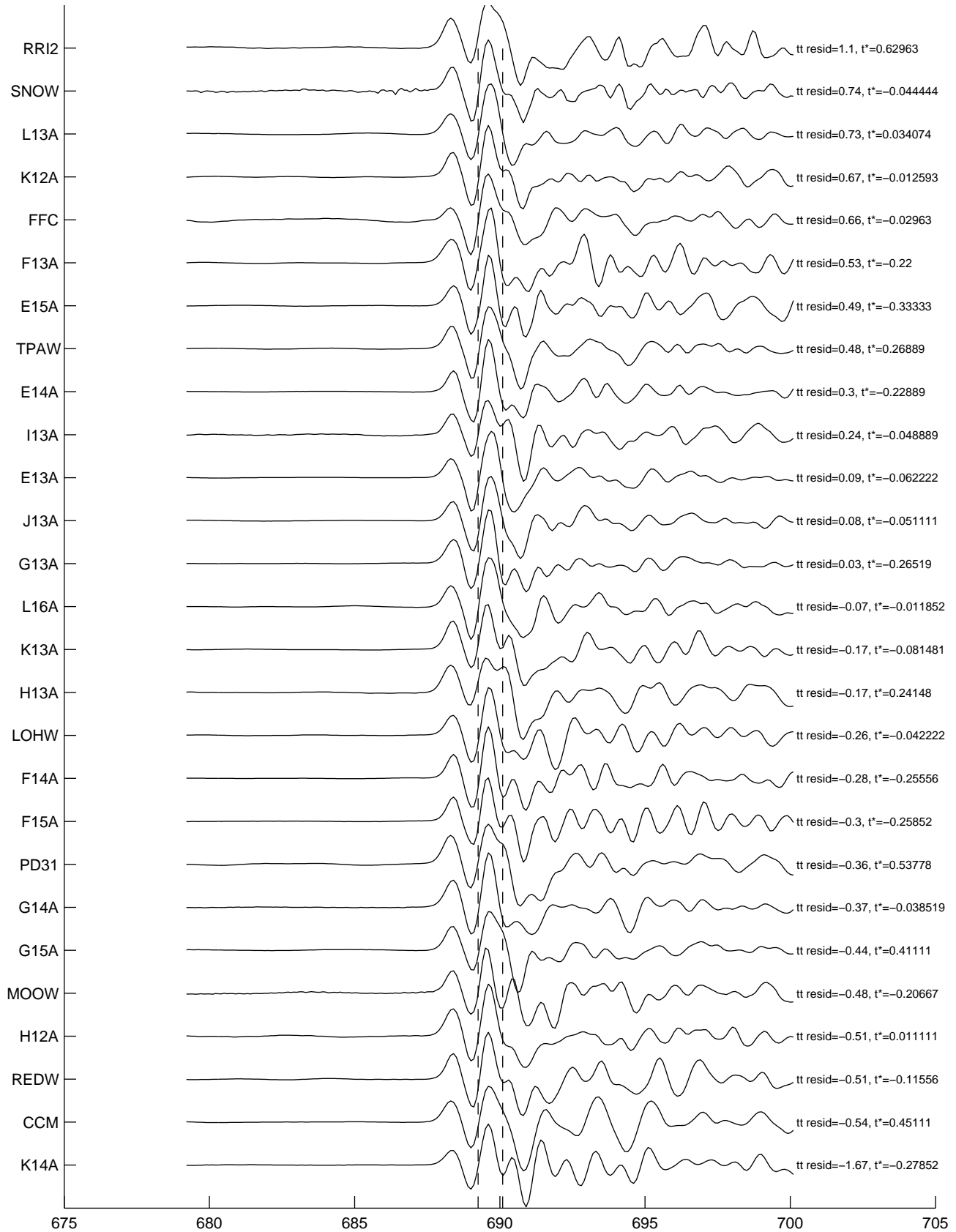
# Event\_2007\_197\_14\_17\_37



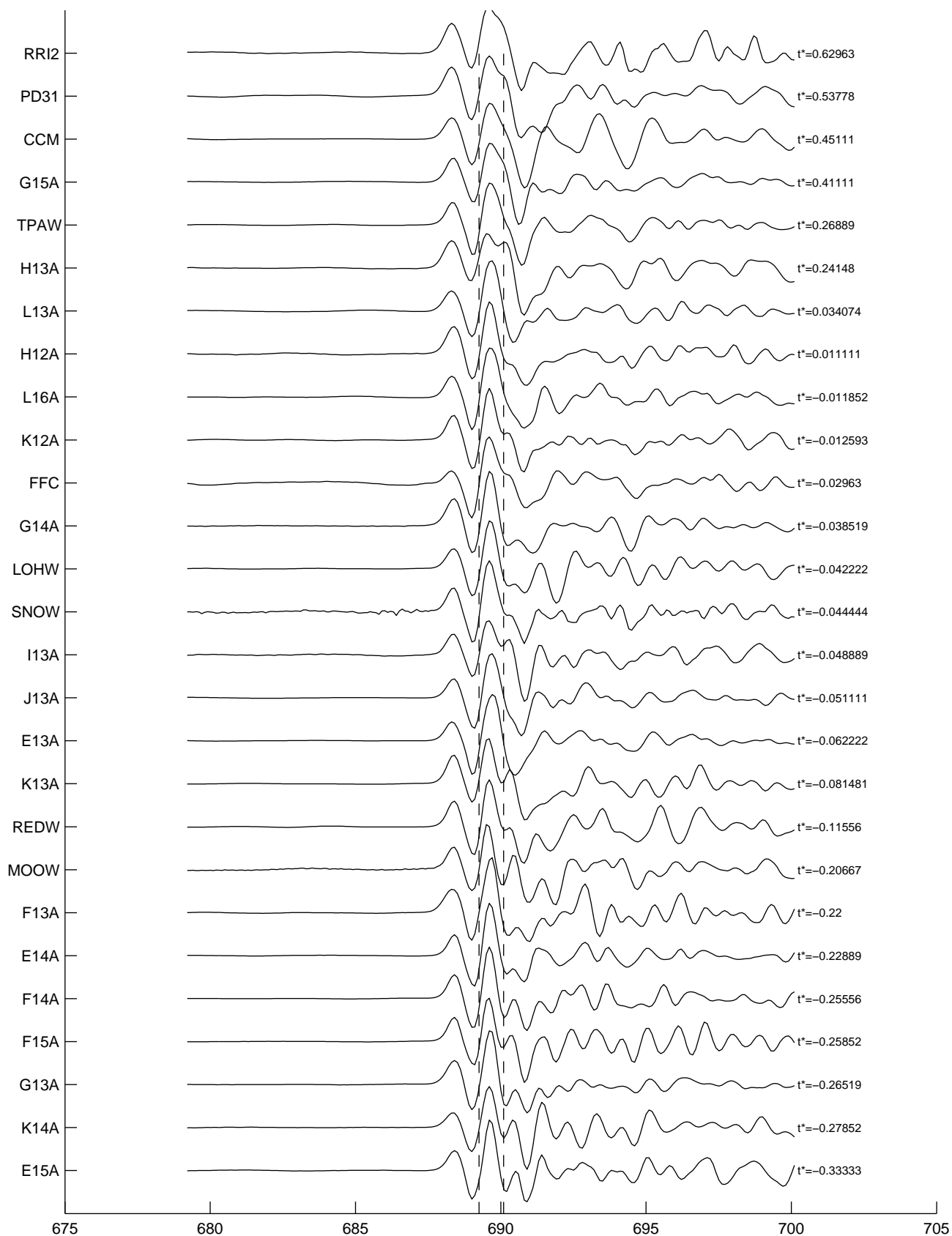
# Sorted by Delta:Event\_2007\_197\_14\_17\_37



# Sorted by travel time:Event\_2007\_197\_14\_17\_37



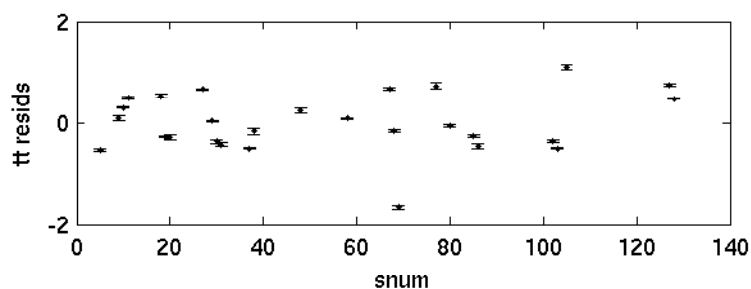
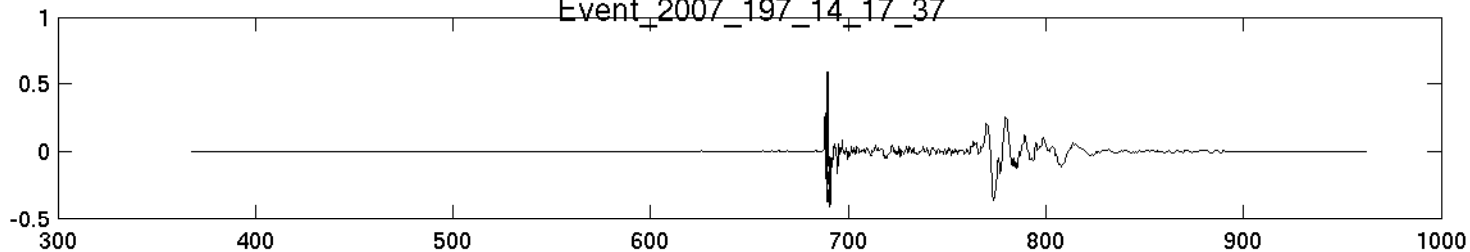
Sorted by  $t^*$ :Event\_2007\_197\_14\_17\_37



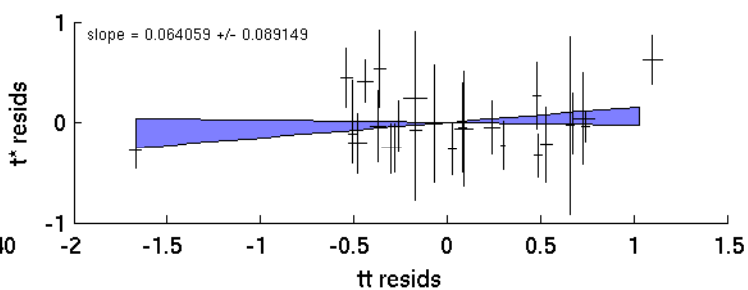
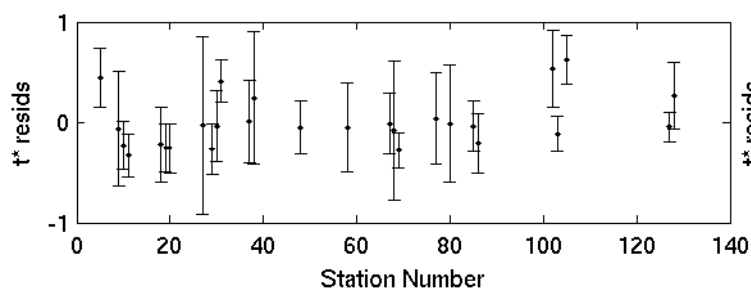


# Event\_2007\_197\_14\_17\_37

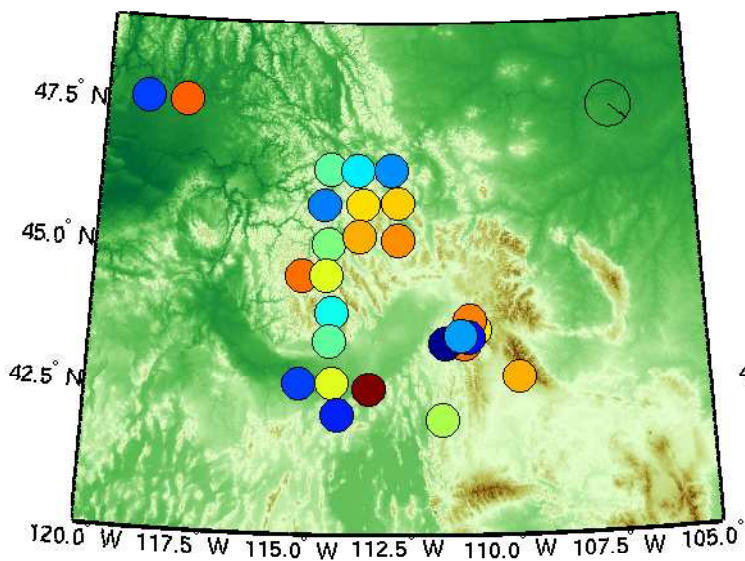
Stack



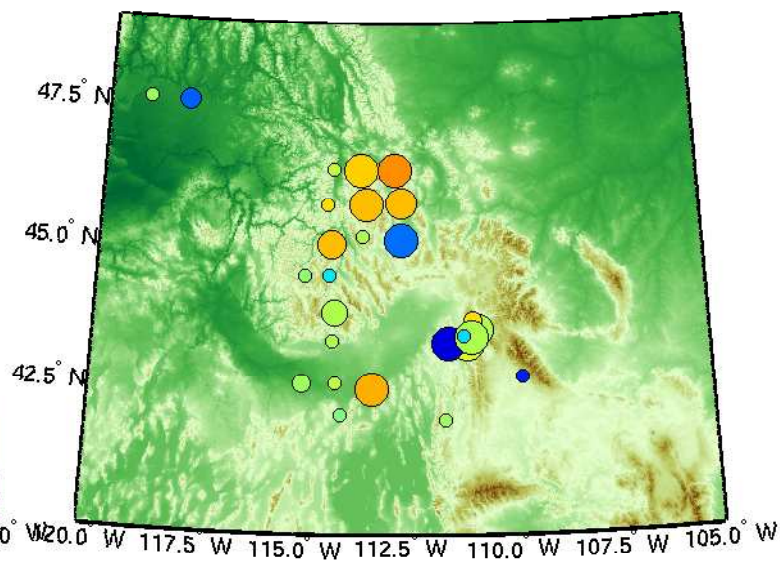
Baz = 311.6238  
Mean xcor value = 0.6663  
Range of  $t^*$  values is 0.96296  
Median  $t^*$  err is 0.29712  
Slope = 0.064059 +/- 0.089149



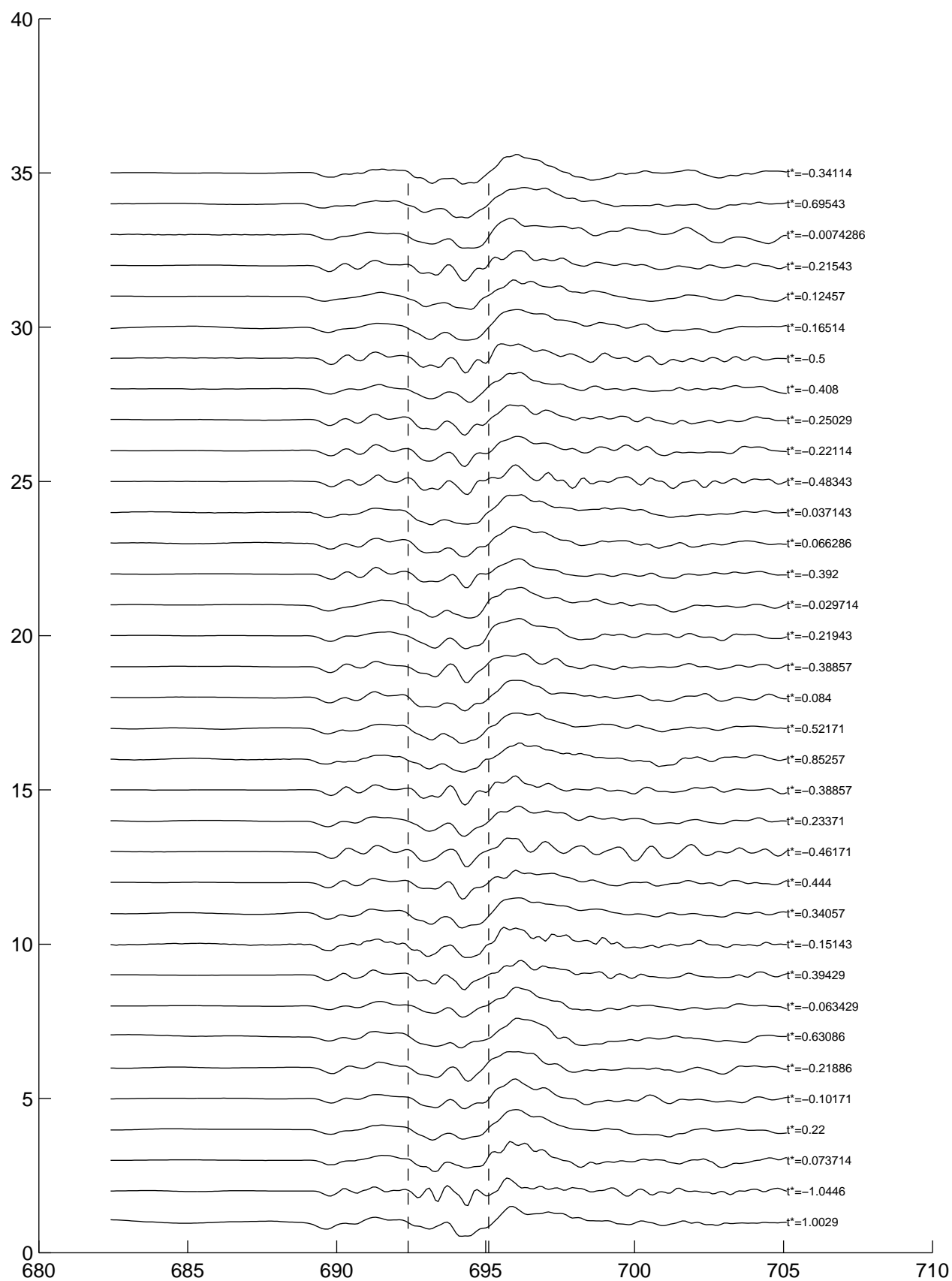
travel time residuals



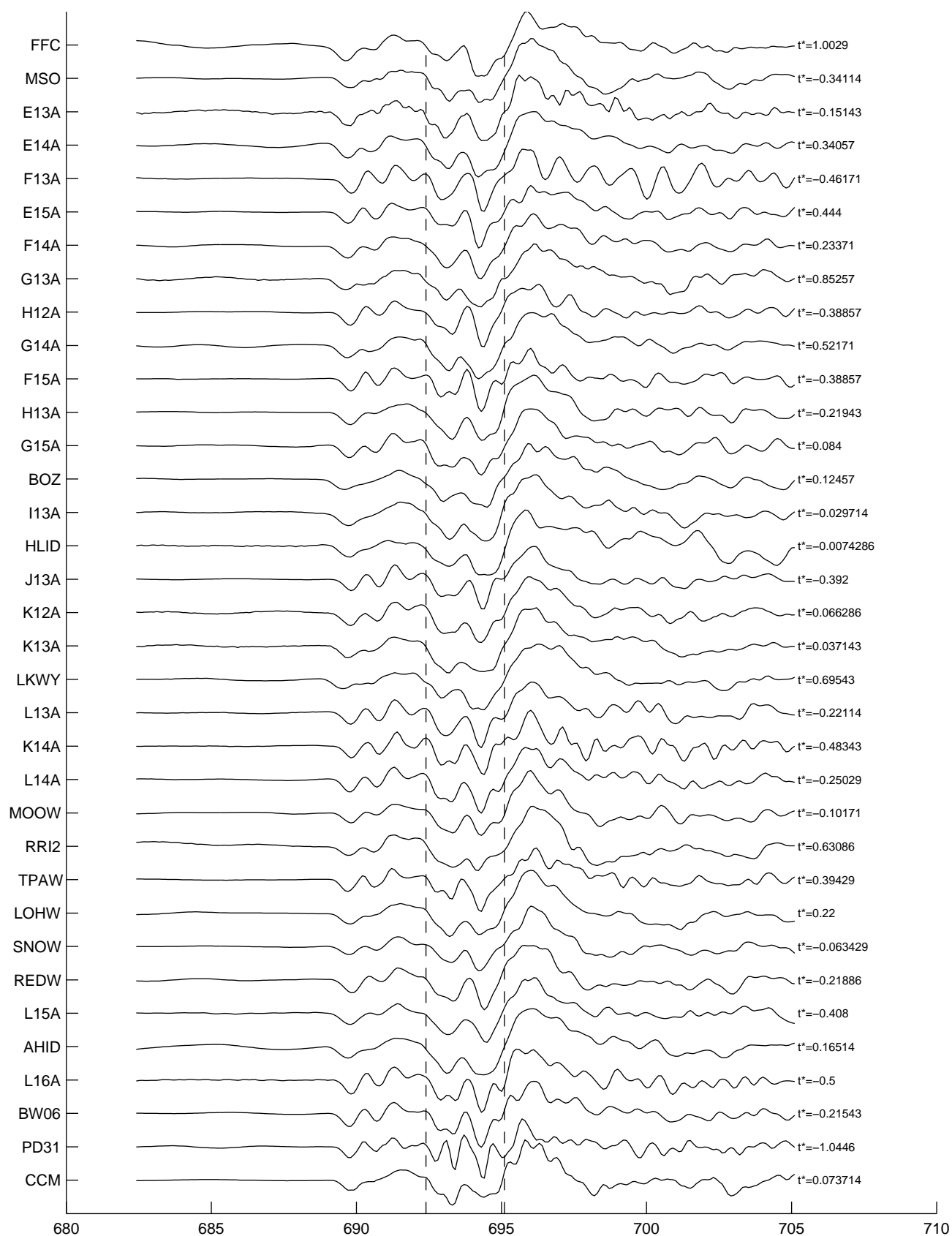
$t^*$  values



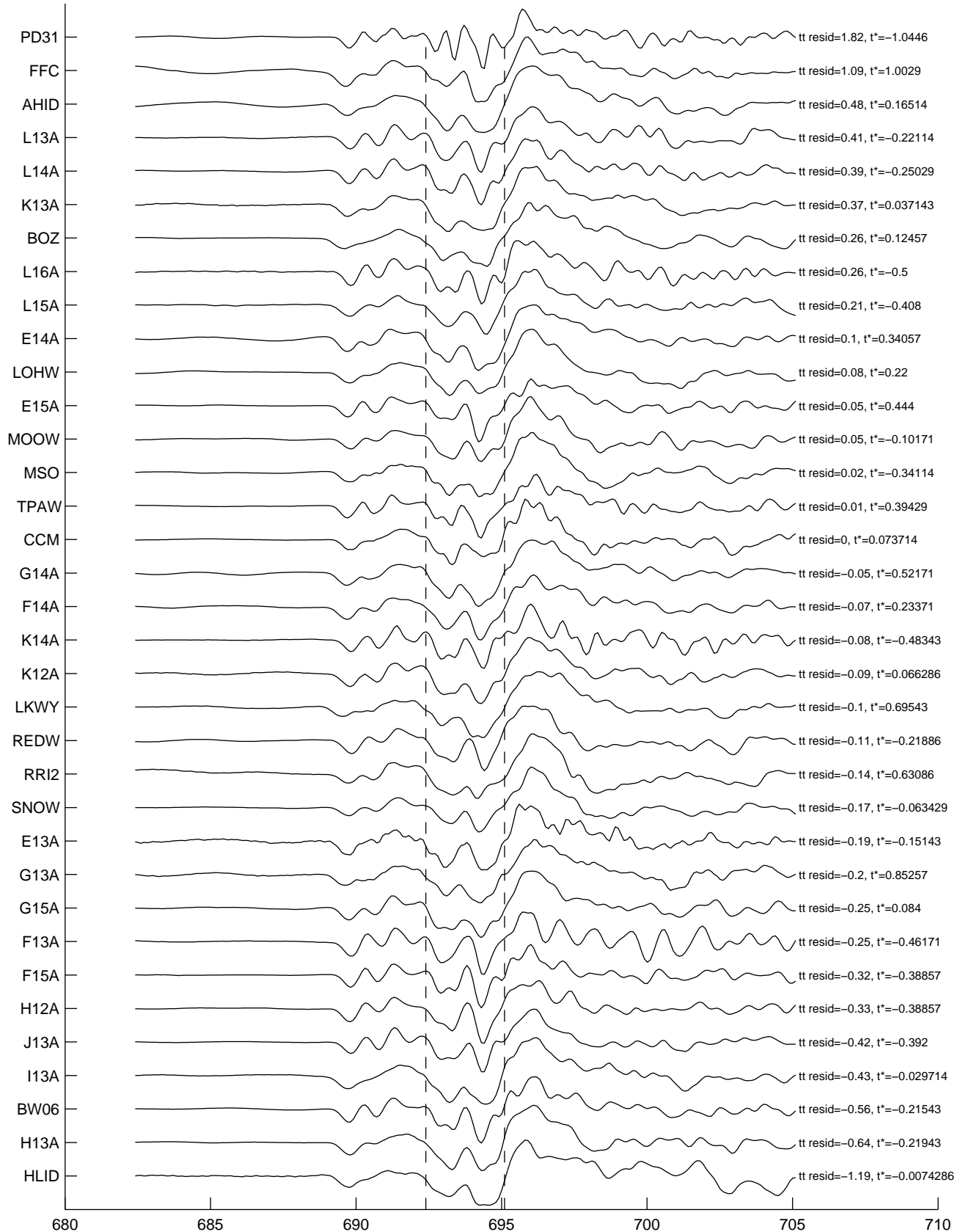
# Event\_2007\_202\_15\_34\_52



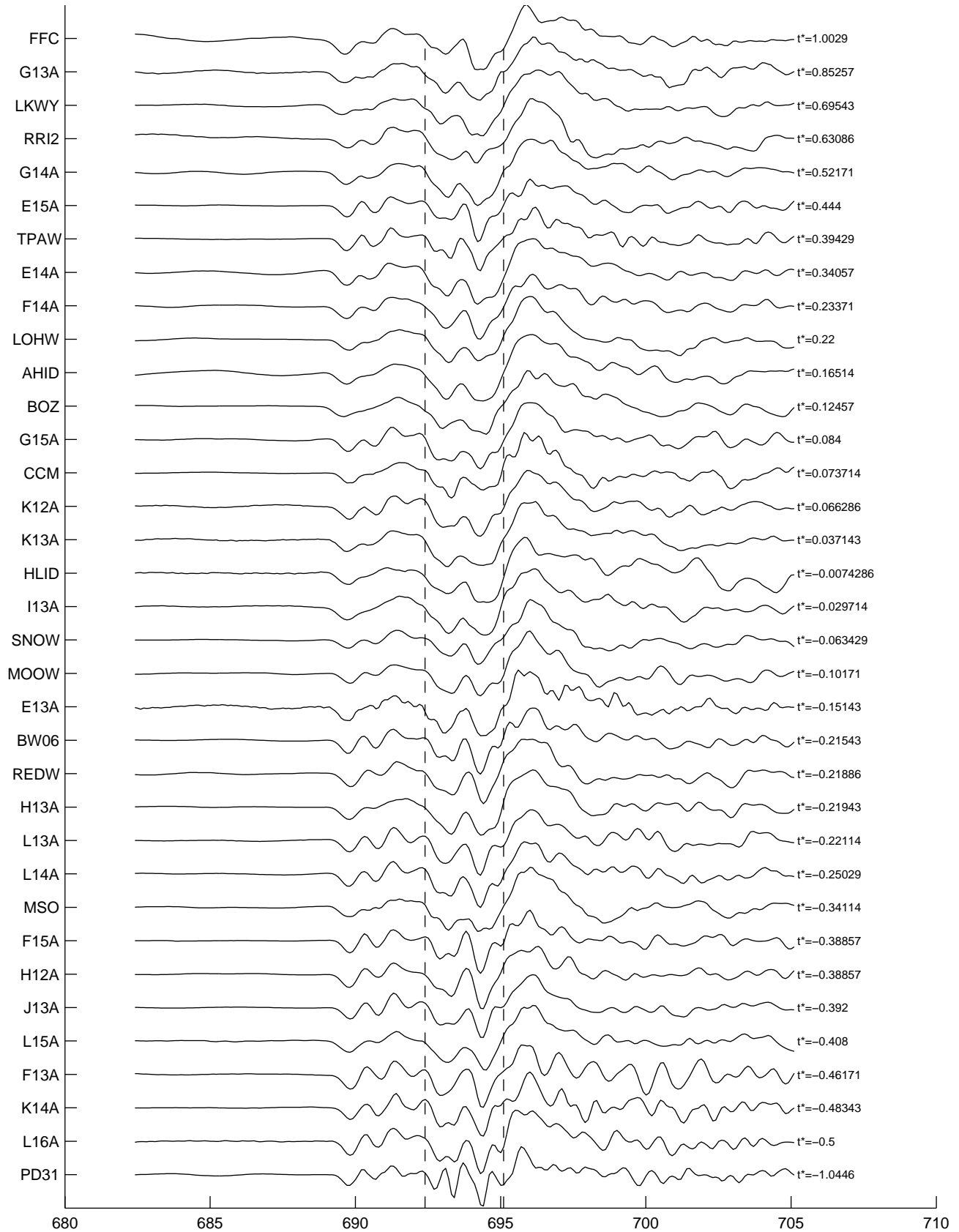
# Sorted by Delta:Event\_2007\_202\_15\_34\_52



# Sorted by travel time:Event\_2007\_202\_15\_34\_52

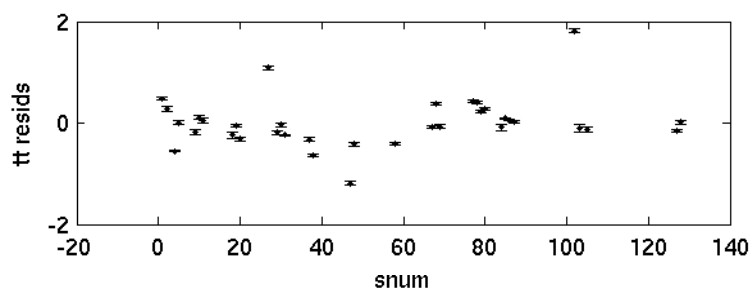
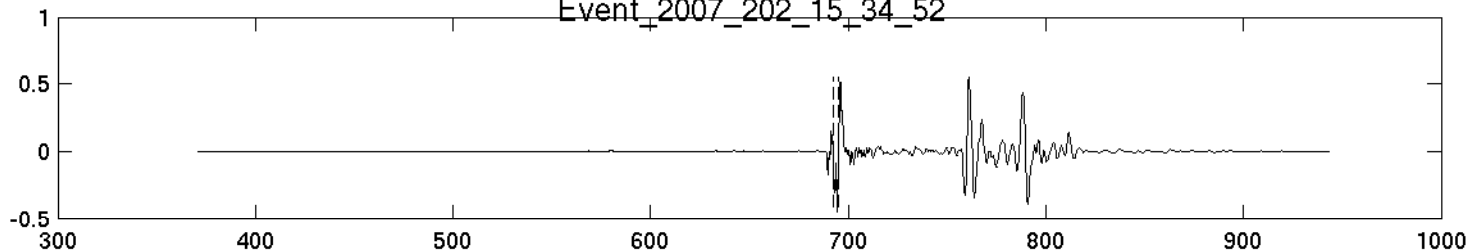


# Sorted by $t^*$ :Event\_2007\_202\_15\_34\_52

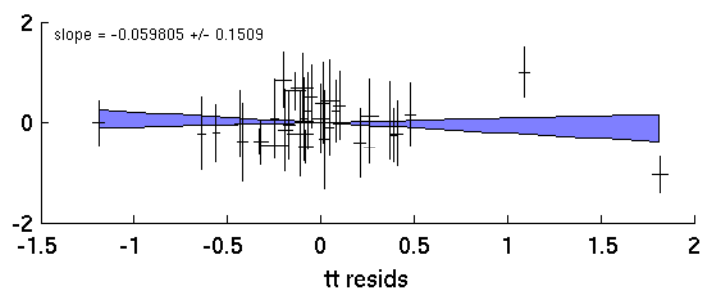
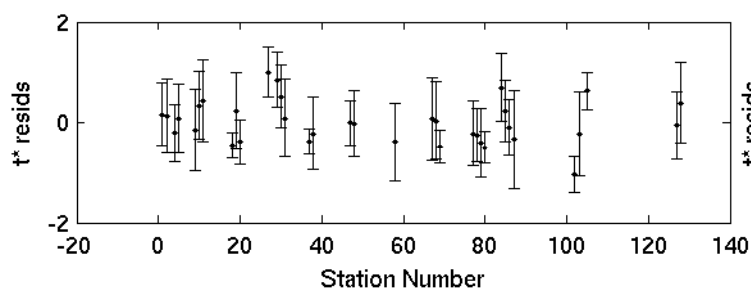


# Event 2007\_202\_15\_34\_52

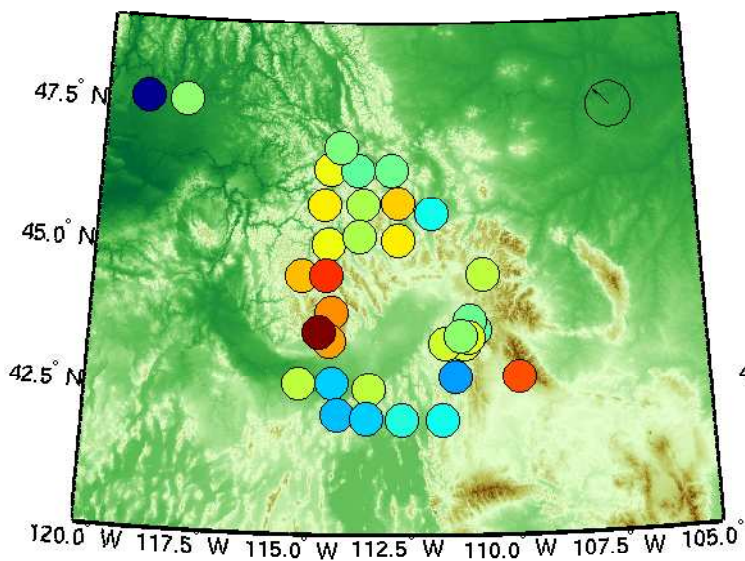
Stack



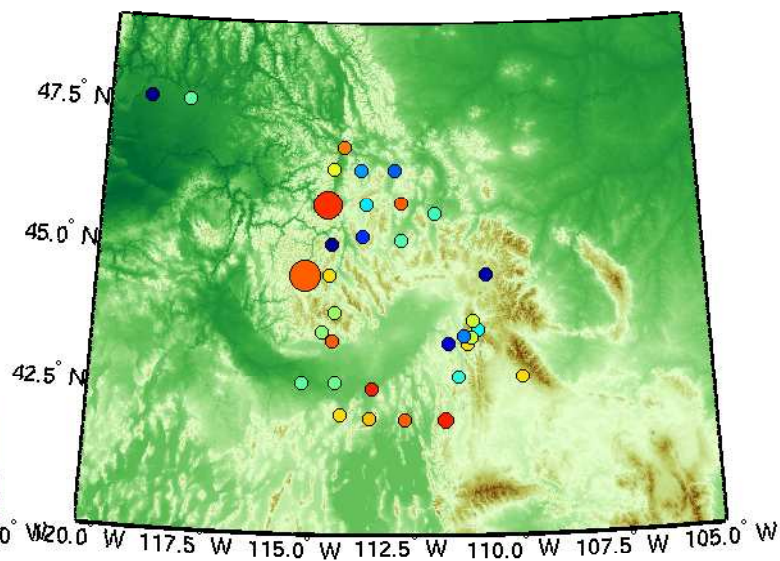
Baz = 137.3071  
Mean xcor value = 0.81686  
Range of  $t^*$  values is 2.0474  
Median  $t^*$  err is 0.66549  
Slope = -0.059805 +/- 0.1509



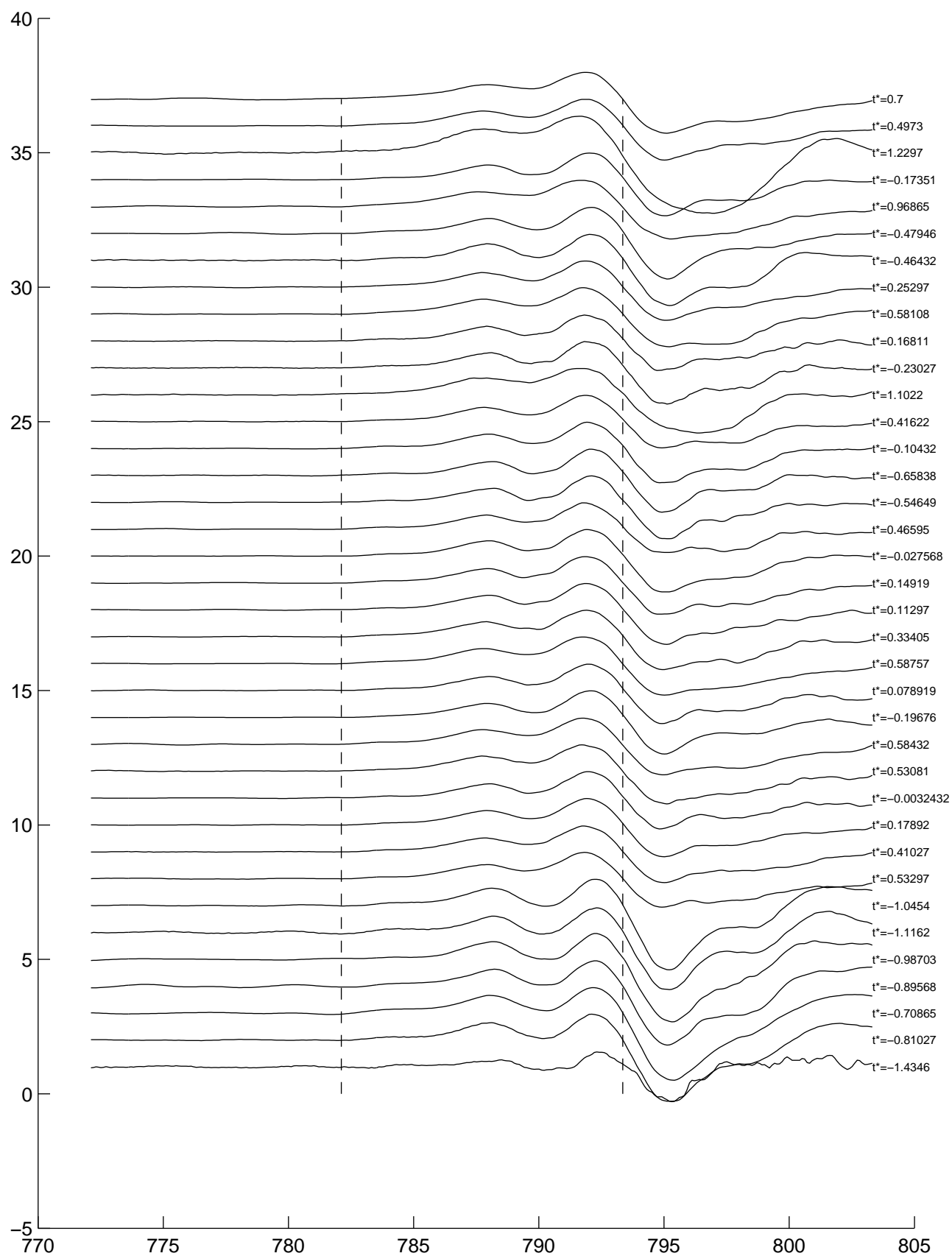
travel time residuals



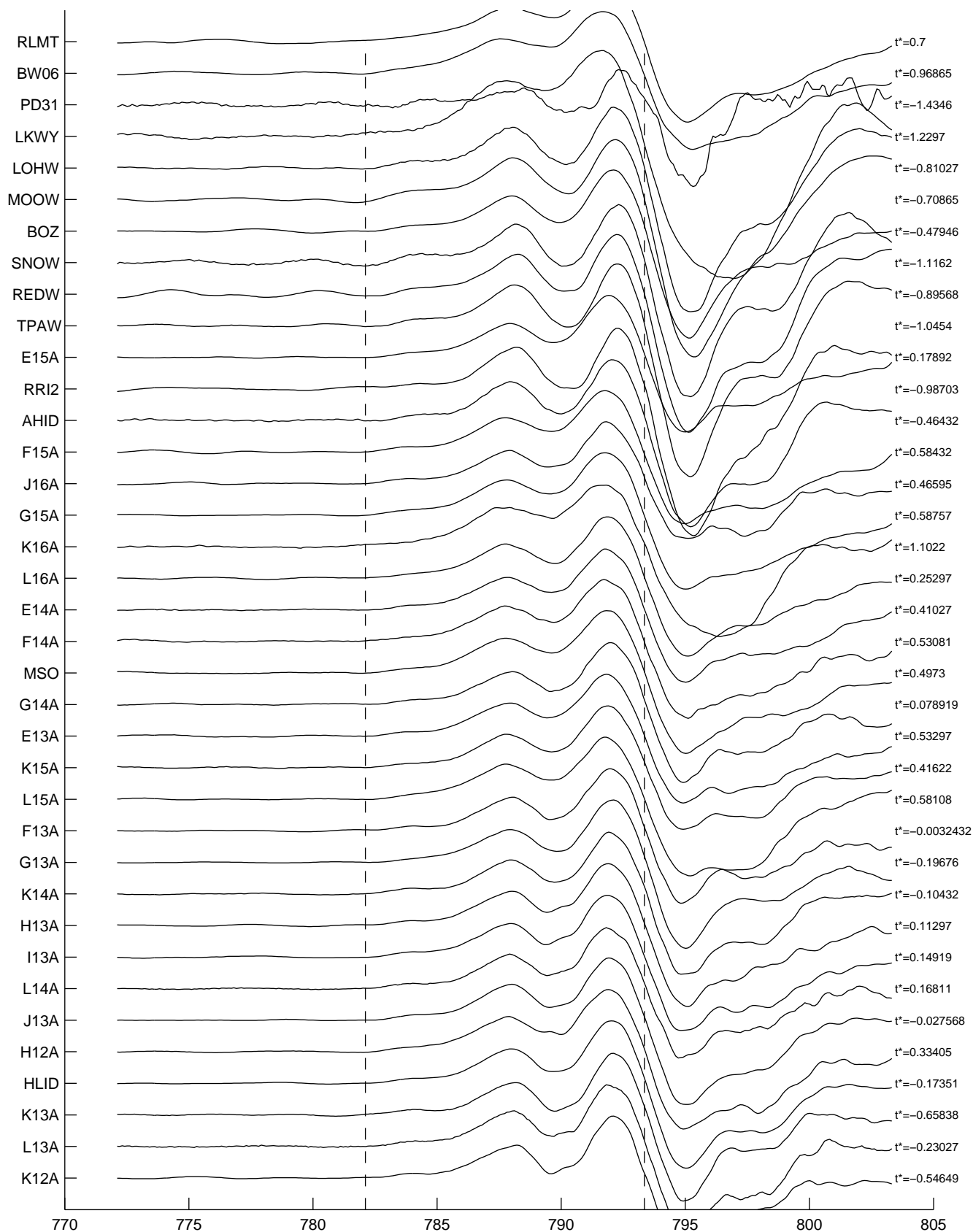
$t^*$  values



# Event\_2007\_213\_17\_08\_51

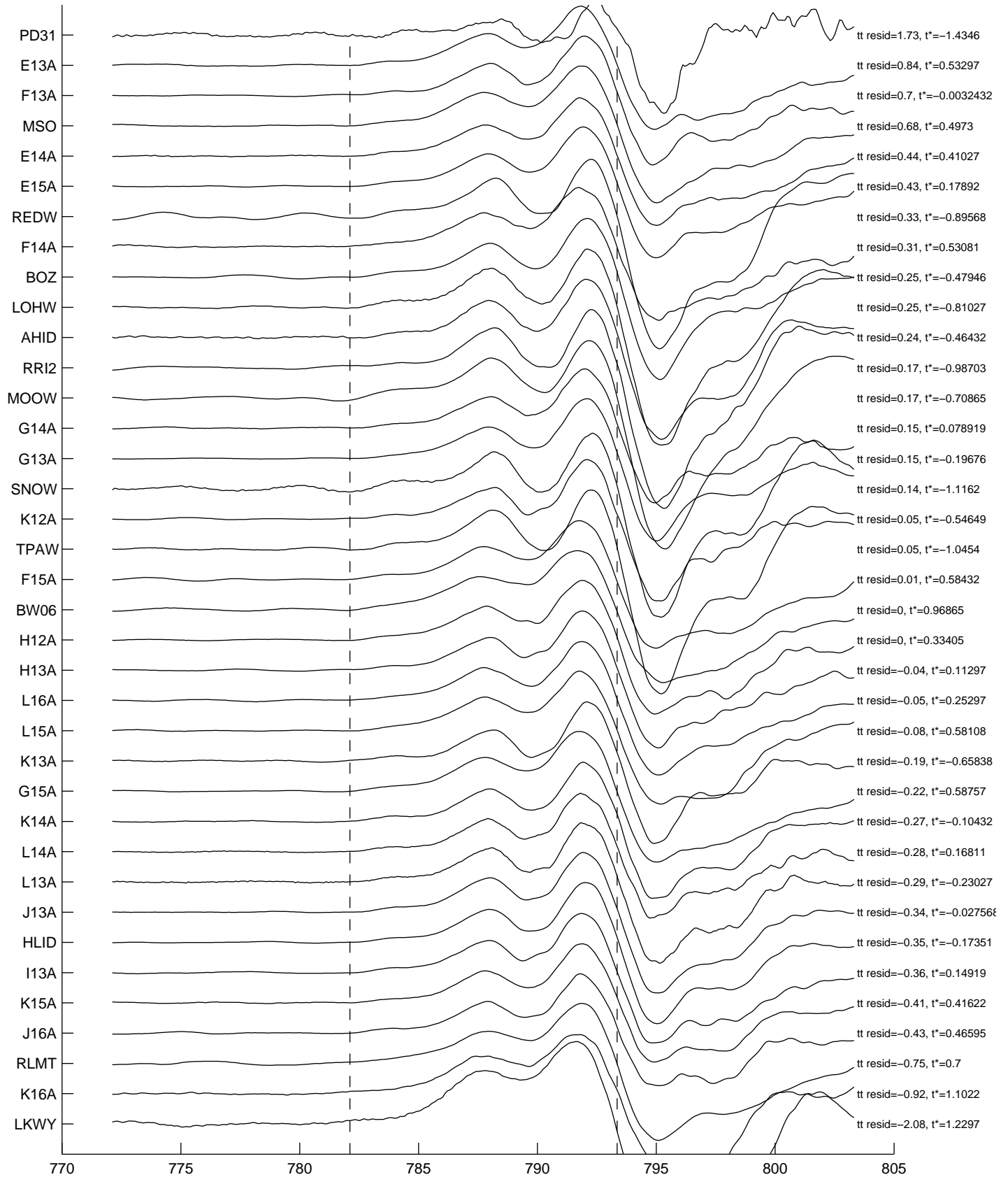


# Sorted by Delta:Event\_2007\_213\_17\_08\_51

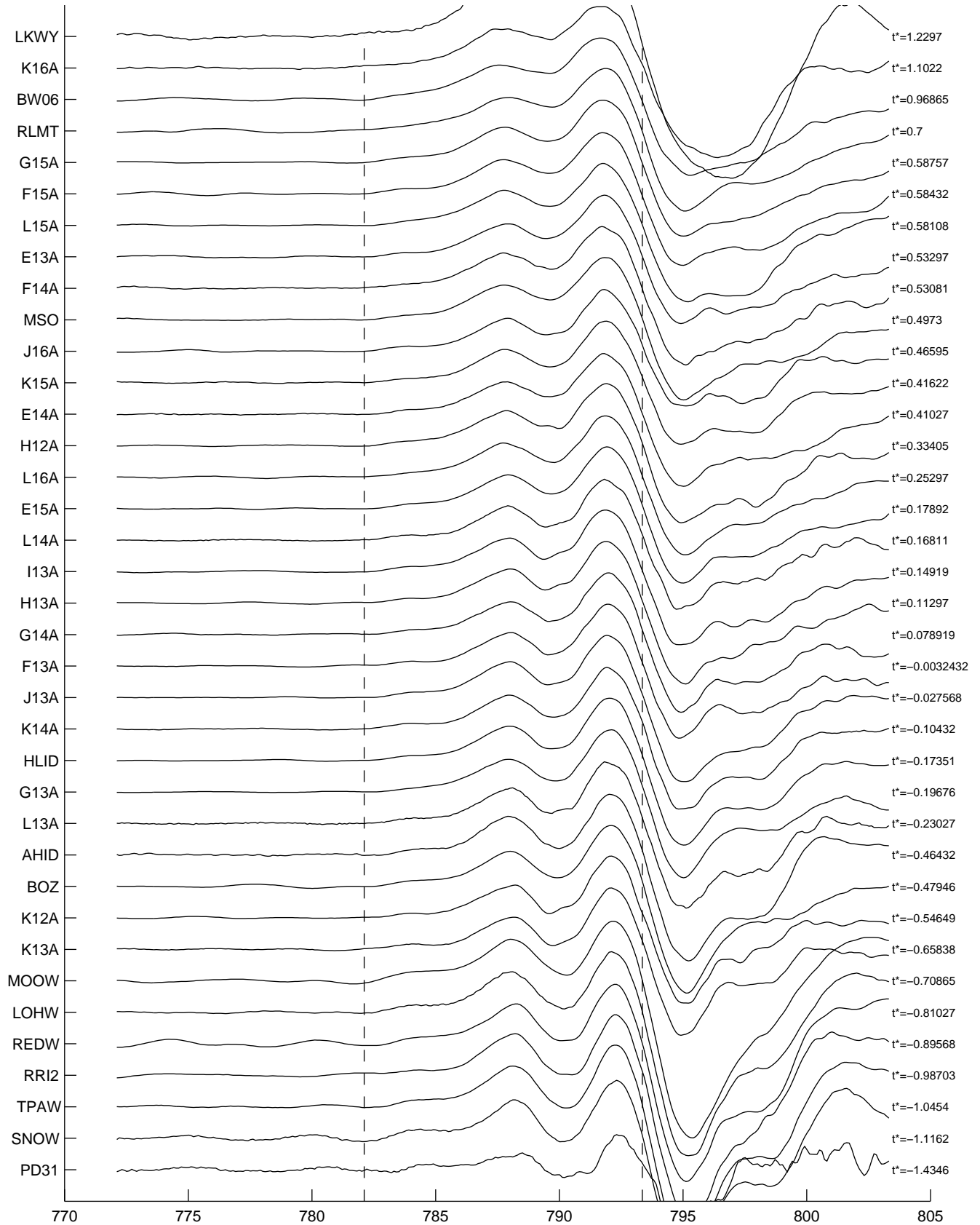




# Sorted by travel time: Event\_2007\_213\_17\_08\_51

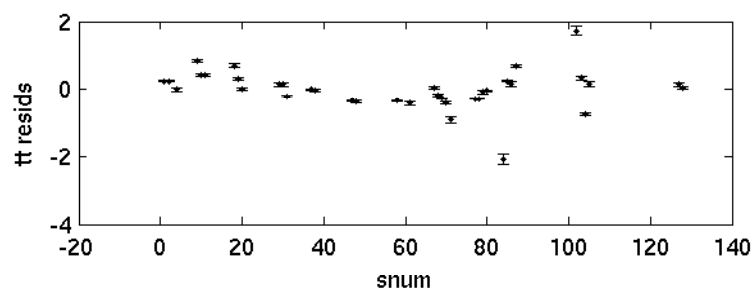
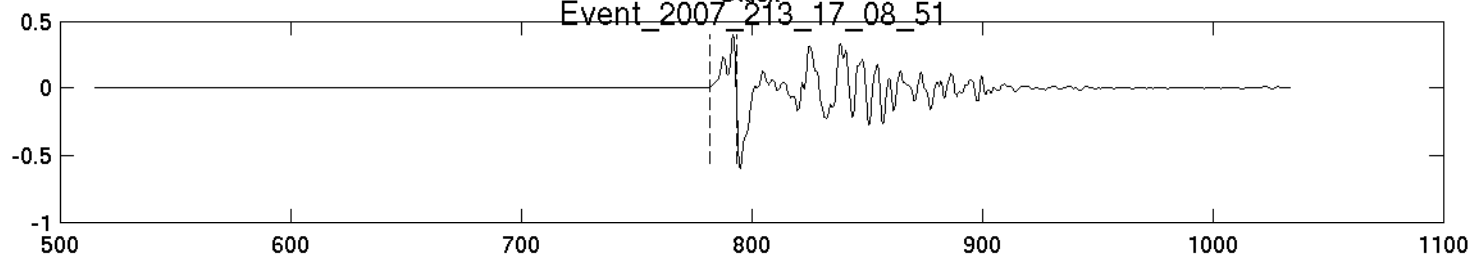


# Sorted by $t^*$ :Event\_2007\_213\_17\_08\_51

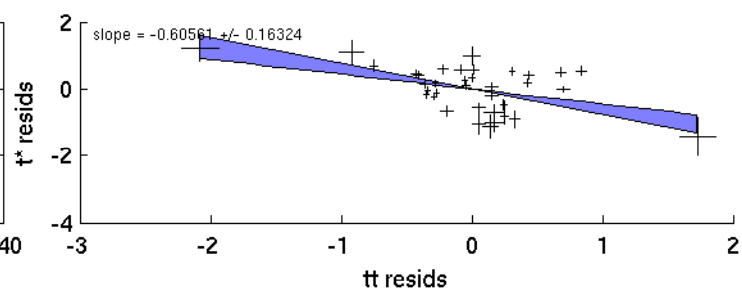
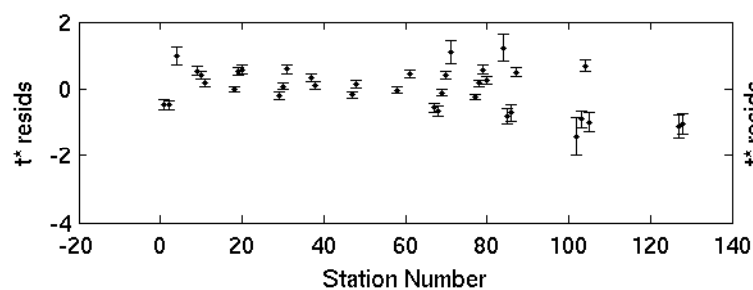


Event\_2007\_213\_17\_08\_51

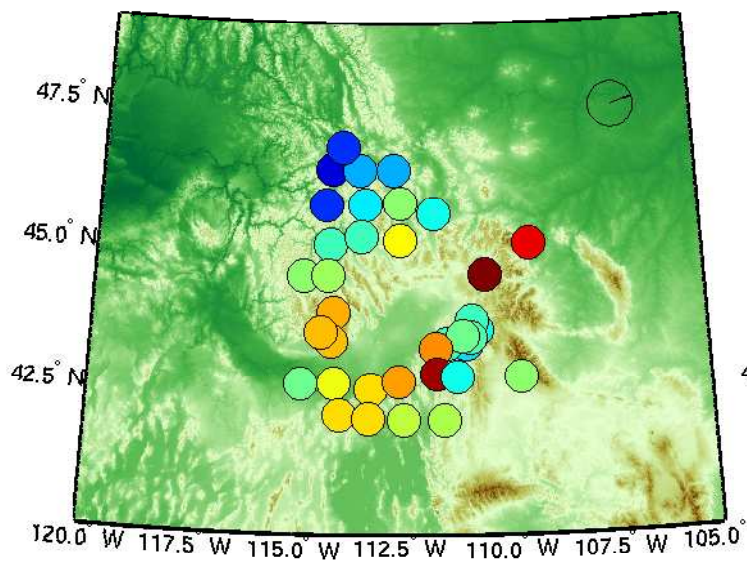
Stack



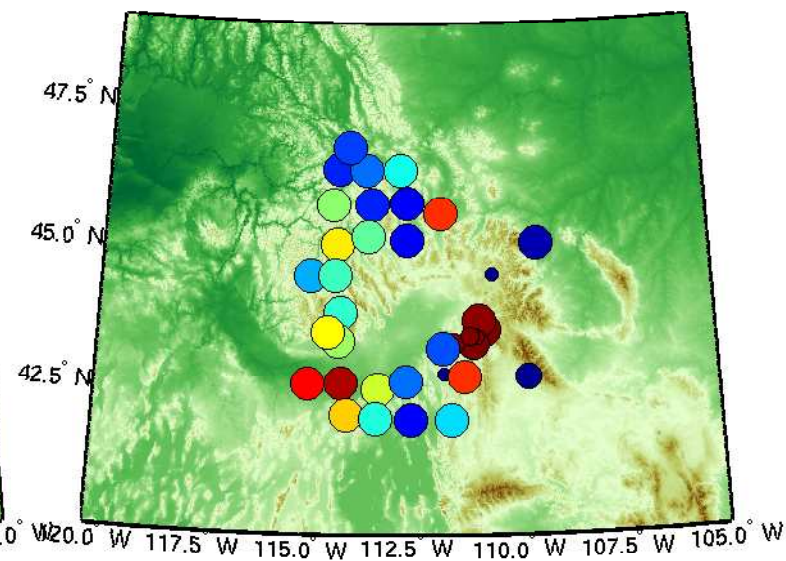
Baz = 251.8077  
Mean xcor value = 0.93378  
Range of  $t^*$  values is 2.6643  
Median  $t^*$  err is 0.13241  
Slope = -0.60561 +/- 0.16324



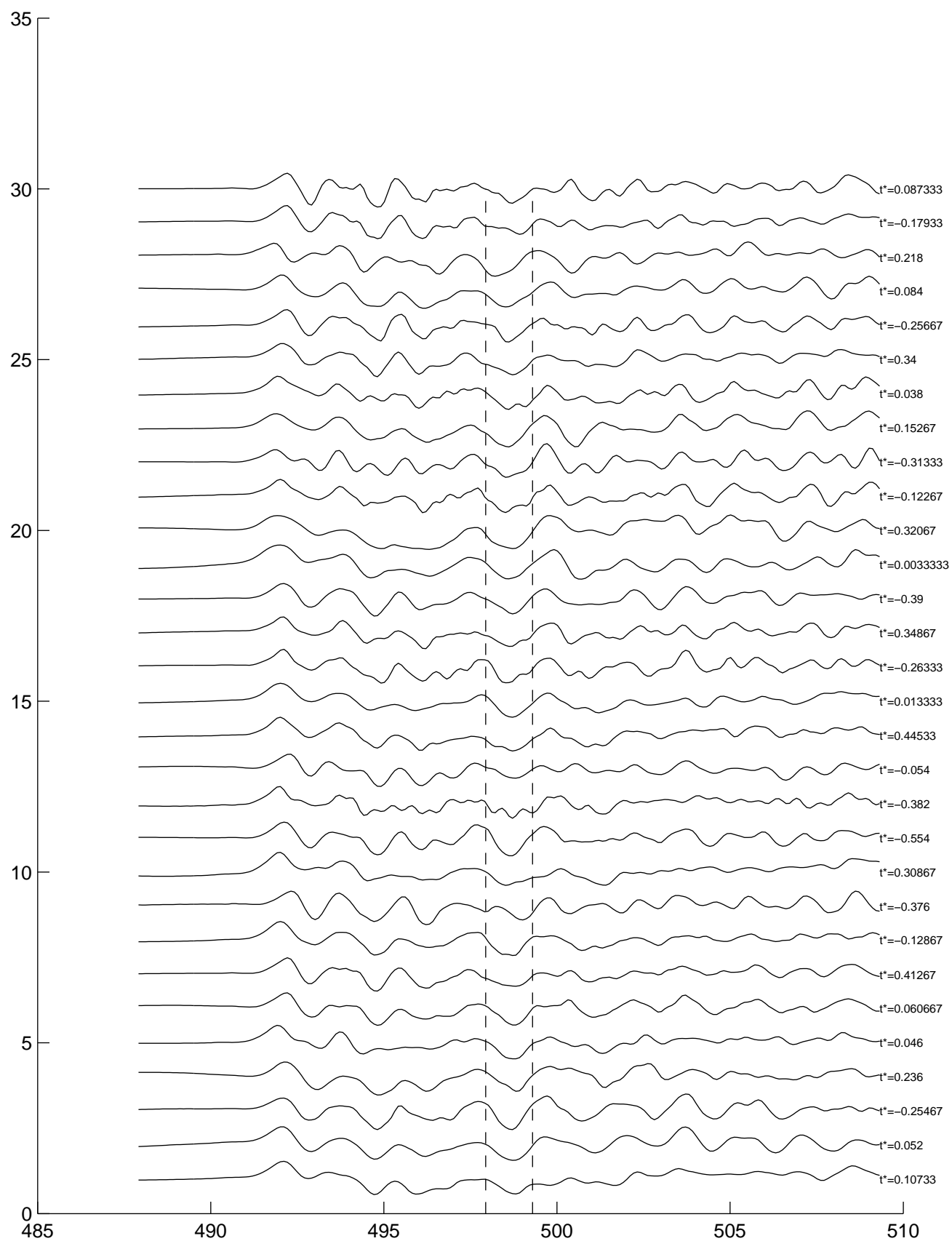
travel time residuals



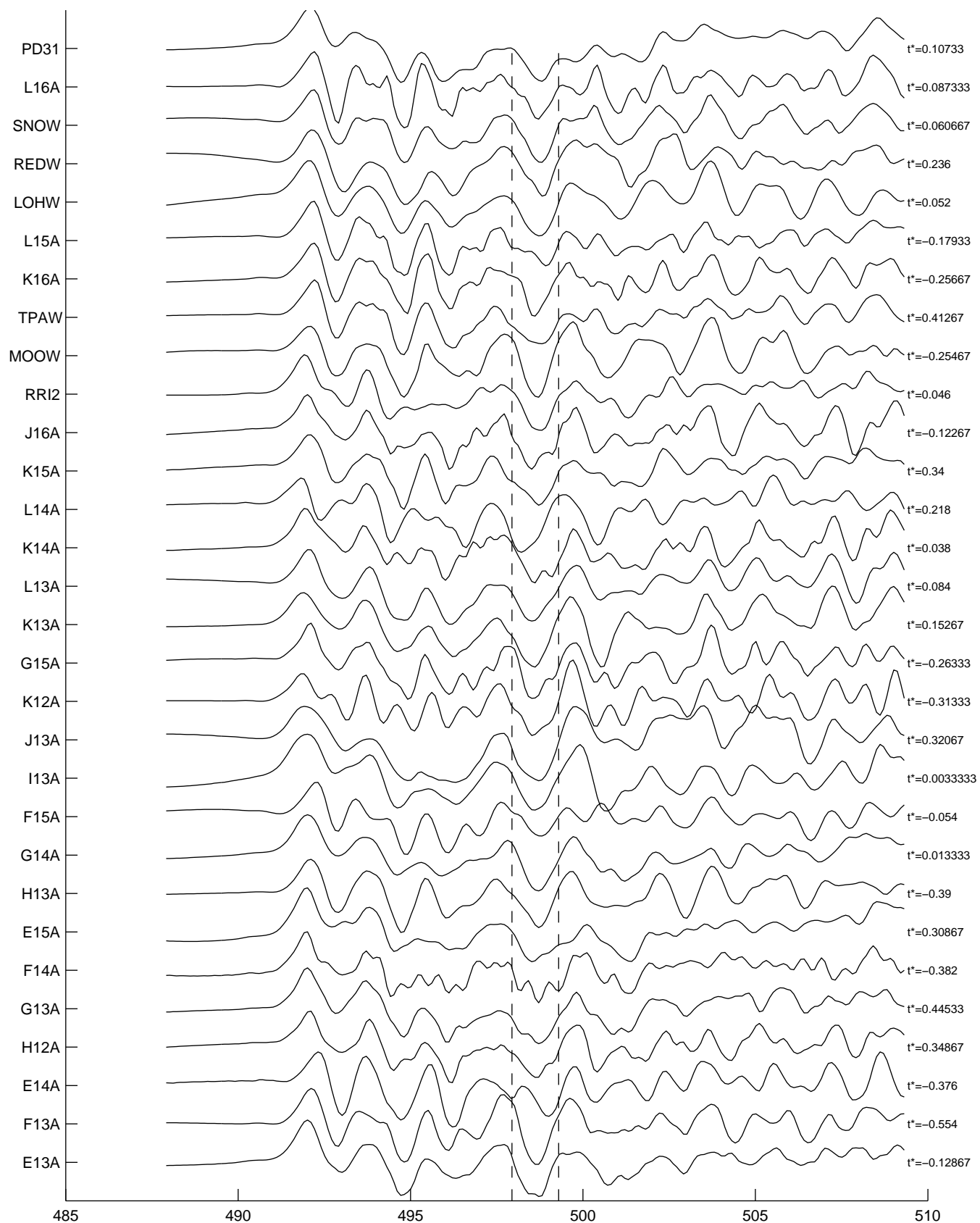
$t^*$  values



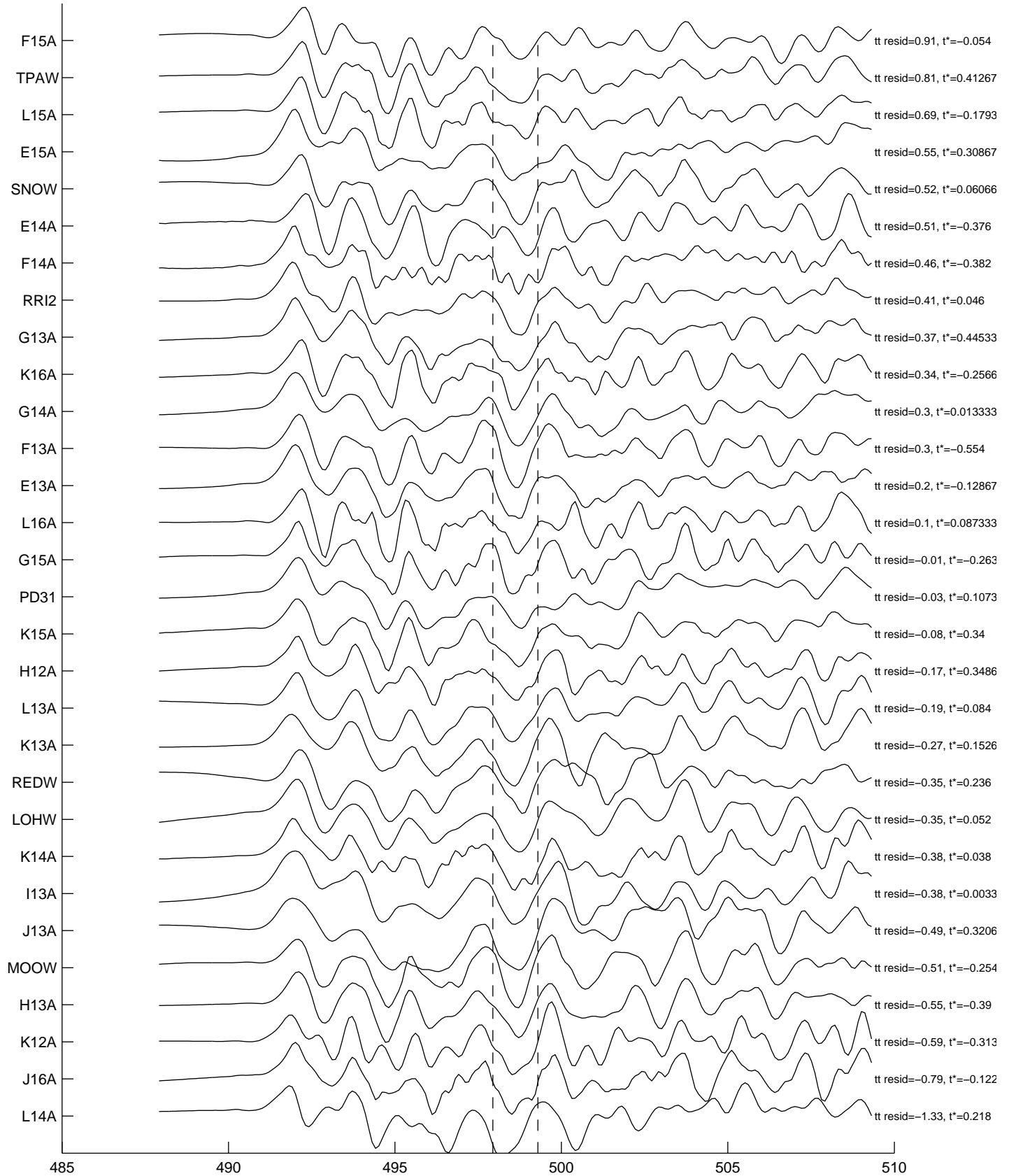
# Event\_2007\_214\_03\_21\_42



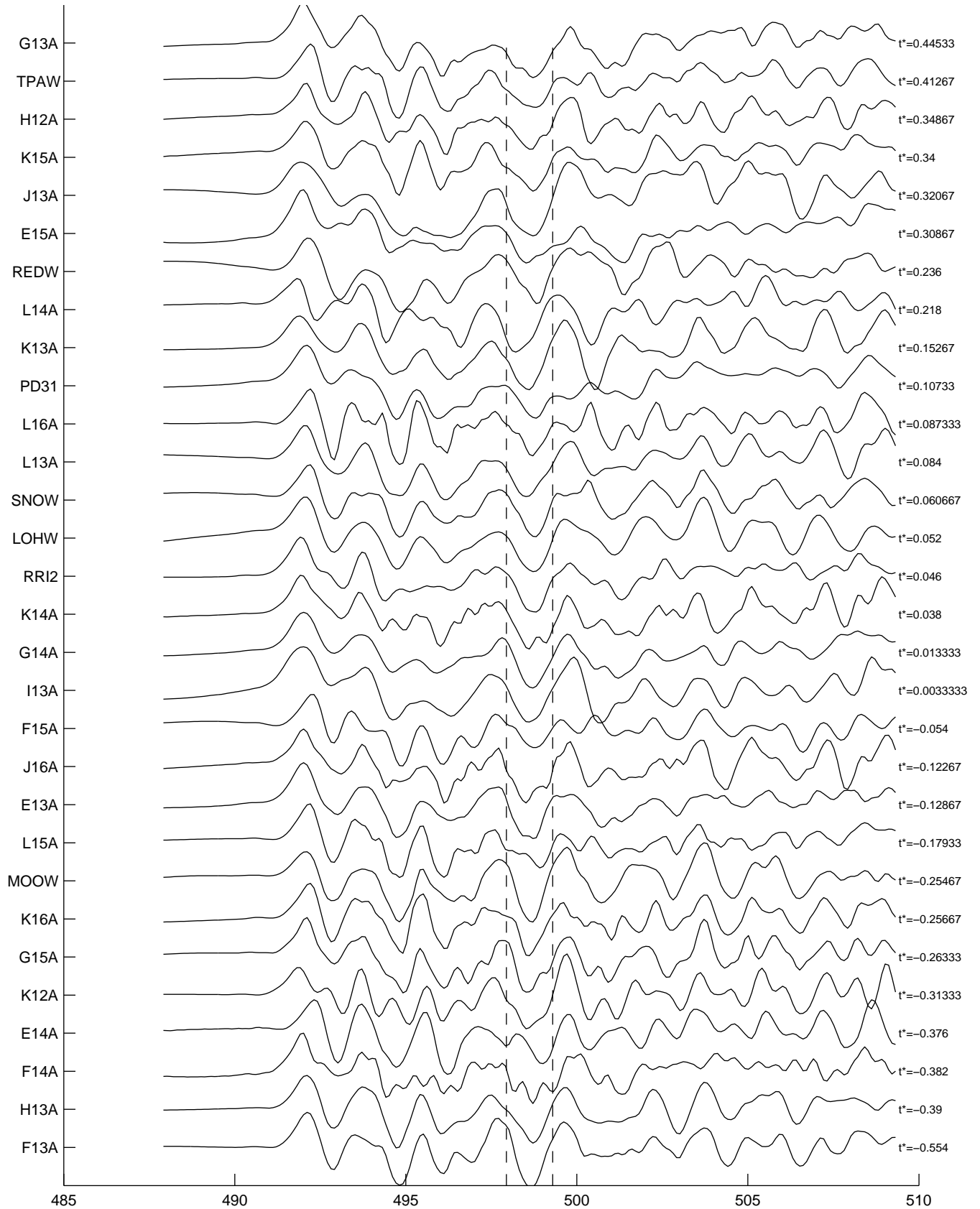
# Sorted by Delta:Event\_2007\_214\_03\_21\_42



# Sorted by travel time:Event\_2007\_214\_03\_21\_42

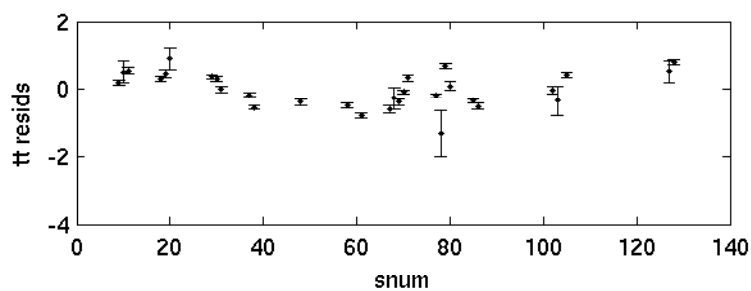
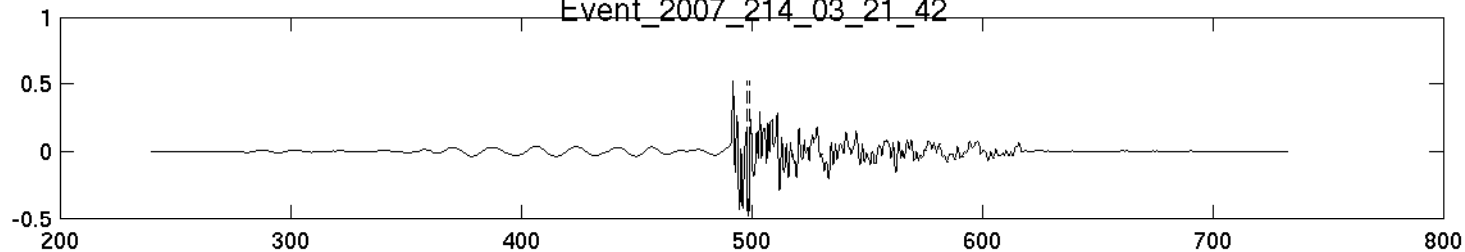


Sorted by  $t^*$ :Event\_2007\_214\_03\_21\_42

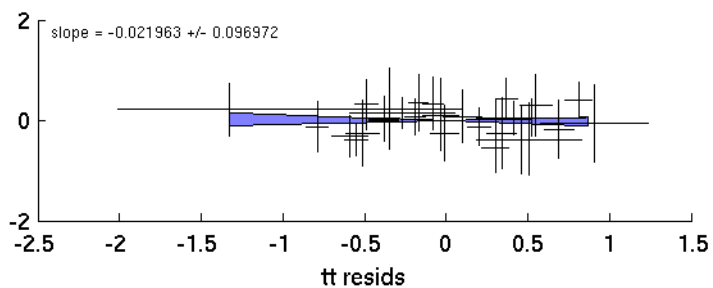
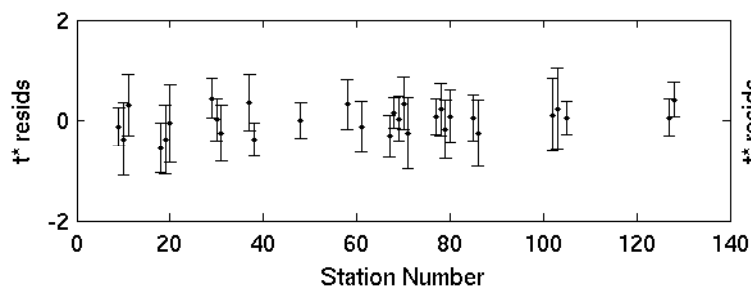


# Event\_2007\_214\_03\_21\_42

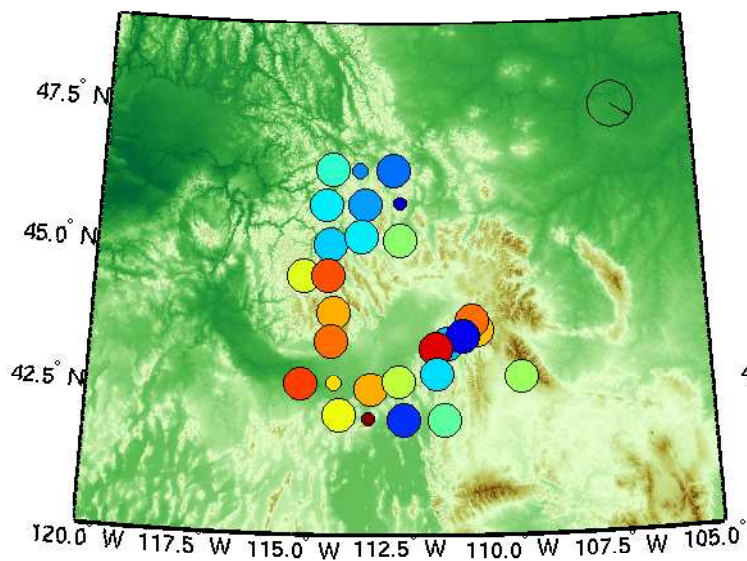
Stack



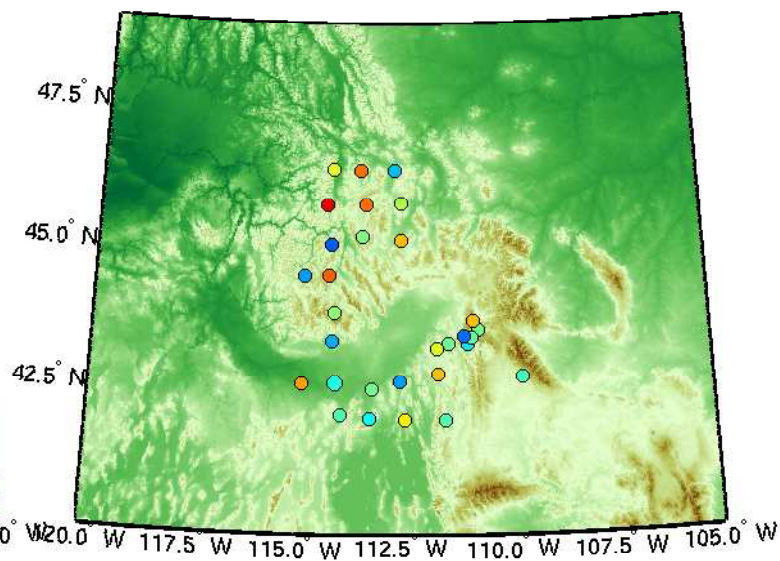
Baz = 304.3411  
Mean xcor value = 0.672  
Range of  $t^*$  values is 0.99933  
Median  $t^*$  err is 0.50372  
Slope =  $-0.021963 \pm 0.096972$



travel time residuals

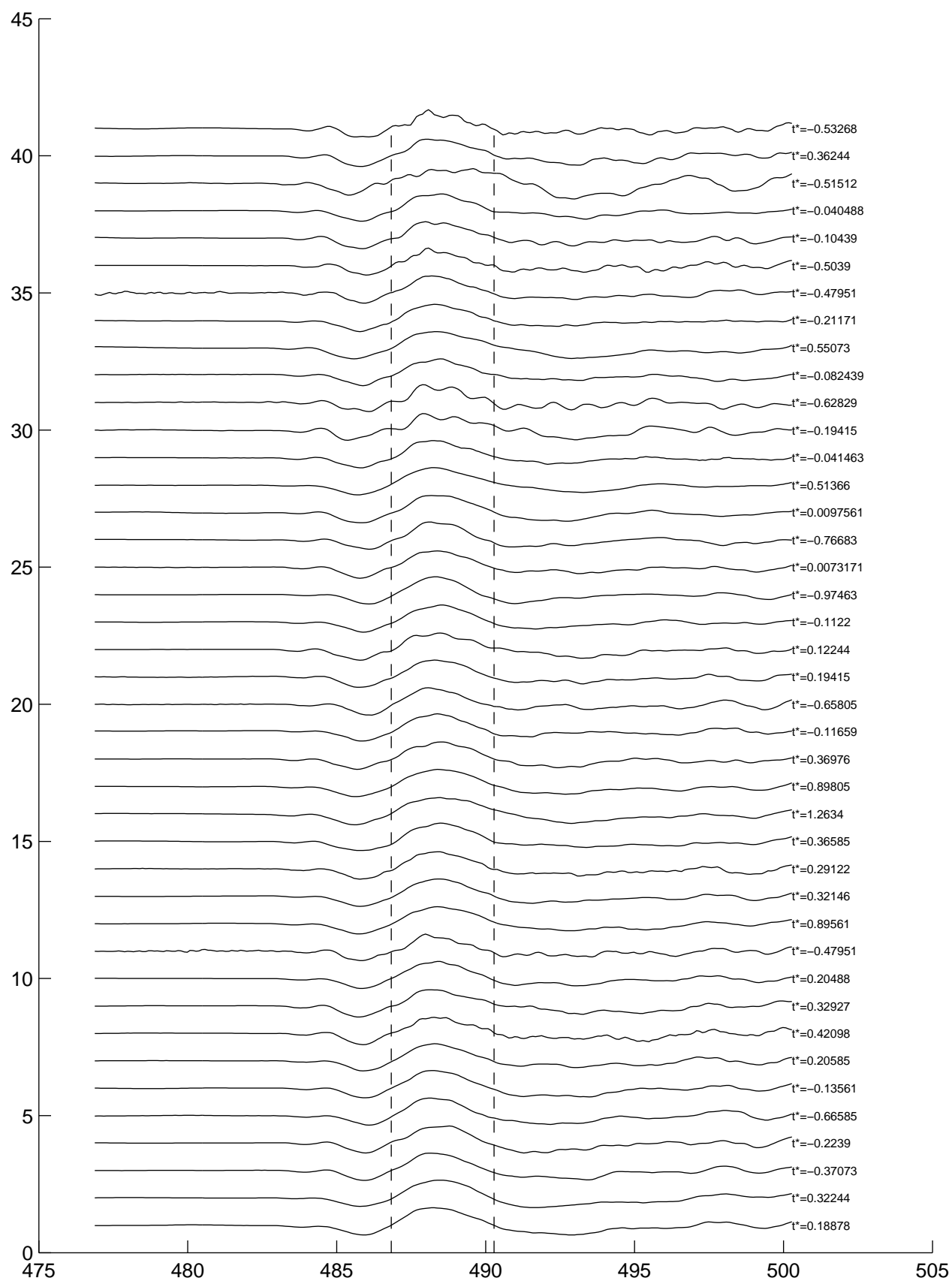


$t^*$  values

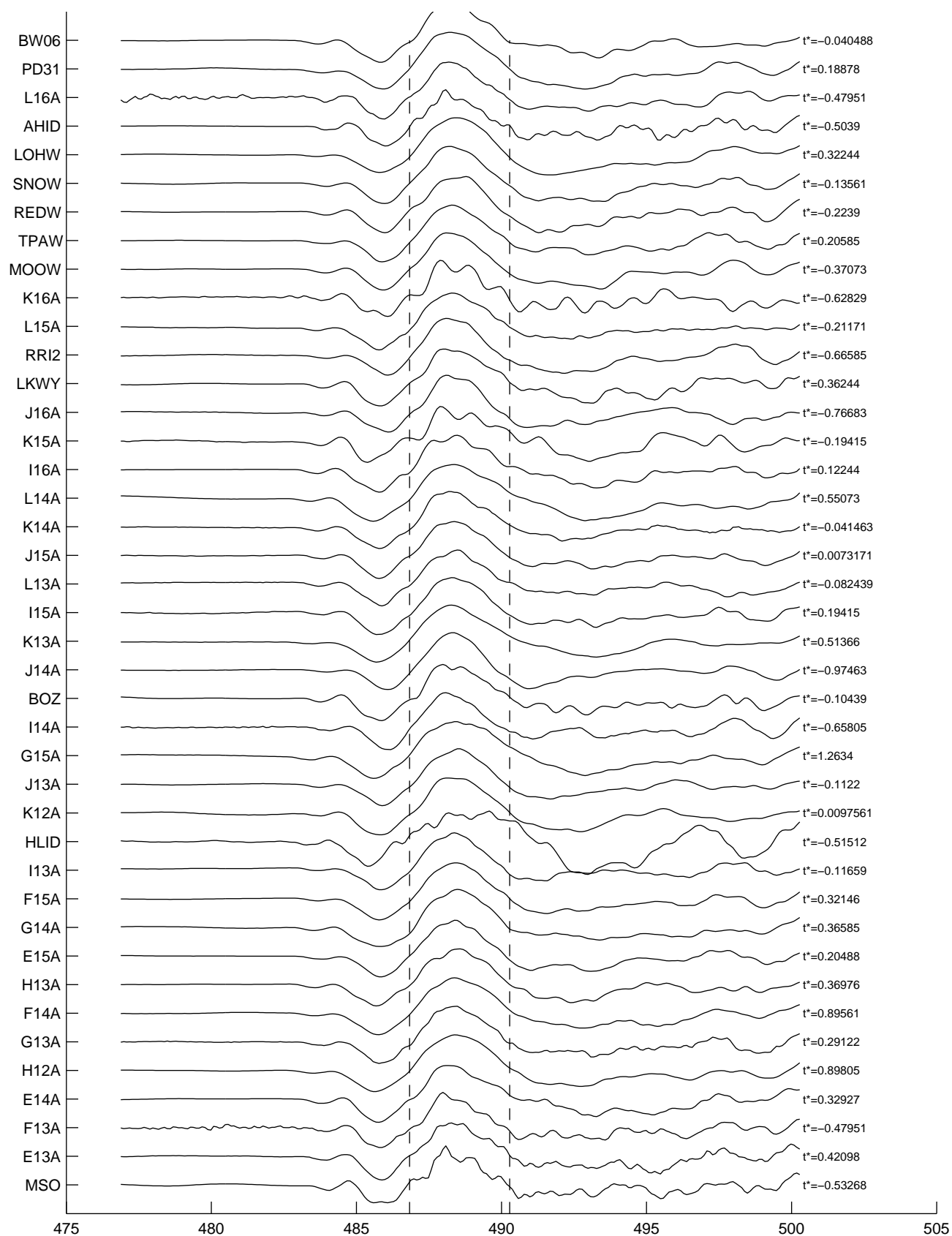




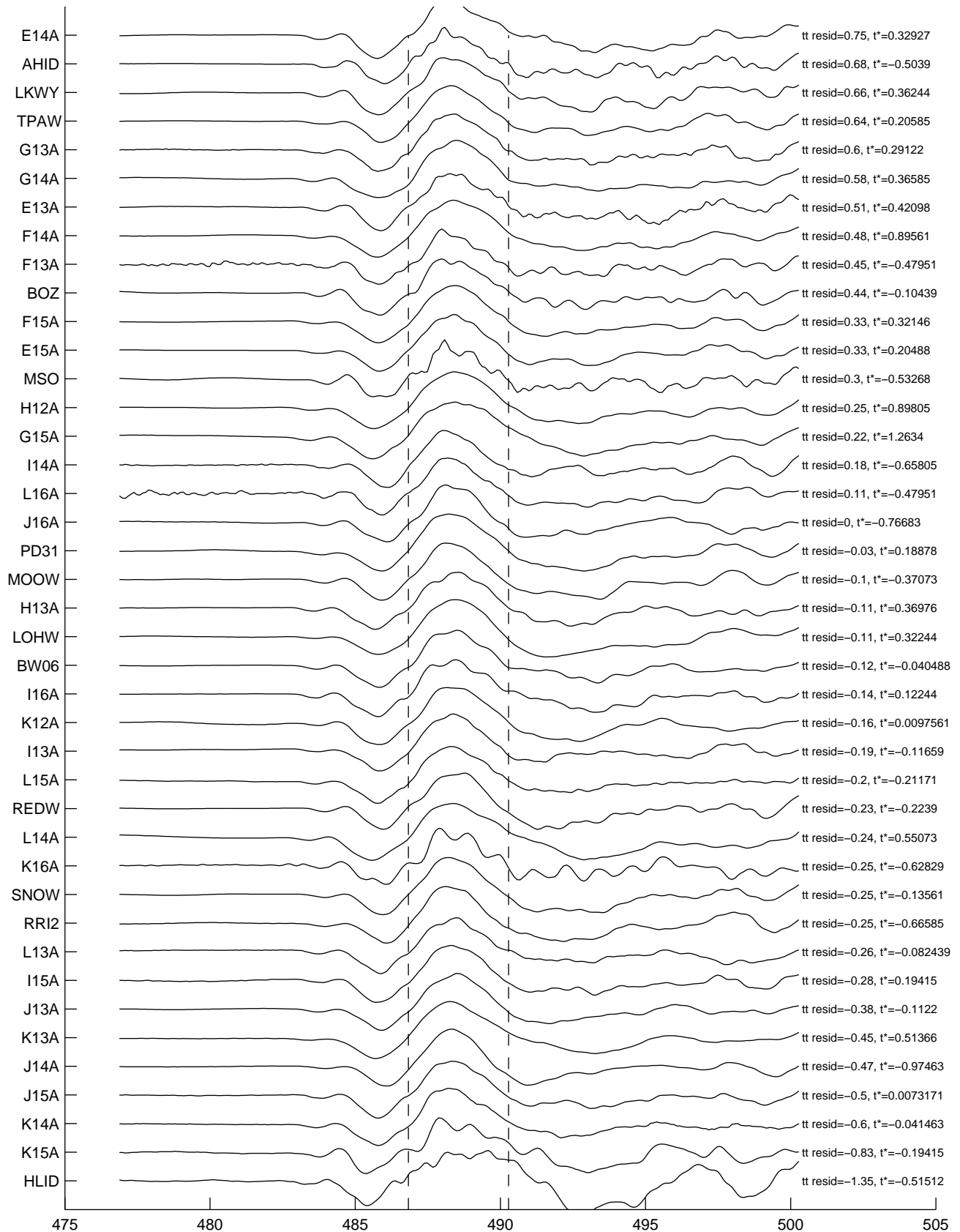
# Event\_2007\_227\_20\_22\_11



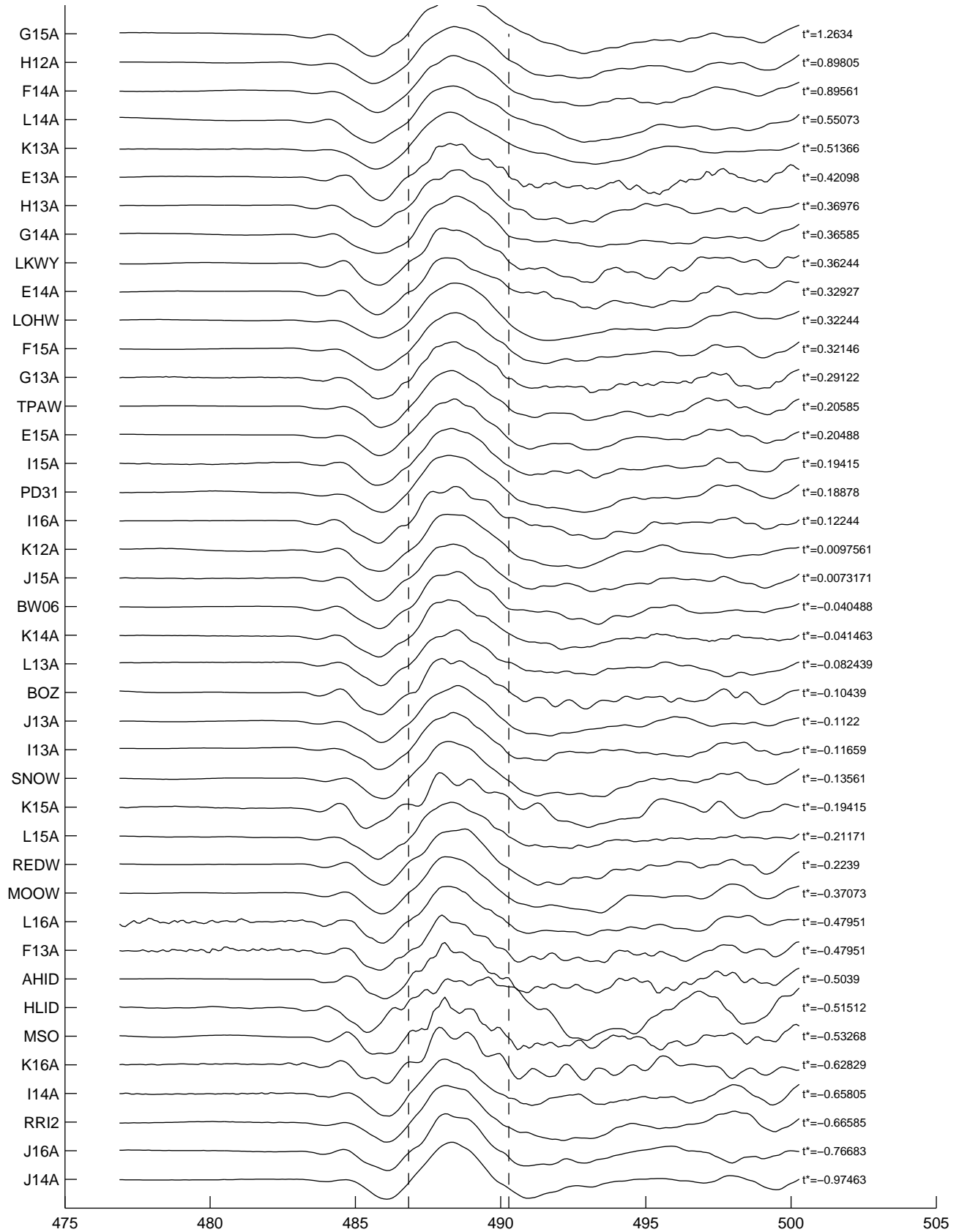
# Sorted by Delta:Event\_2007\_227\_20\_22\_11



# Sorted by travel time: Event\_2007\_227\_20\_22\_11

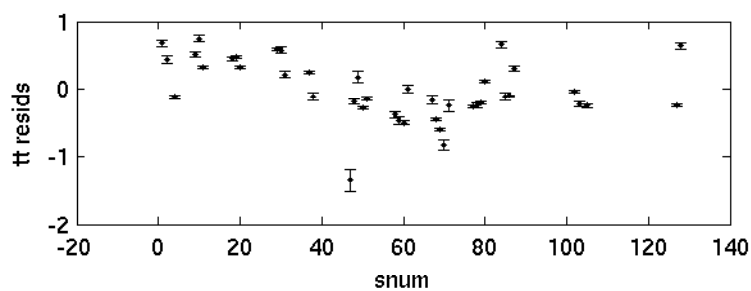
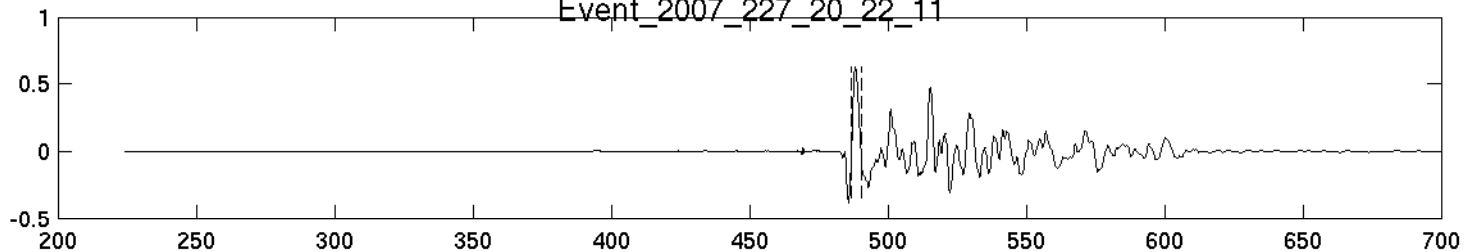


# Sorted by $t^*$ :Event\_2007\_227\_20\_22\_11

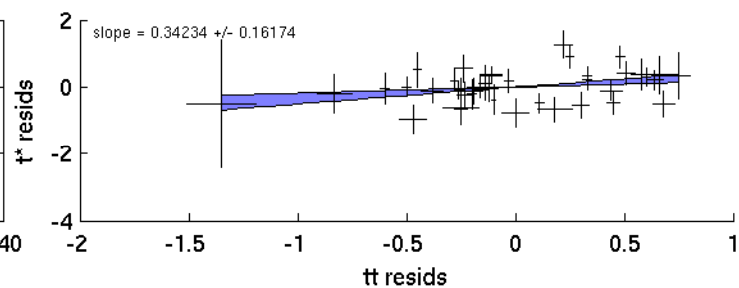
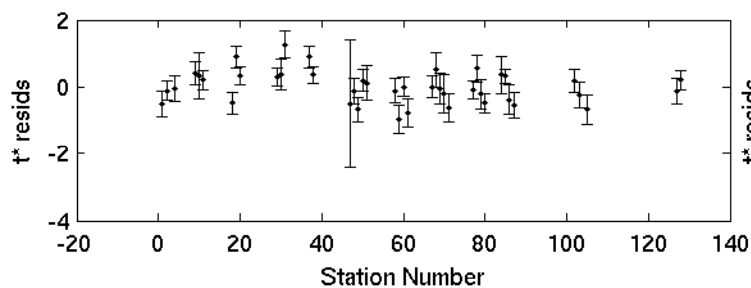


Event\_2007\_227\_20\_22\_11

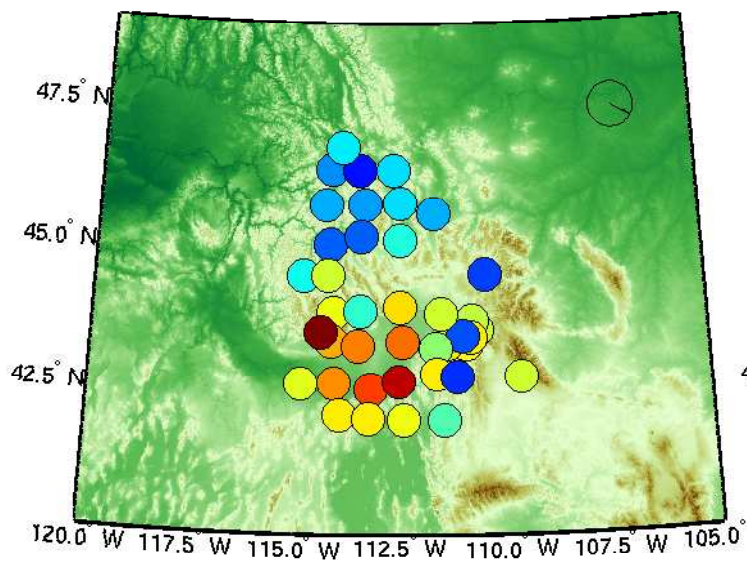
Stack



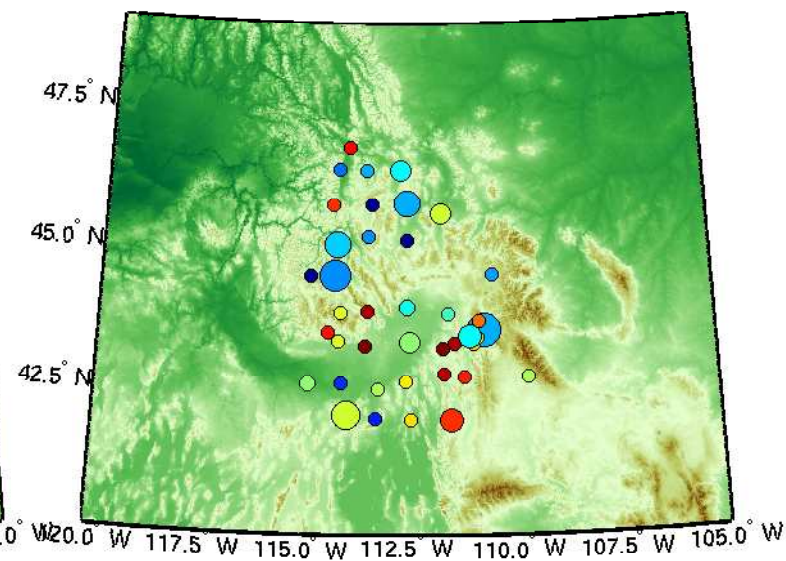
Baz = 302.332  
Mean xcor value = 0.89463  
Range of  $t^*$  values is 2.238  
Median  $t^*$  err is 0.37766  
Slope = 0.34234 +/- 0.16174



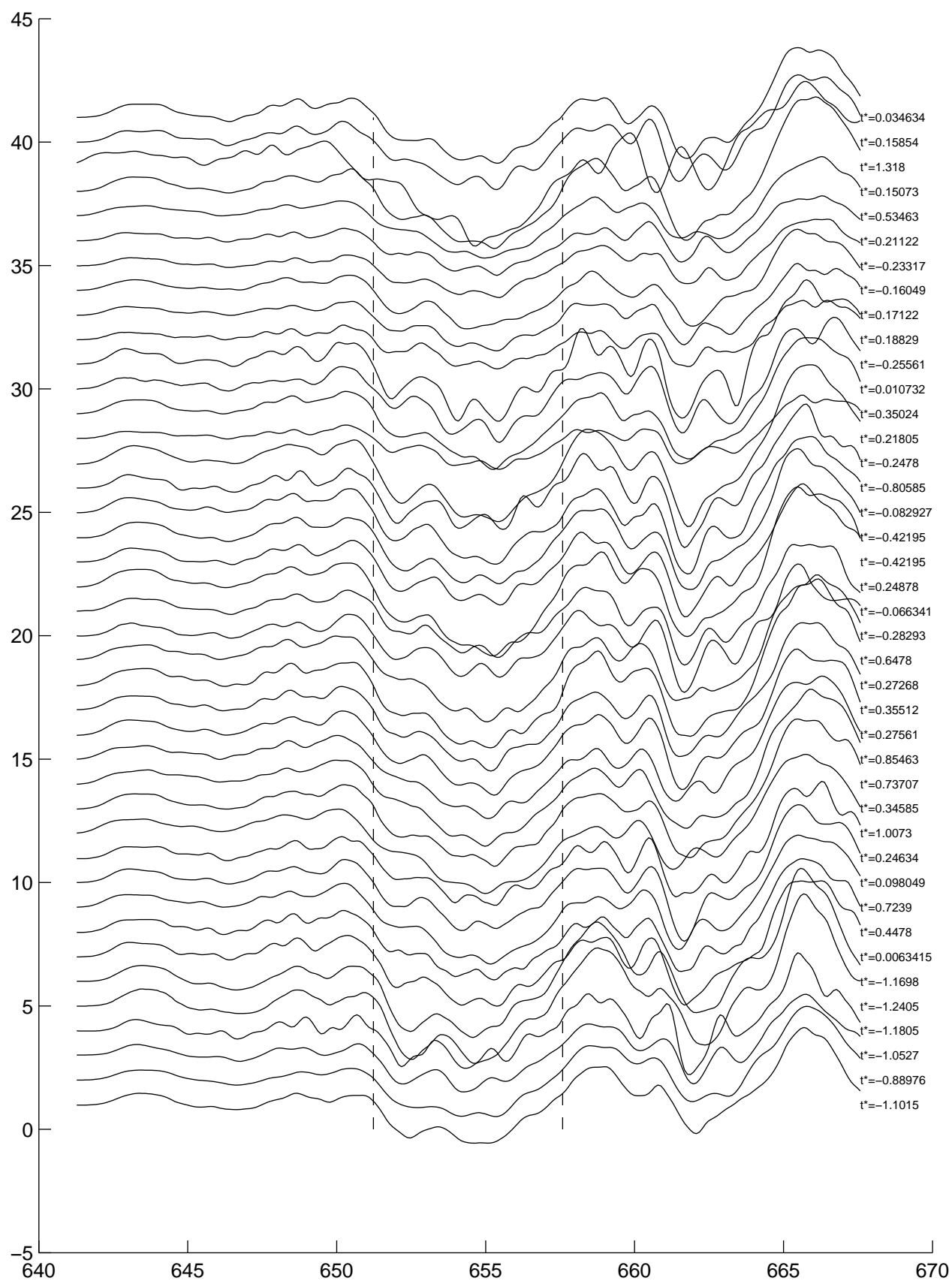
travel time residuals



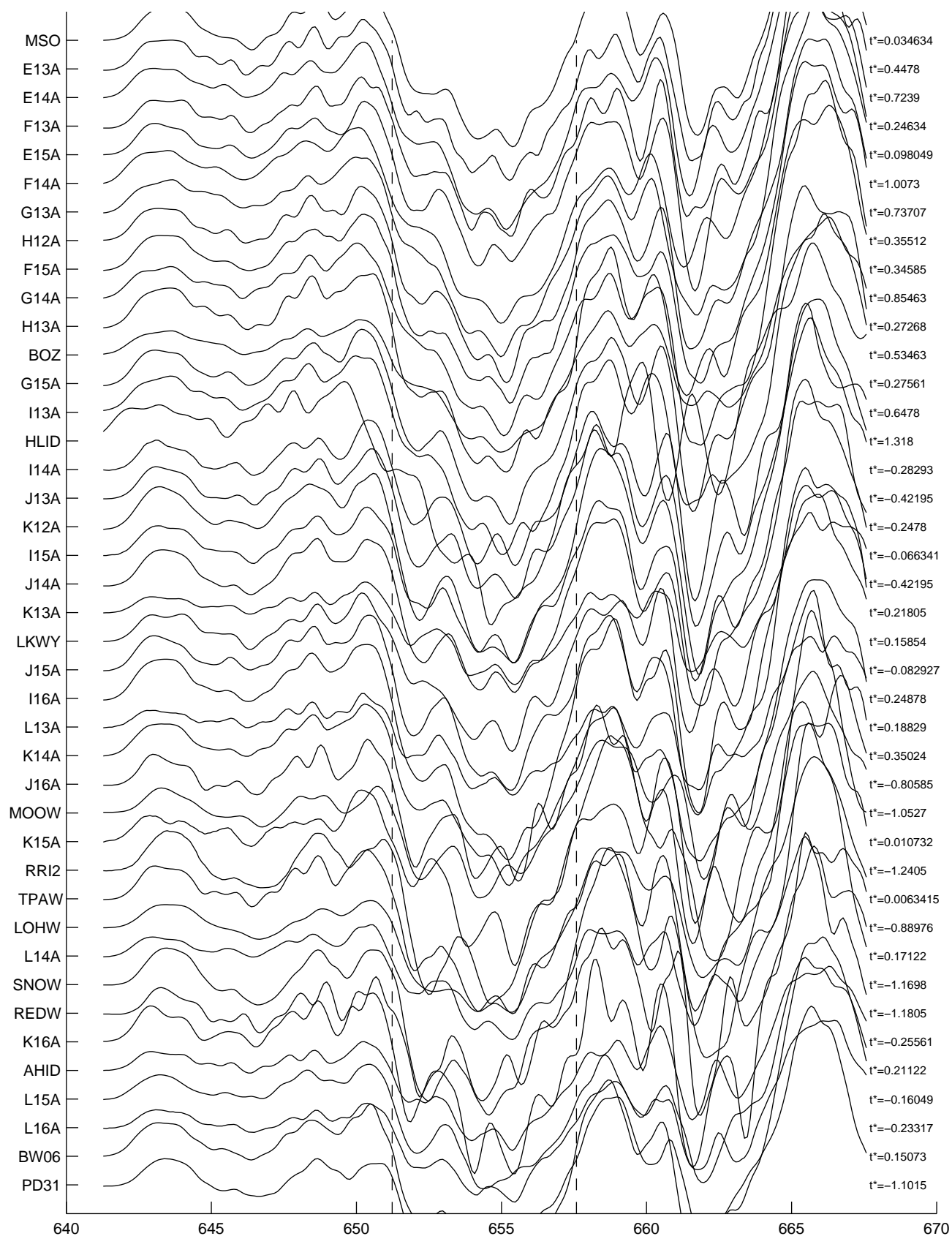
$t^*$  values



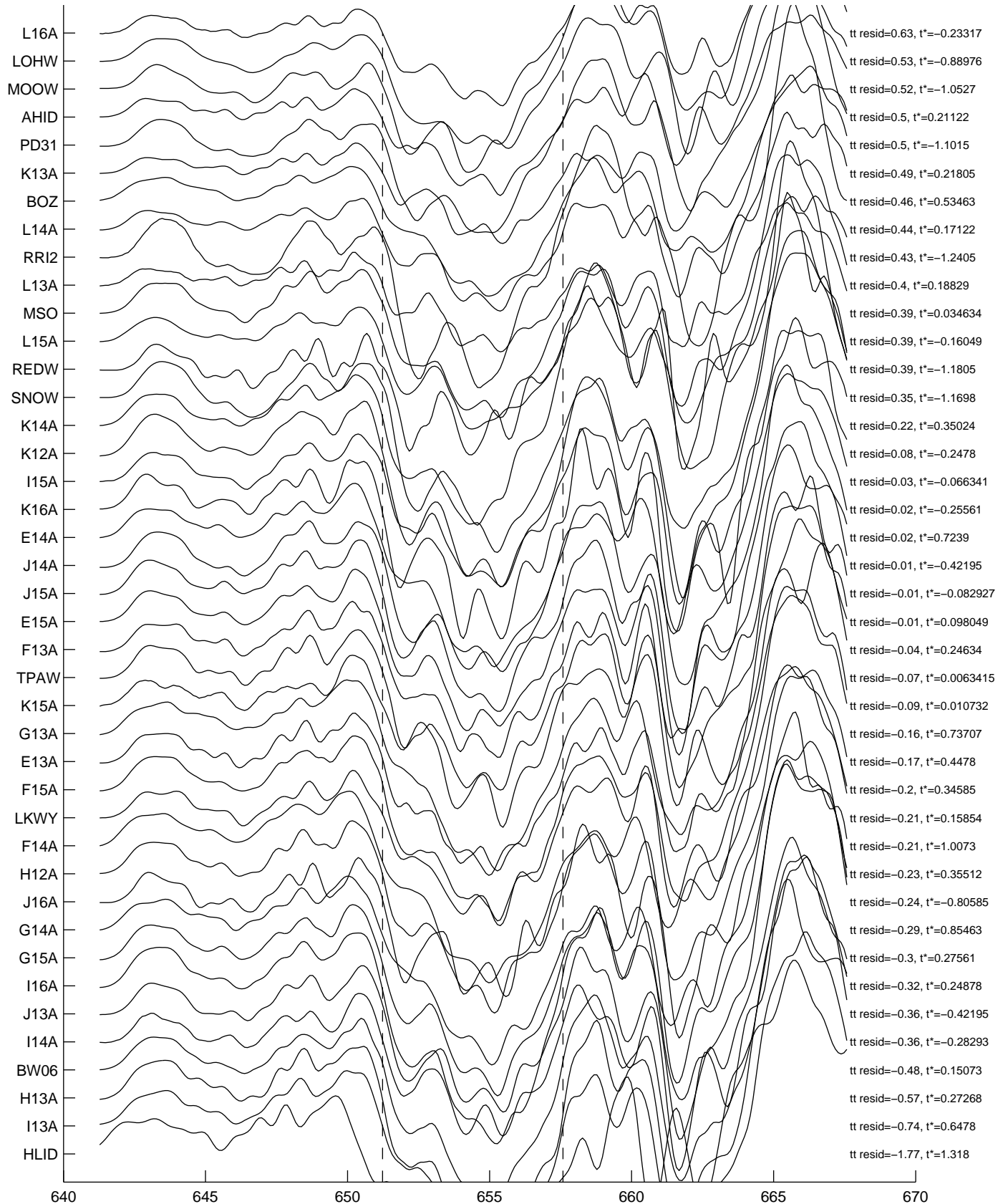
# Event\_2007\_227\_23\_40\_57



# Sorted by Delta:Event\_2007\_227\_23\_40\_57

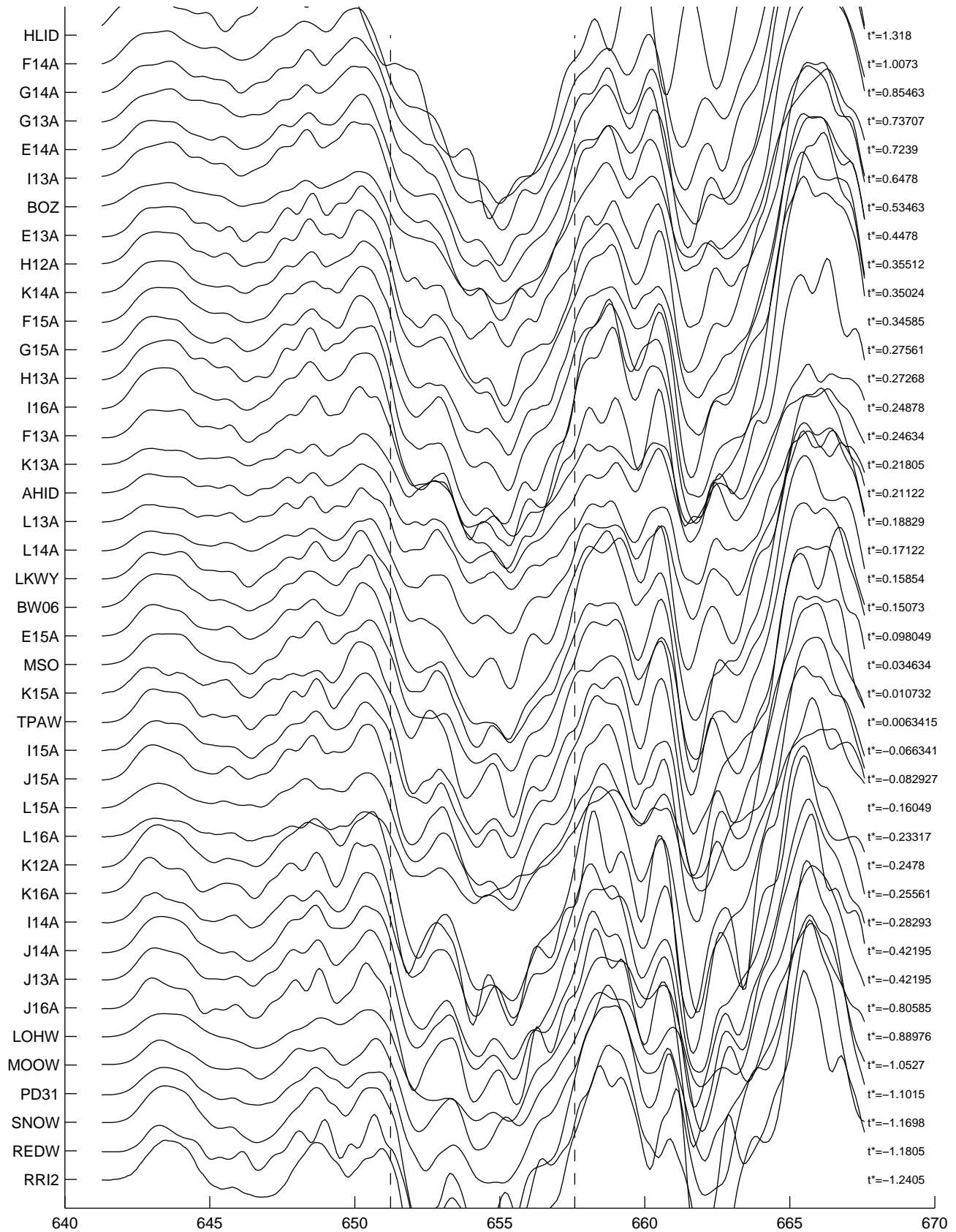


# Sorted by travel time: Event\_2007\_227\_23\_40\_57



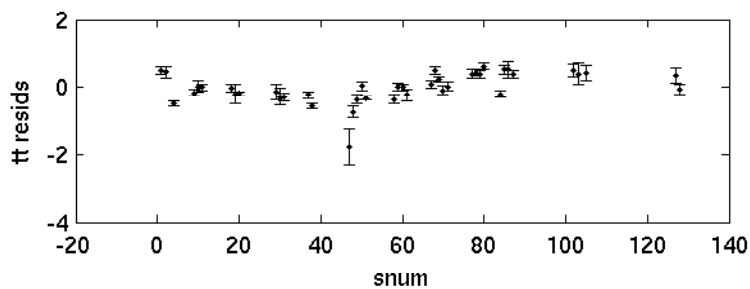
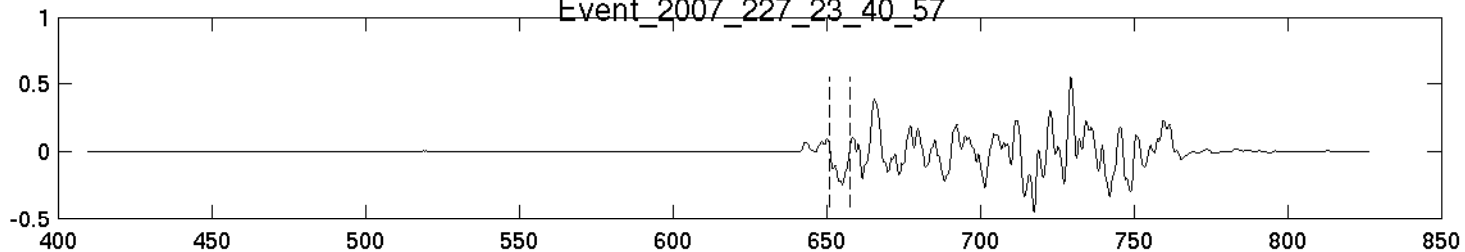


Sorted by  $t^*$ :Event\_2007\_227\_23\_40\_57

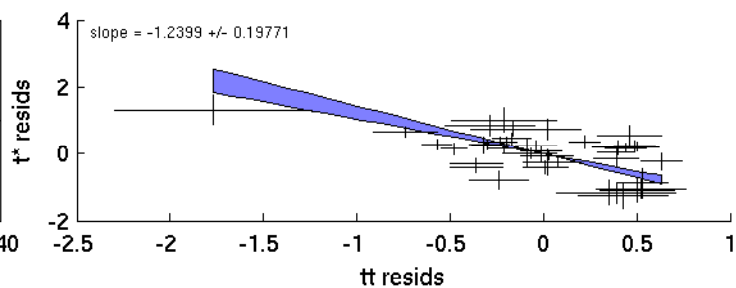
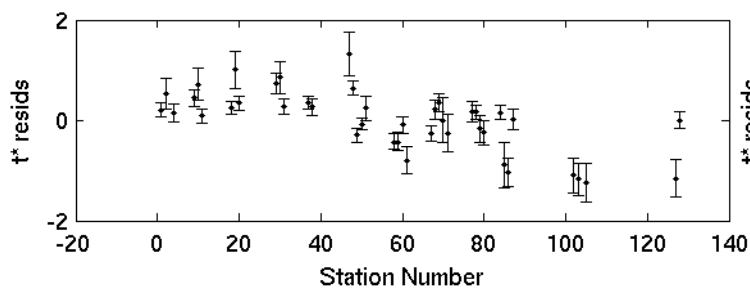


# Event\_2007\_227\_23\_40\_57

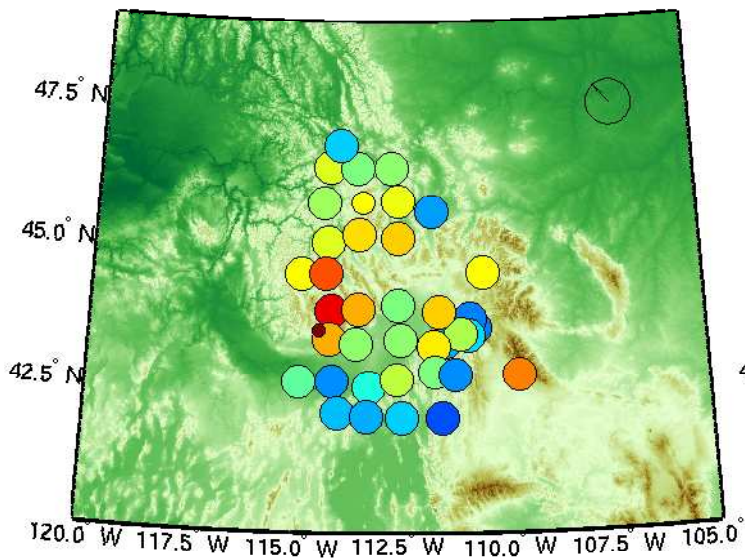
Stack



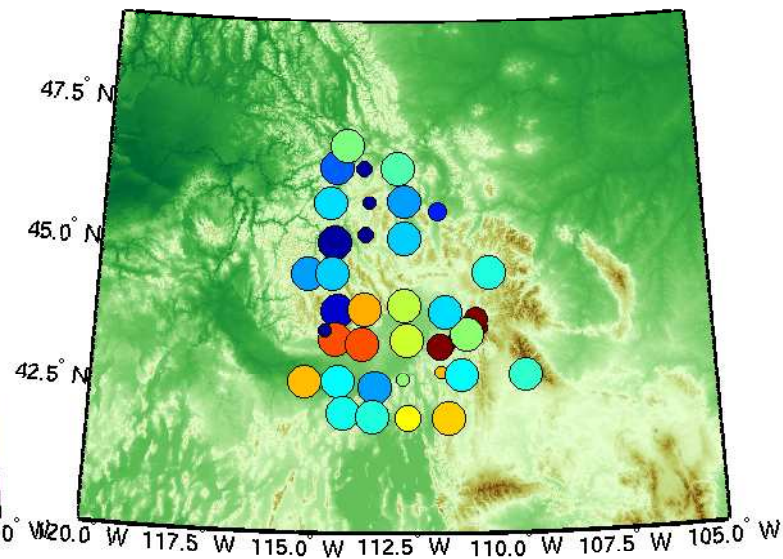
Baz = 141.3604  
Mean xcor value = 0.90561  
Range of  $t^*$  values is 2.5585  
Median  $t^*$  err is 0.1985  
Slope =  $-1.2399 \pm 0.19771$



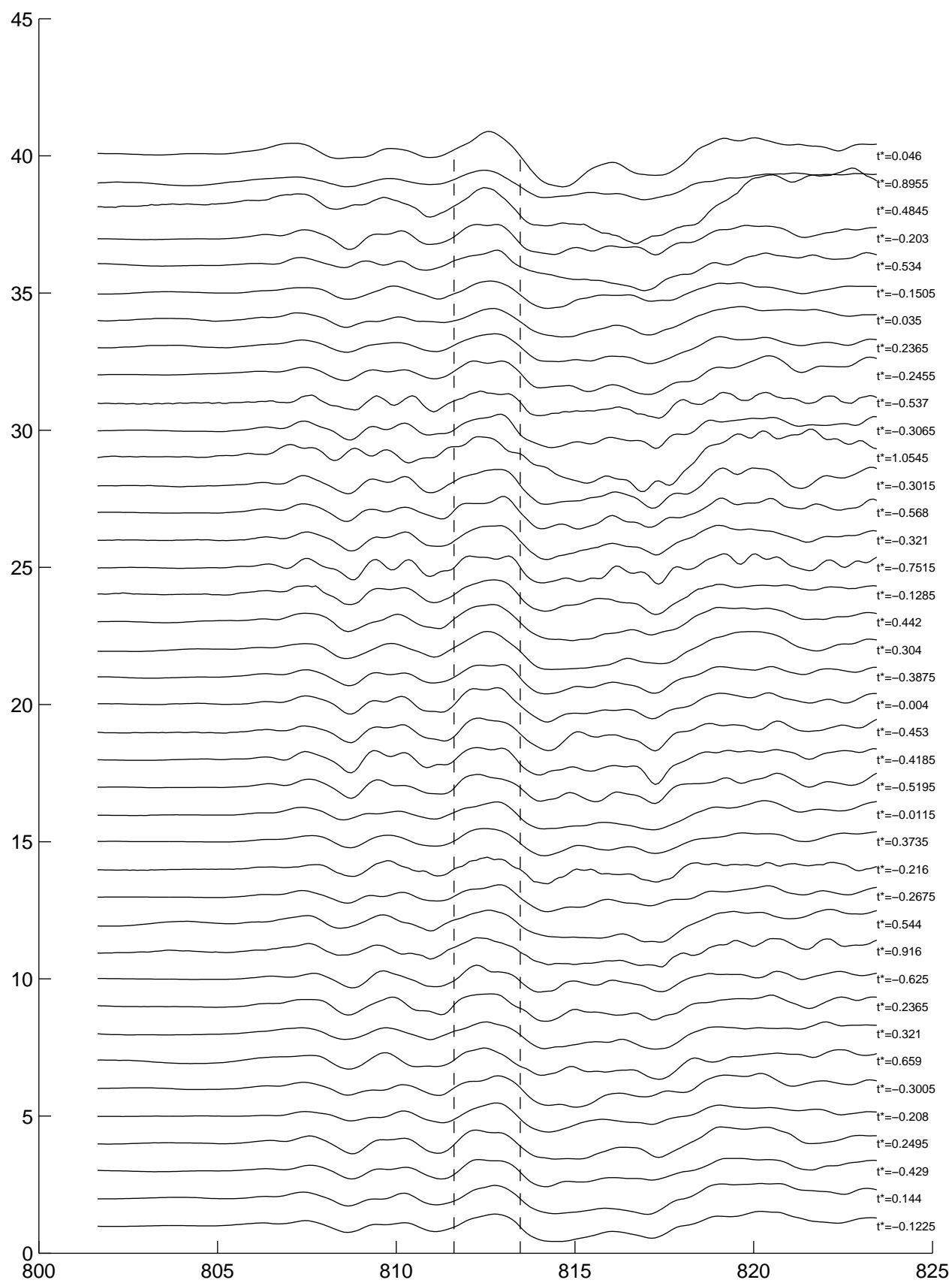
travel time residuals



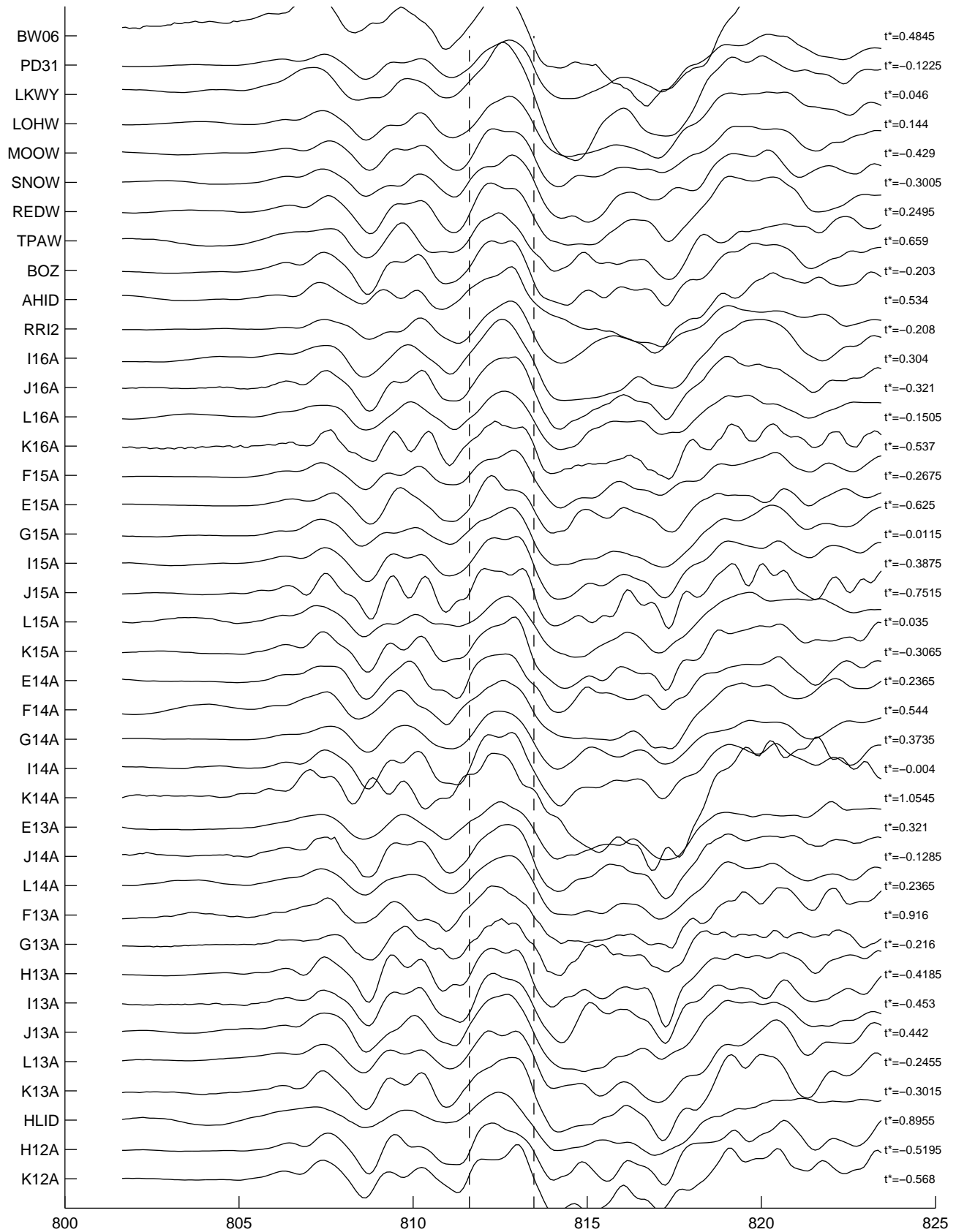
$t^*$  values



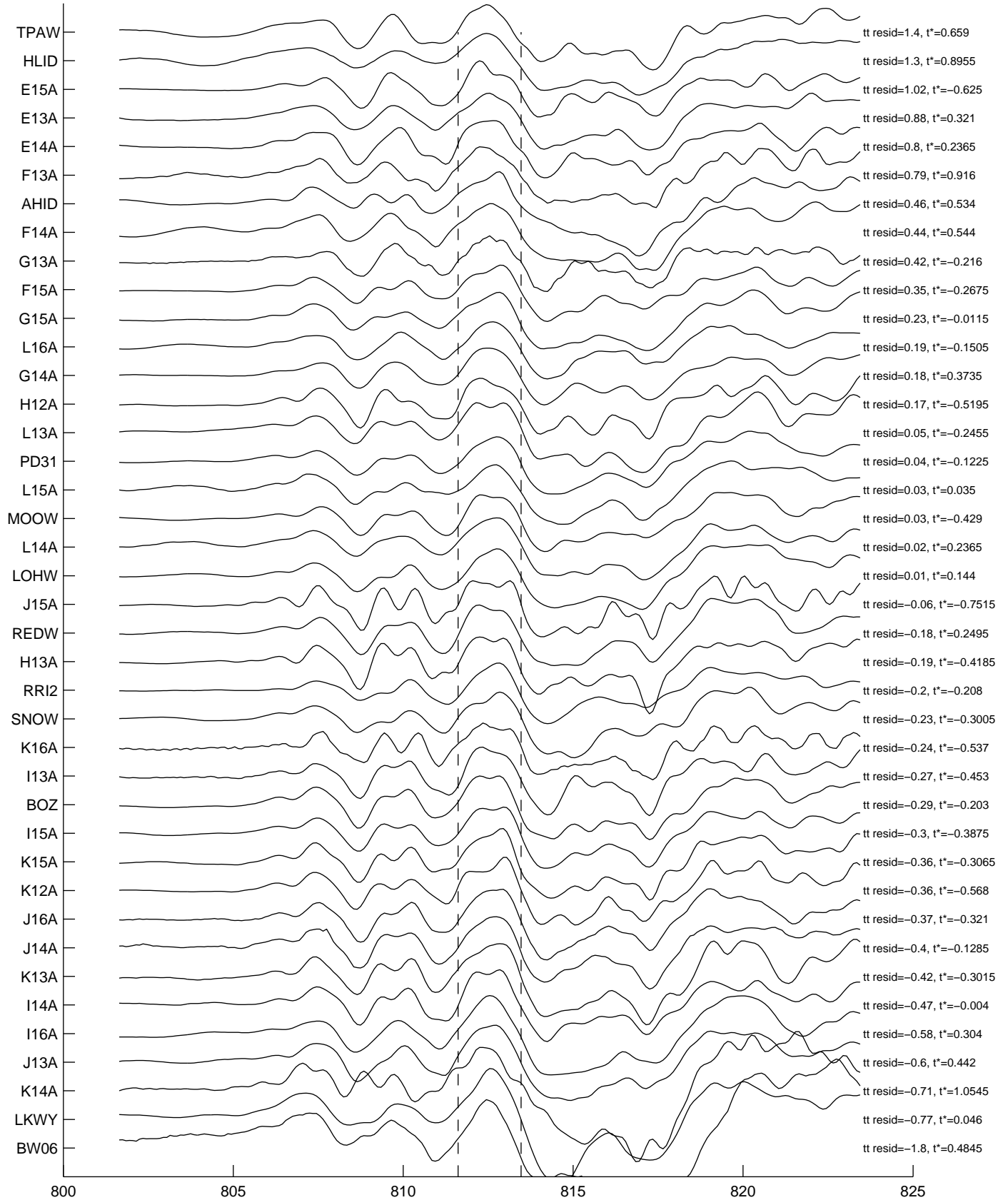
# Event\_2007\_228\_08\_39\_27



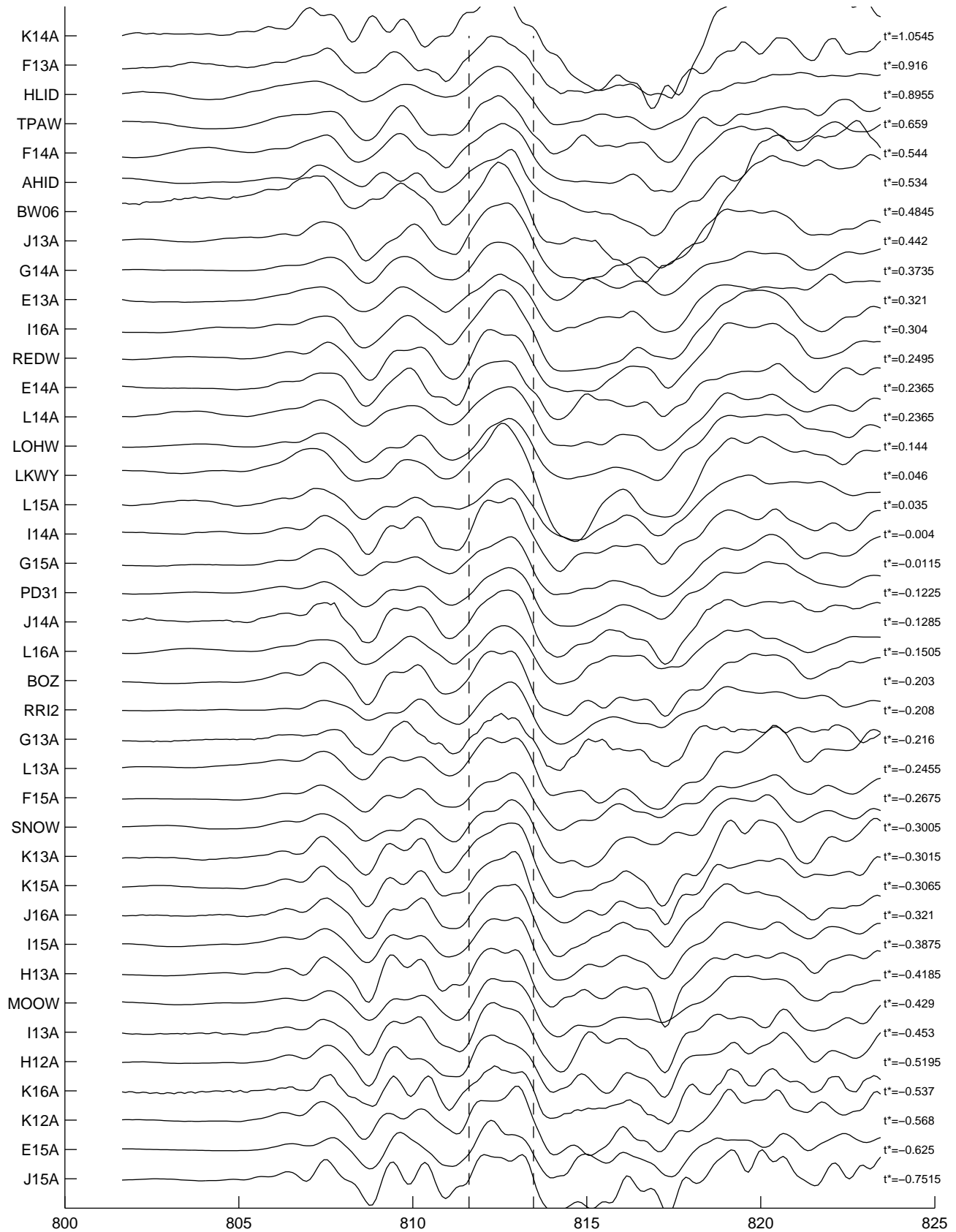
# Sorted by Delta:Event\_2007\_228\_08\_39\_27



# Sorted by travel time: Event\_2007\_228\_08\_39\_27

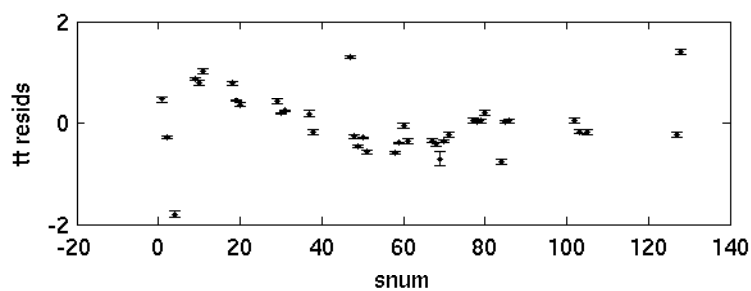
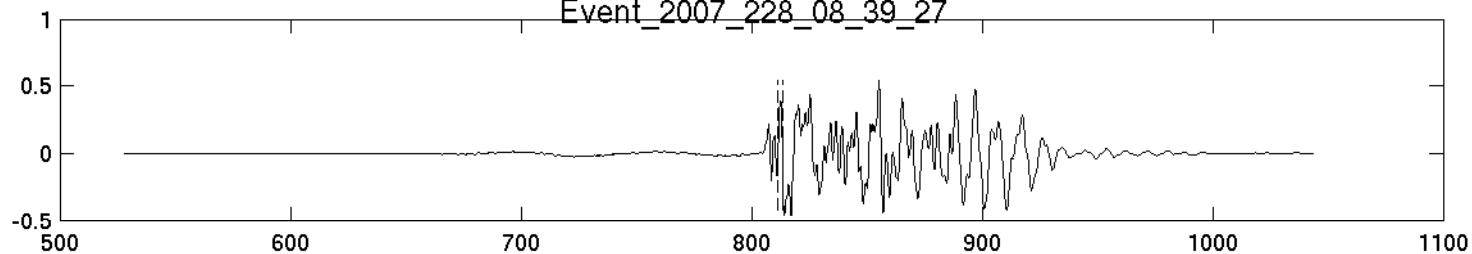


# Sorted by $t^*$ :Event\_2007\_228\_08\_39\_27

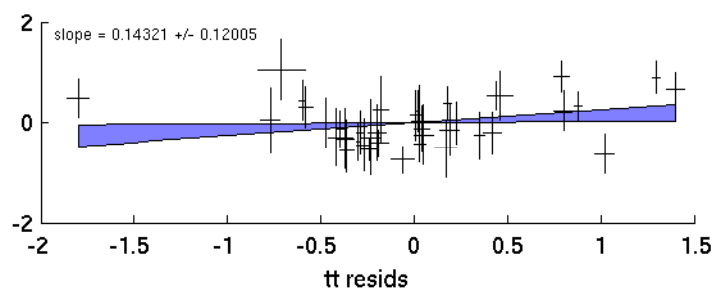
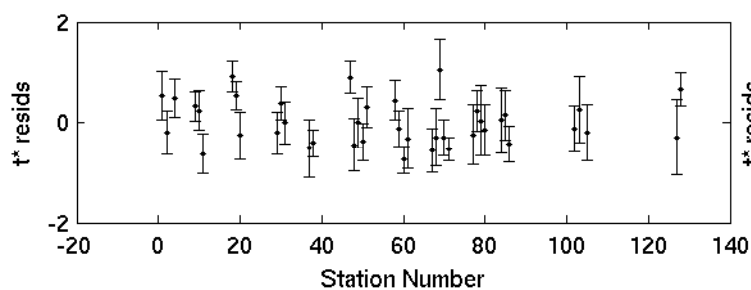


Event\_2007\_228\_08\_39\_27

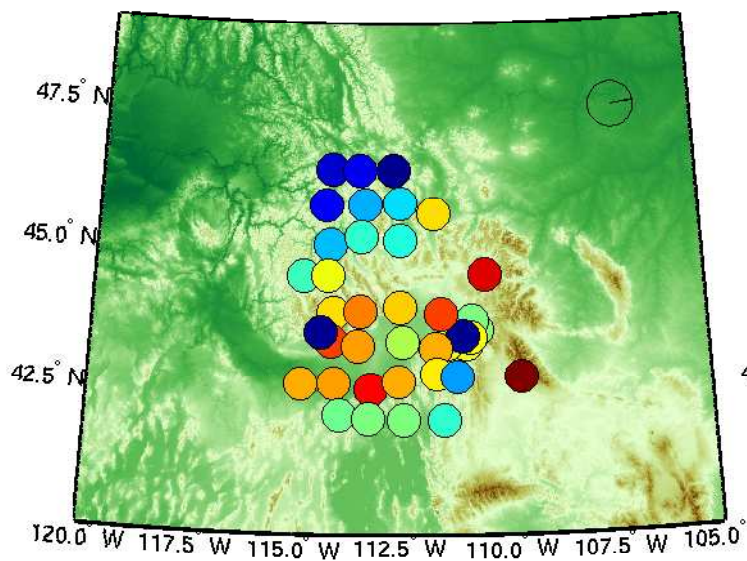
Stack



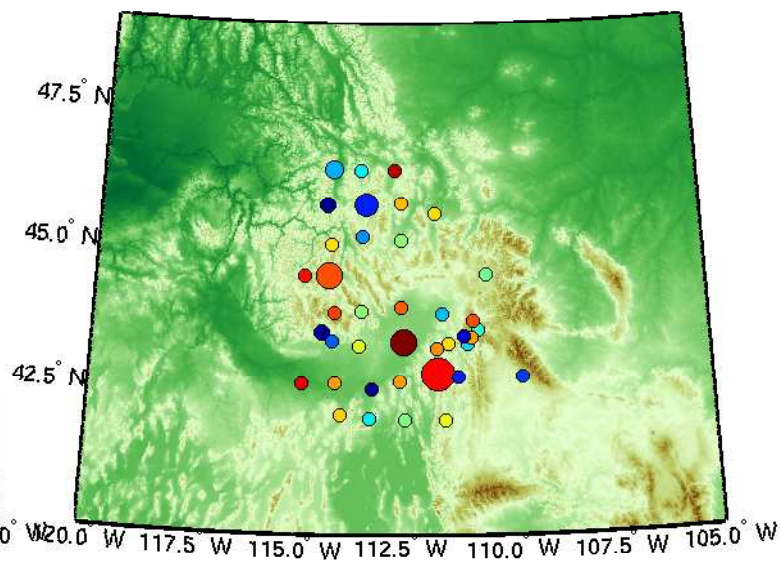
Baz = 261.5356  
Mean xcor value = 0.84925  
Range of  $t^*$  values is 1.806  
Median  $t^*$  err is 0.42868  
Slope = 0.14321 +/- 0.12005



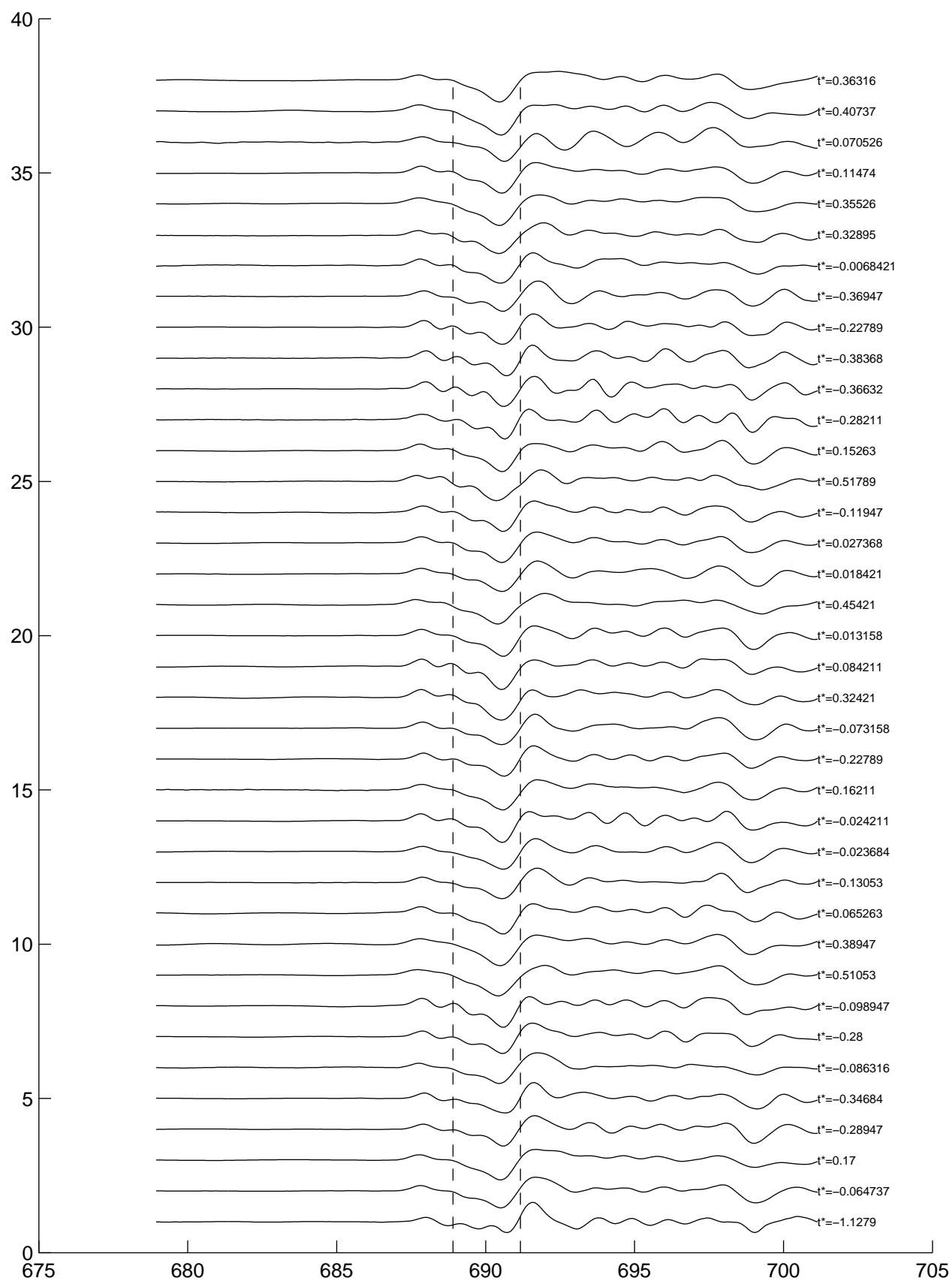
travel time residuals



$t^*$  values

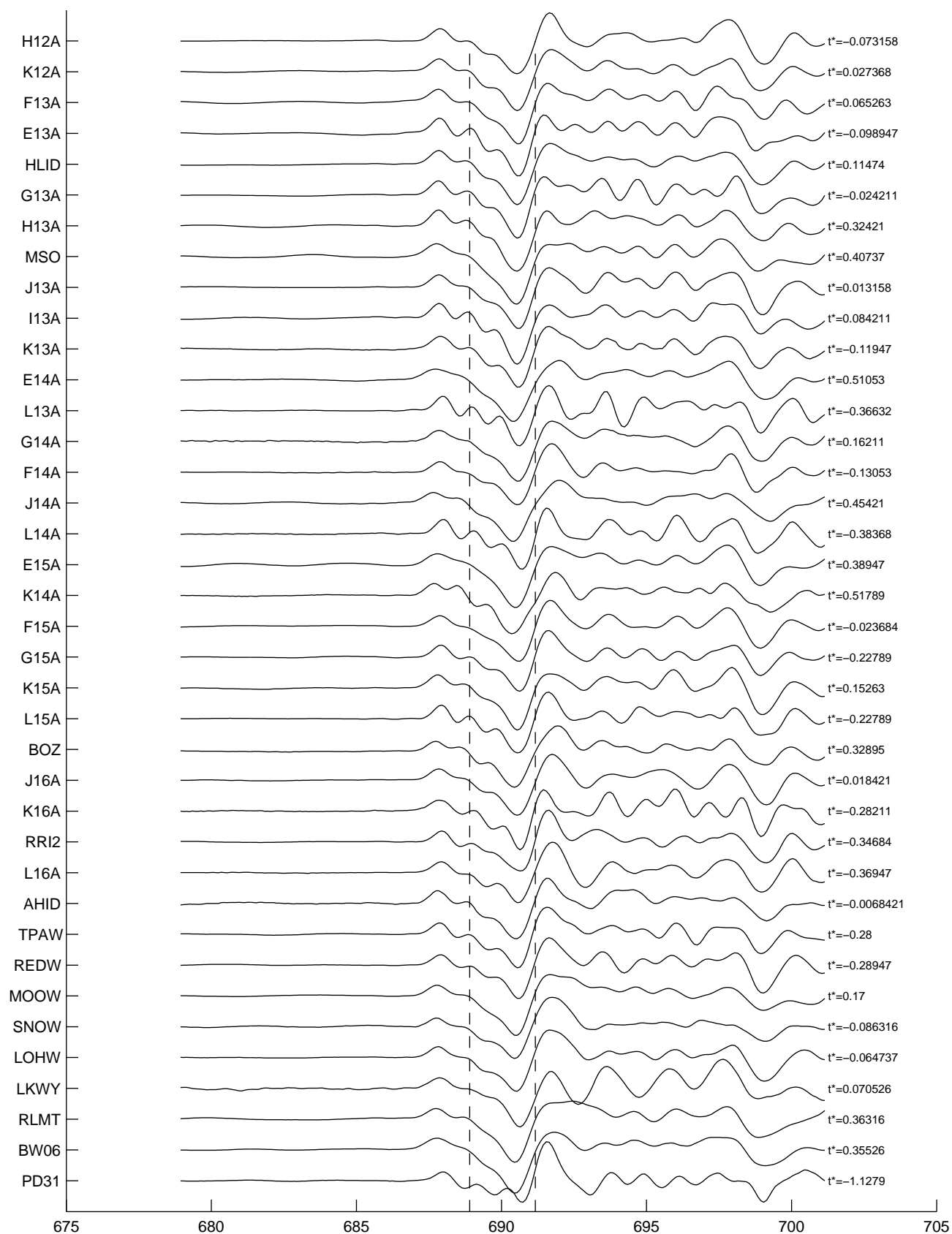


# Event\_2007\_232\_22\_42\_29

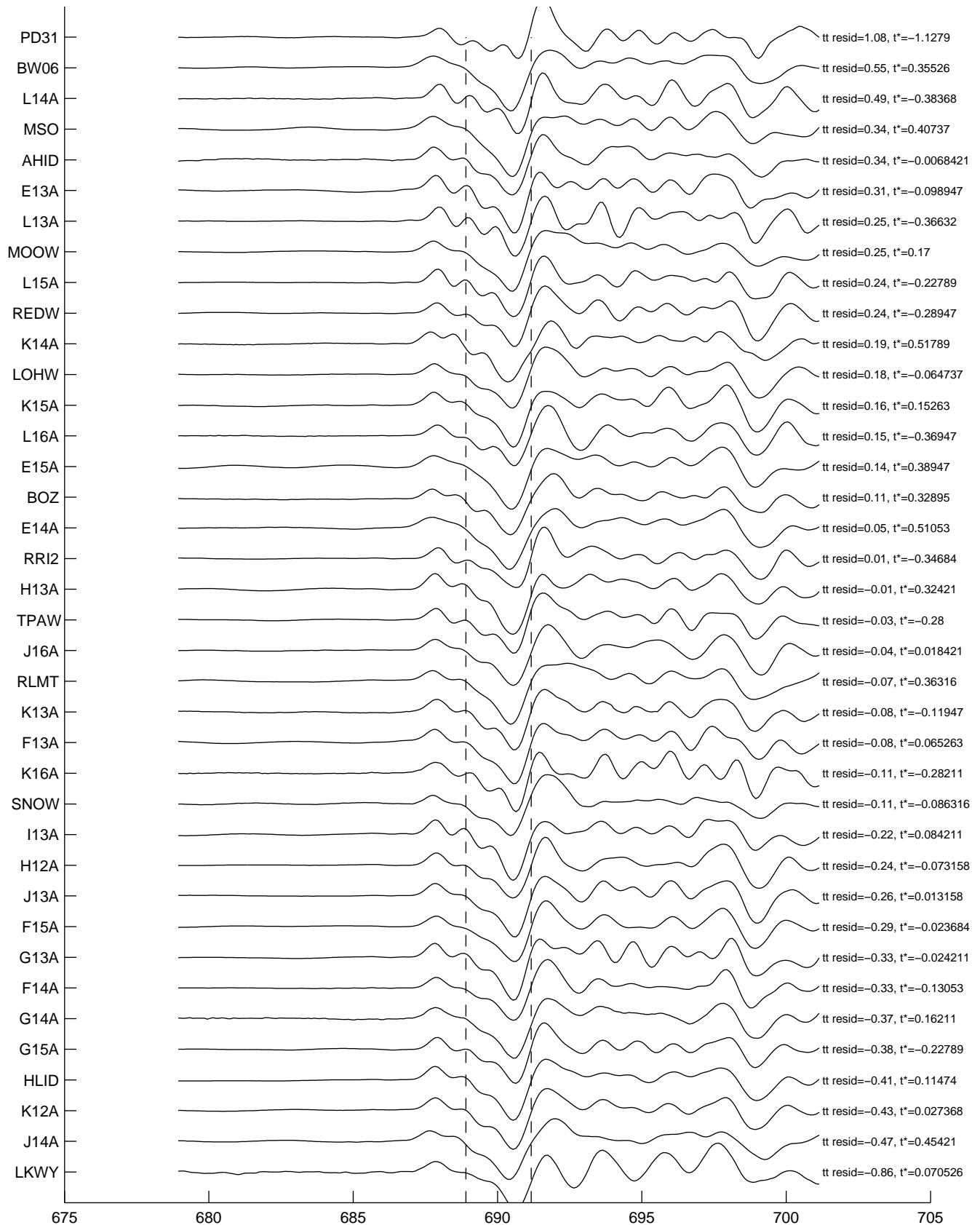




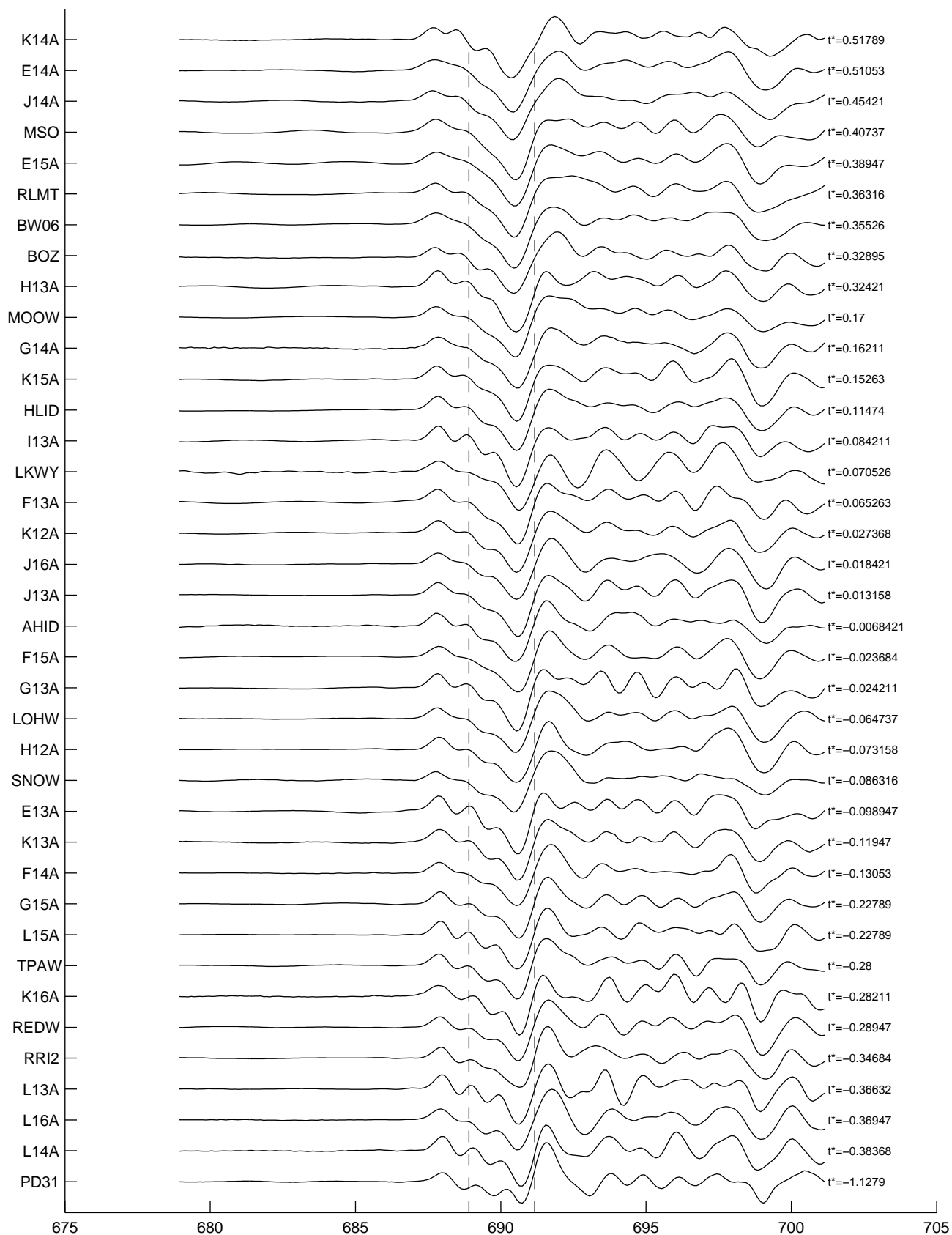
# Sorted by Delta:Event\_2007\_232\_22\_42\_29



# Sorted by travel time: Event\_2007\_232\_22\_42\_29

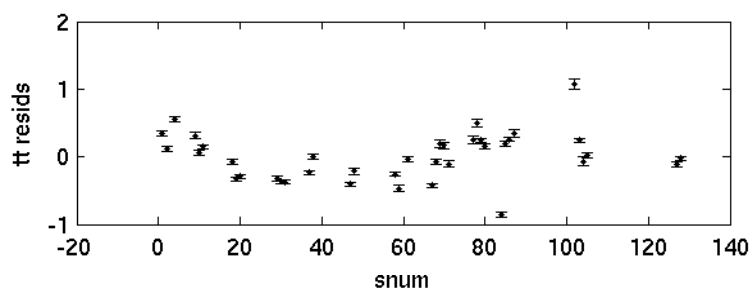
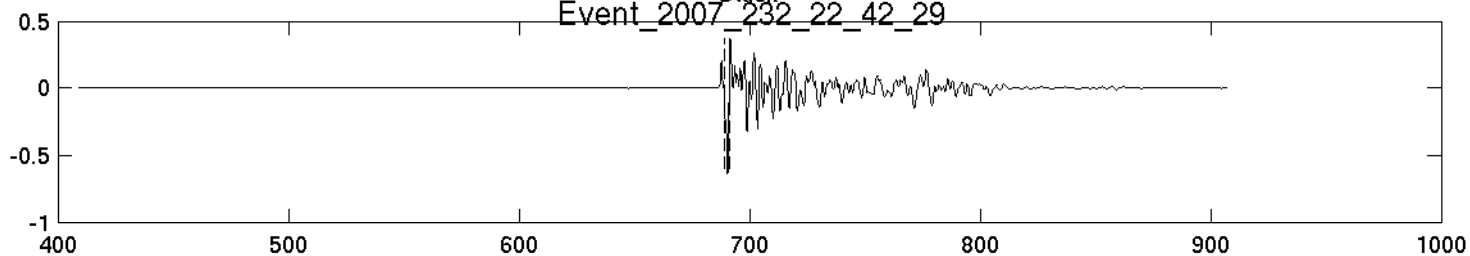


Sorted by  $t^*$ :Event\_2007\_232\_22\_42\_29

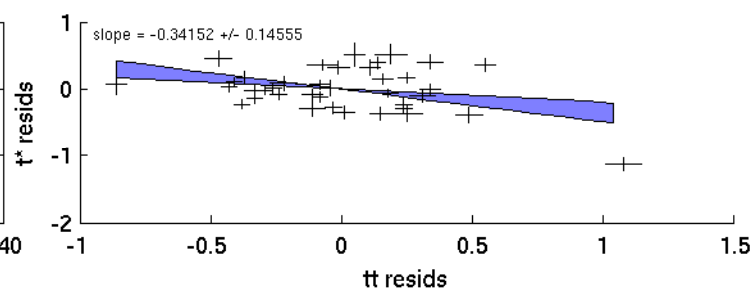
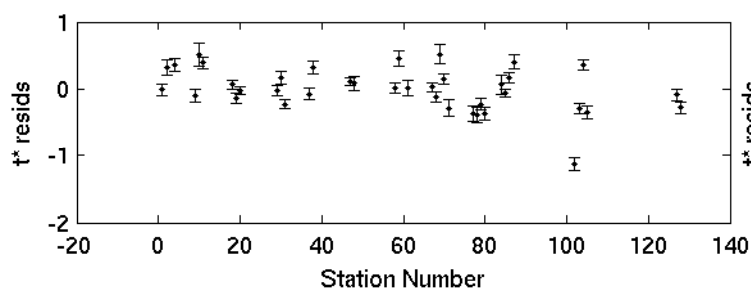


Event\_2007\_232\_22\_42\_29

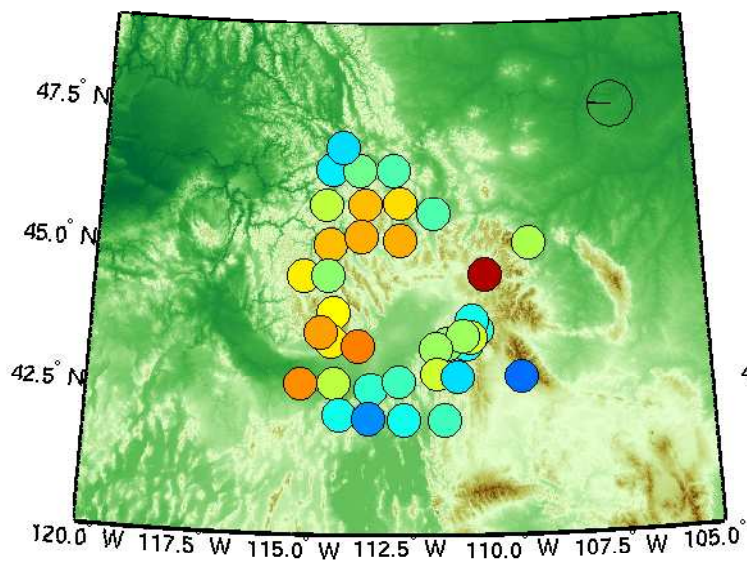
Stack



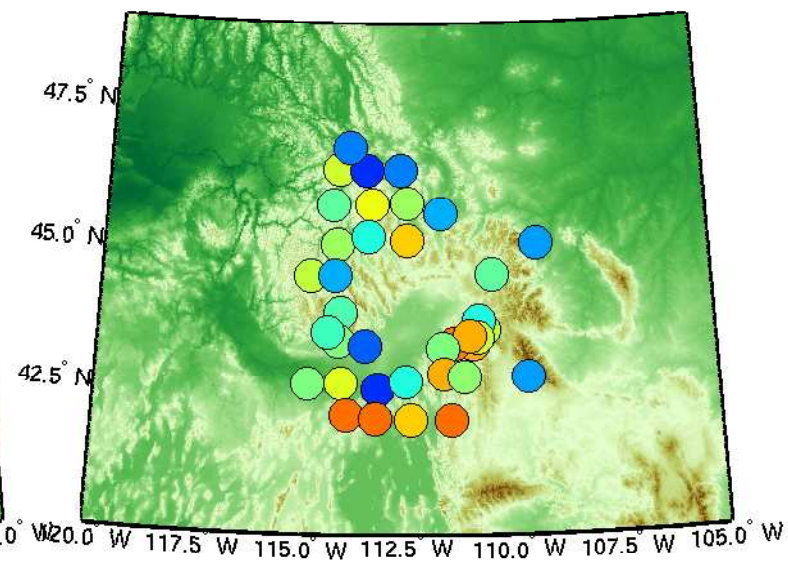
Baz = 95.8614  
Mean xcor value = 0.85632  
Range of  $t^*$  values is 1.6458  
Median  $t^*$  err is 0.091927  
Slope =  $-0.34152 \pm 0.14555$



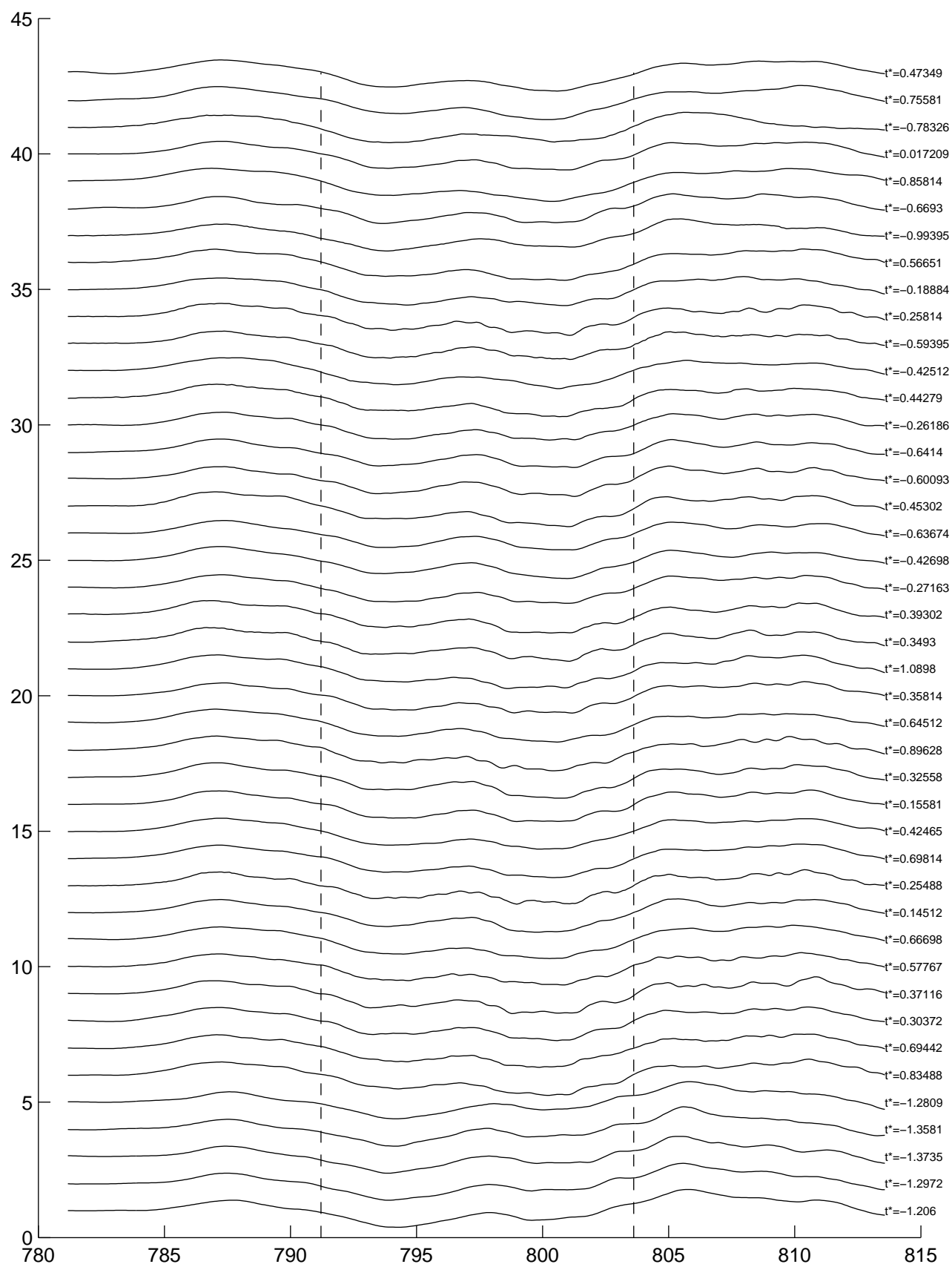
travel time residuals



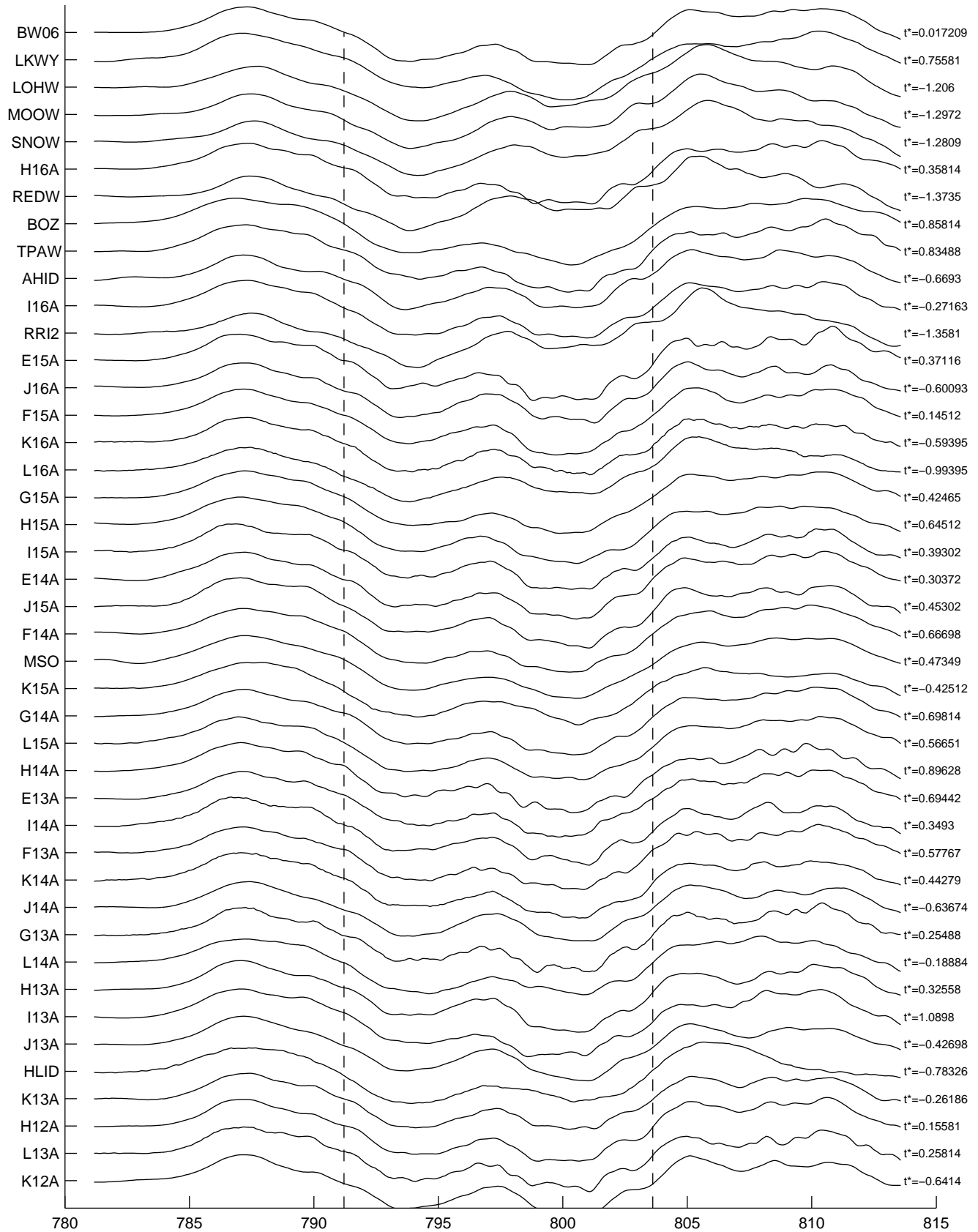
$t^*$  values



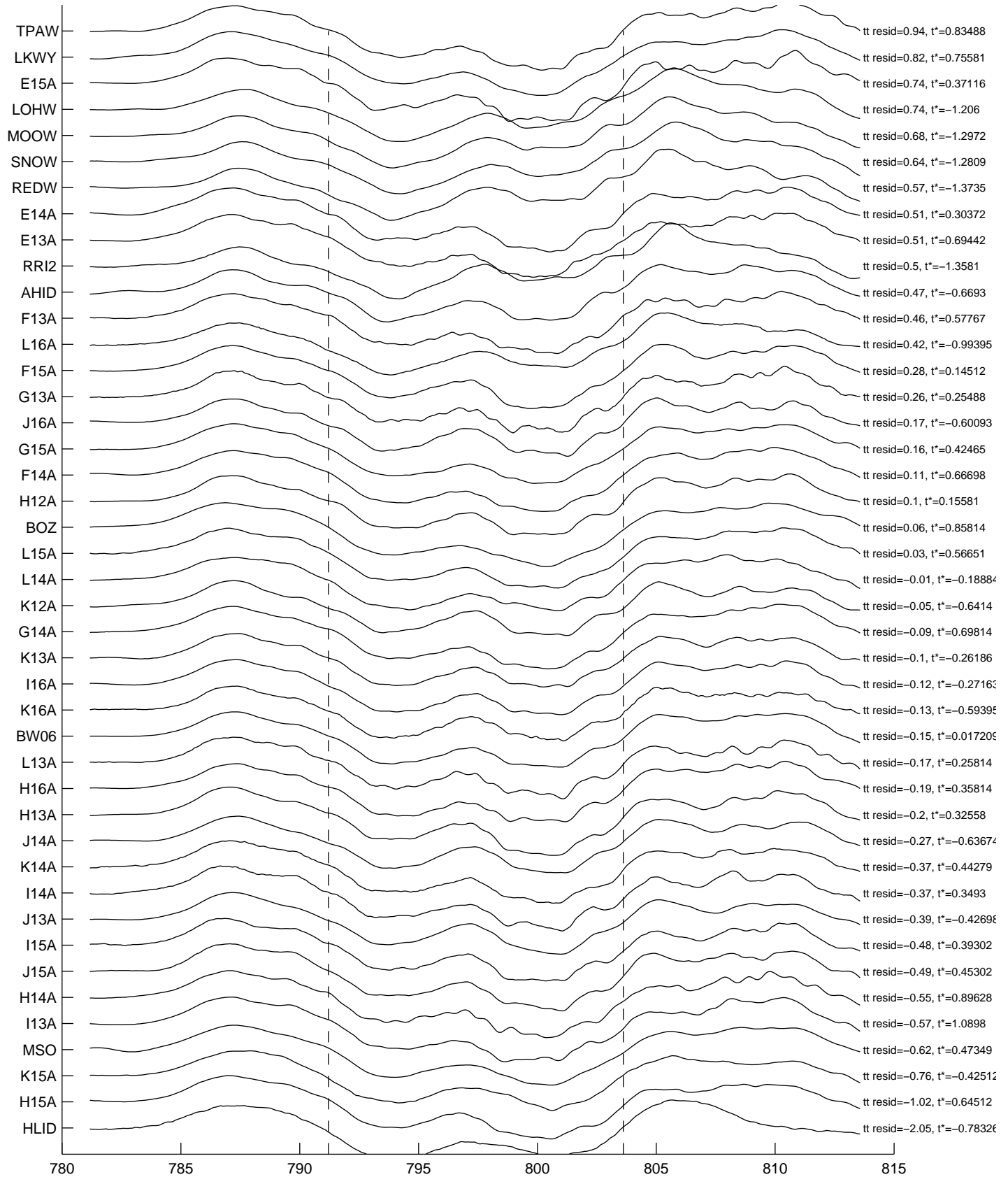
# Event\_2007\_245\_01\_05\_18



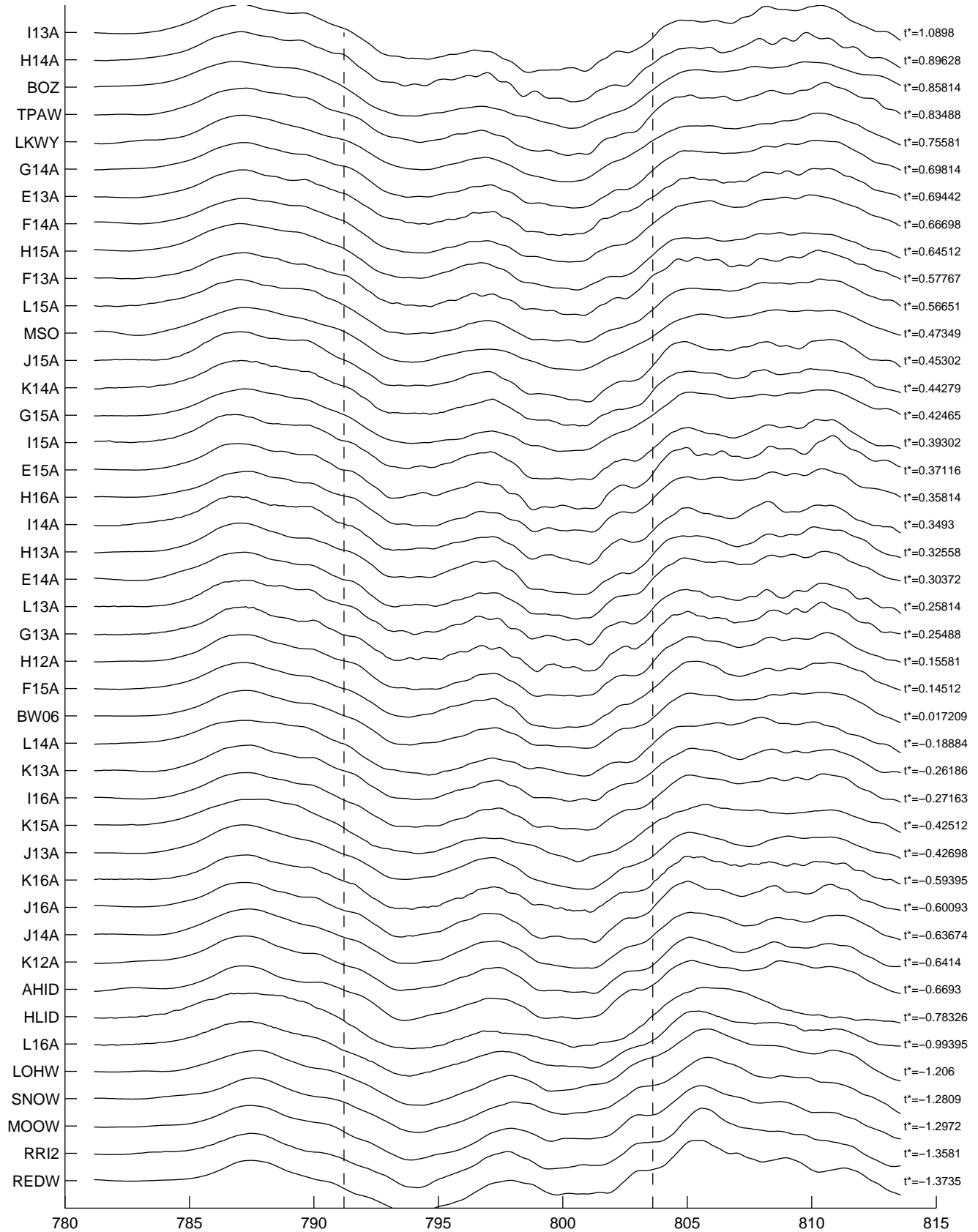
# Sorted by Delta:Event\_2007\_245\_01\_05\_18



# Sorted by travel time:Event\_2007\_245\_01\_05\_18



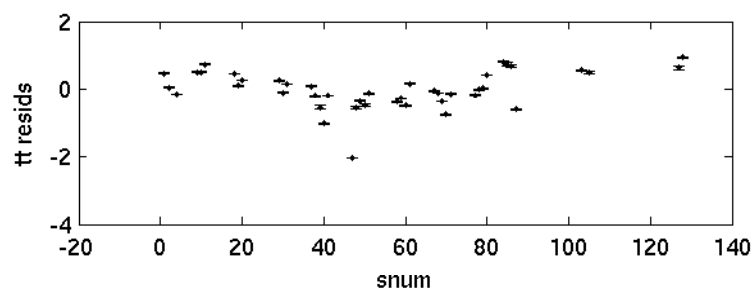
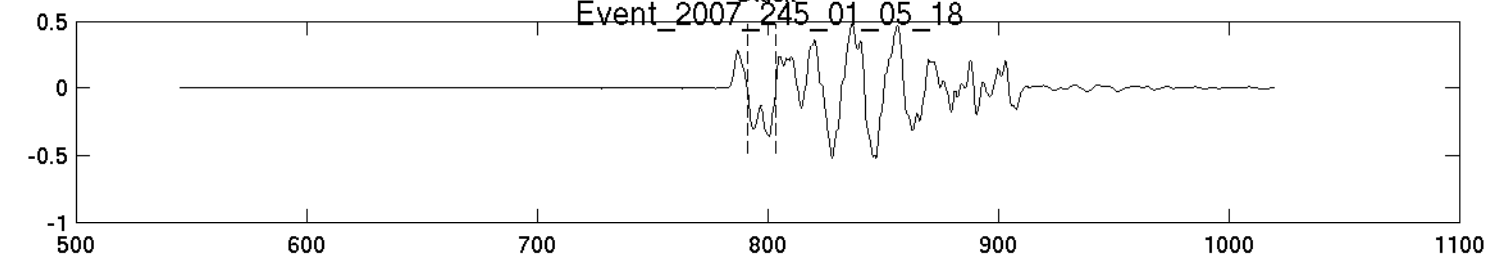
# Sorted by $t^*$ :Event\_2007\_245\_01\_05\_18



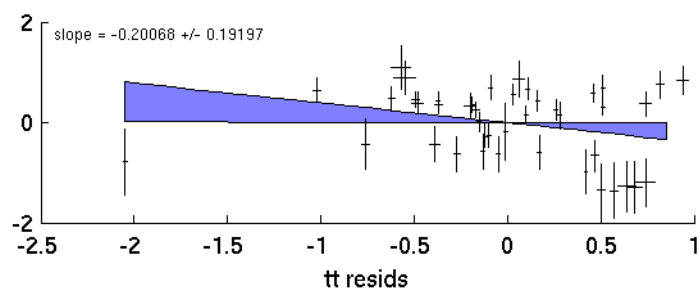
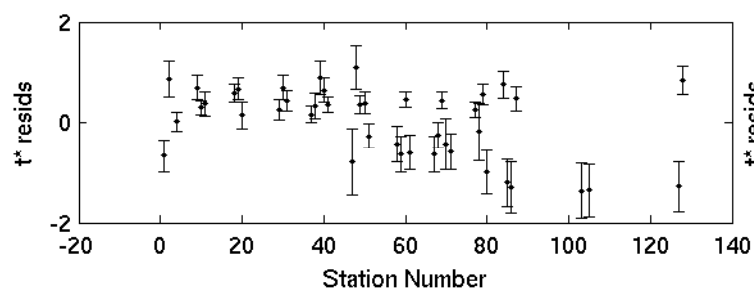


Event\_2007\_245\_01\_05\_18

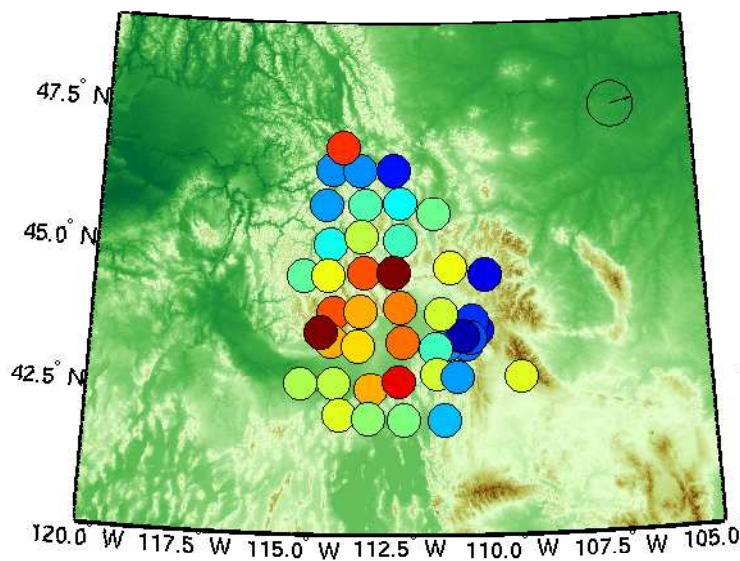
Stack



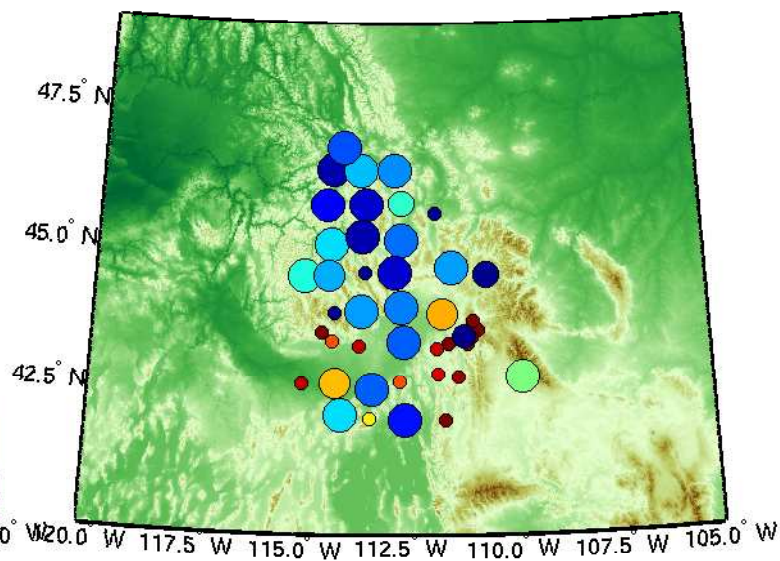
Baz = 255.9024  
Mean xcor value = 0.91767  
Range of  $t^*$  values is 2.4633  
Median  $t^*$  err is 0.25119  
Slope = -0.20068 +/- 0.19197



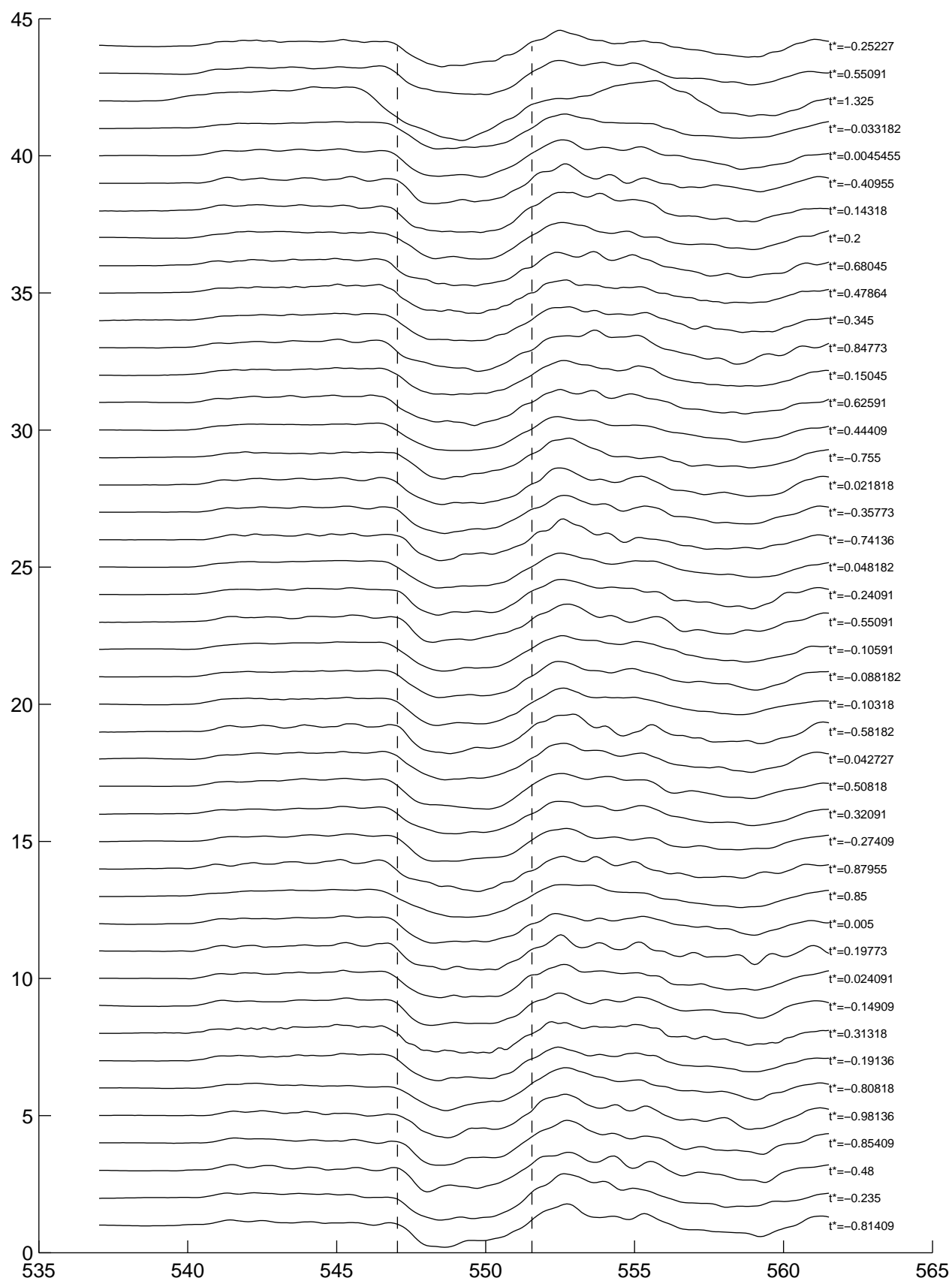
travel time residuals



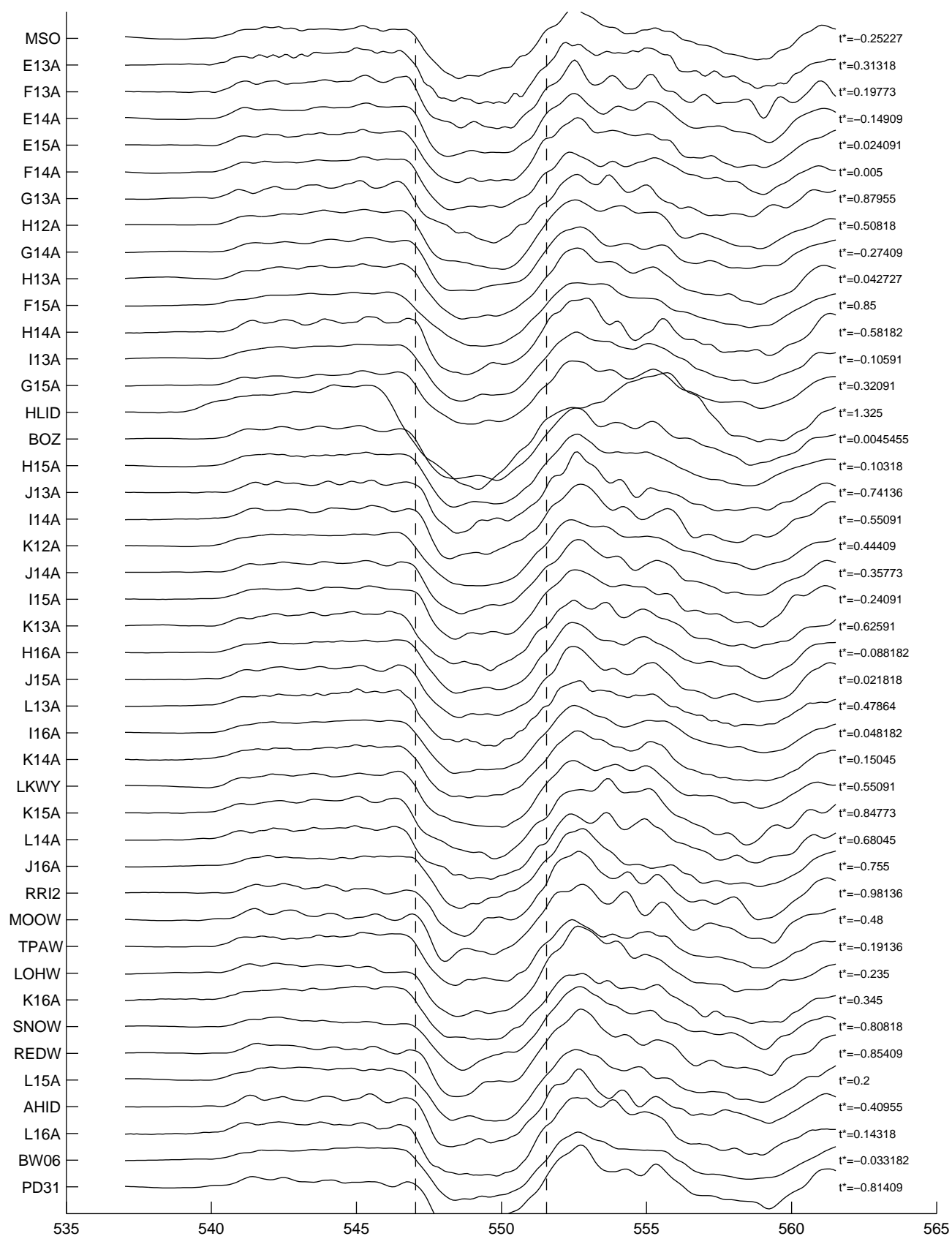
$t^*$  values



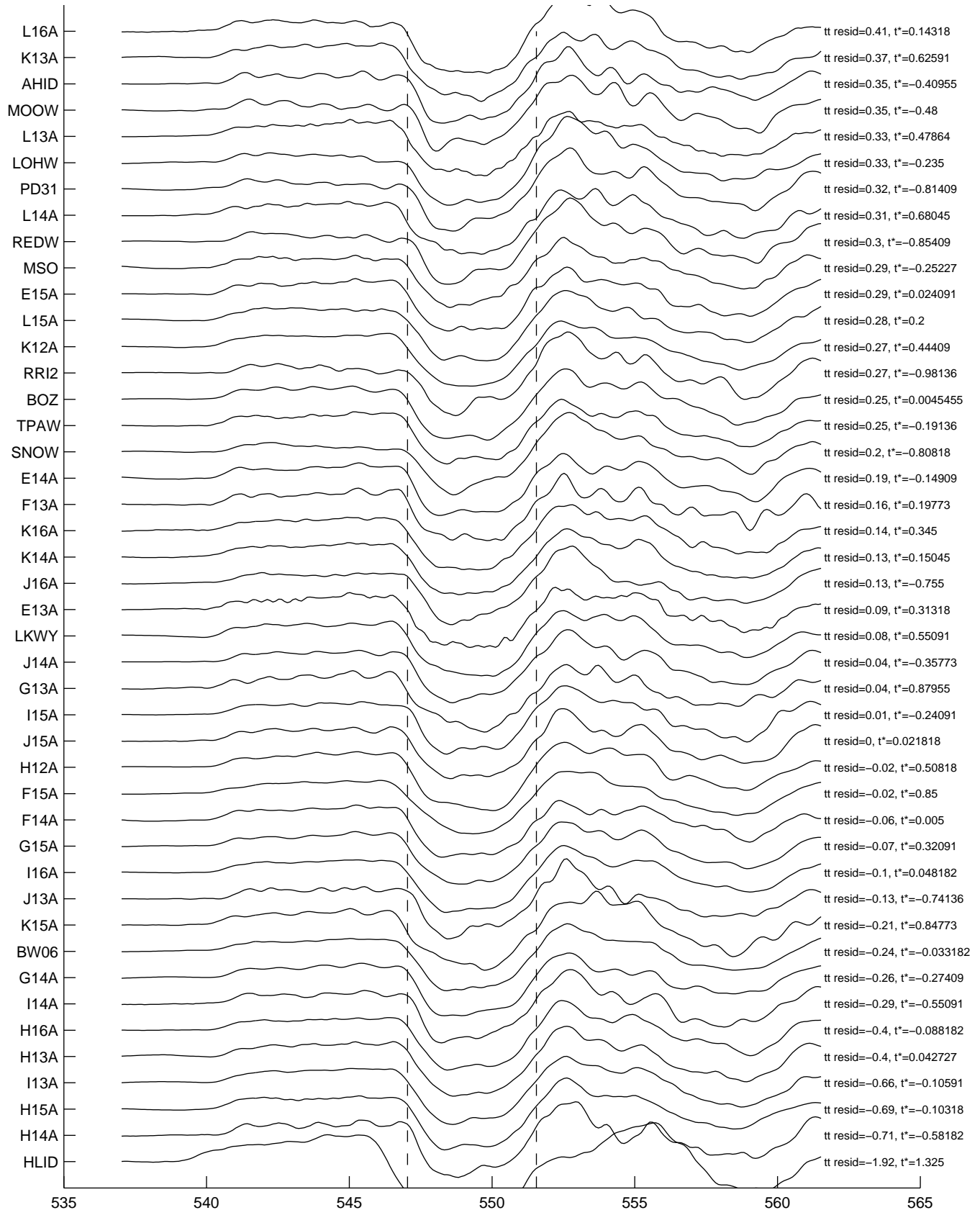
# Event\_2007\_253\_01\_49\_14



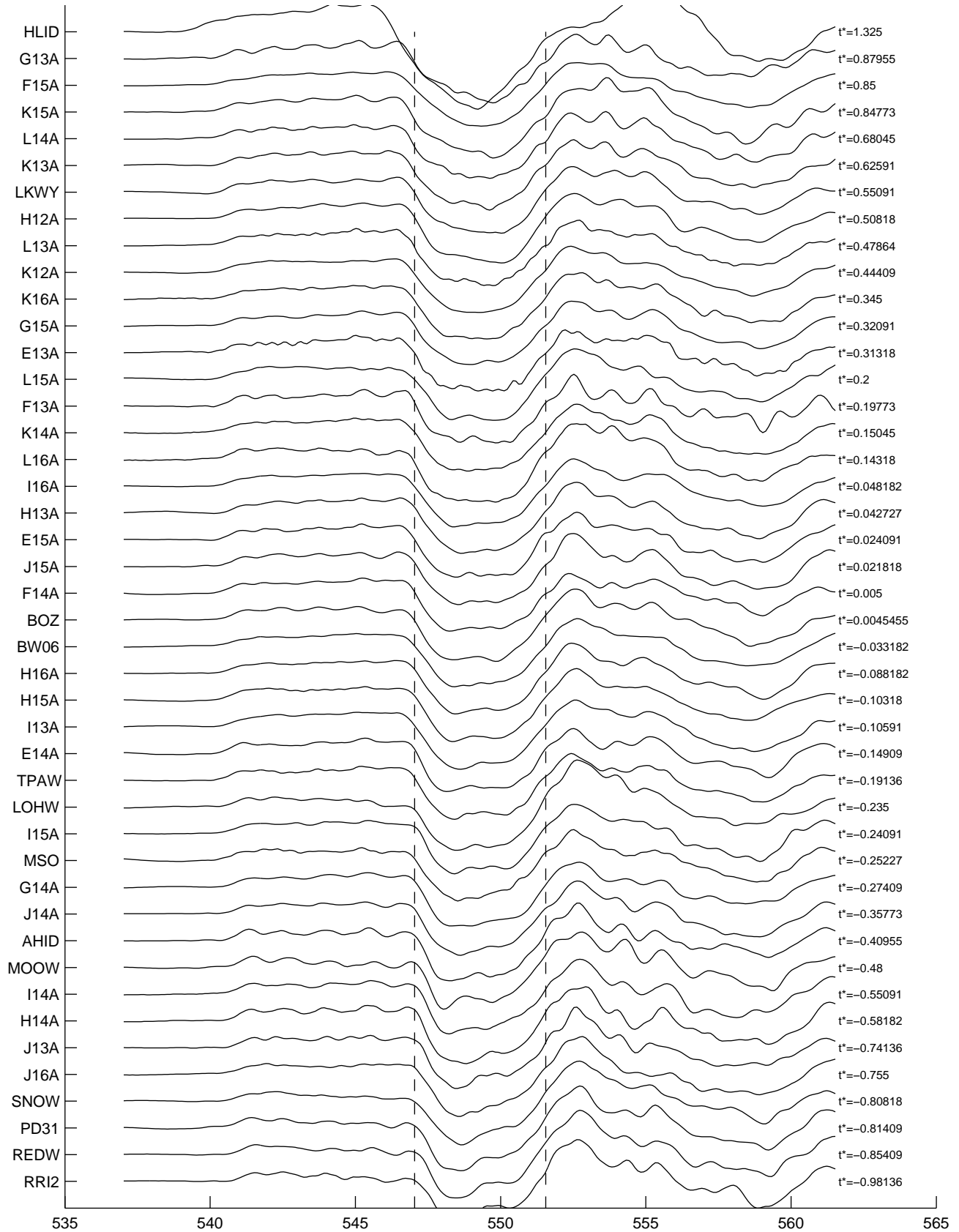
# Sorted by Delta:Event\_2007\_253\_01\_49\_14



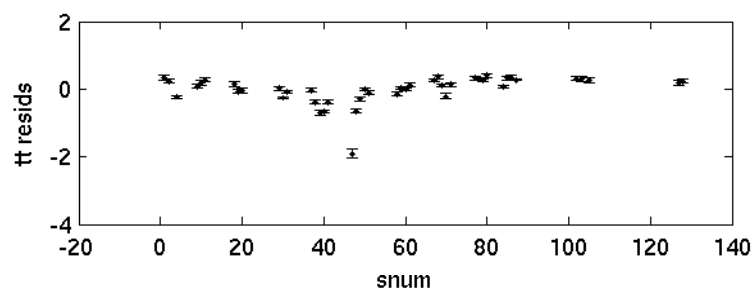
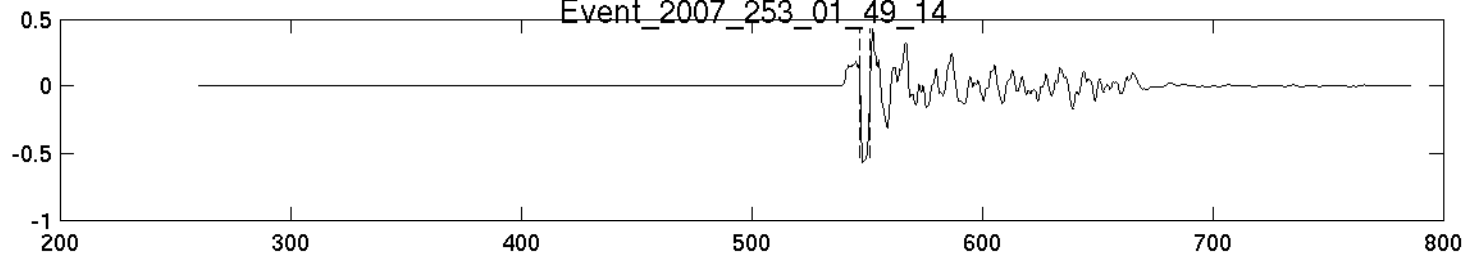
# Sorted by travel time: Event\_2007\_253\_01\_49\_14



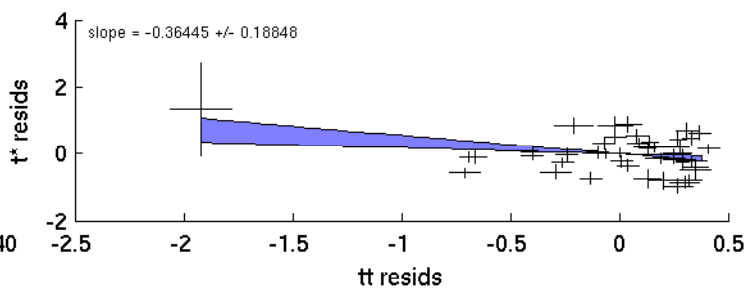
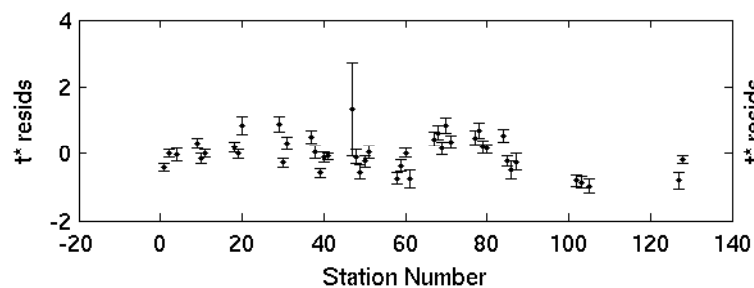
# Sorted by $t^*$ :Event\_2007\_253\_01\_49\_14



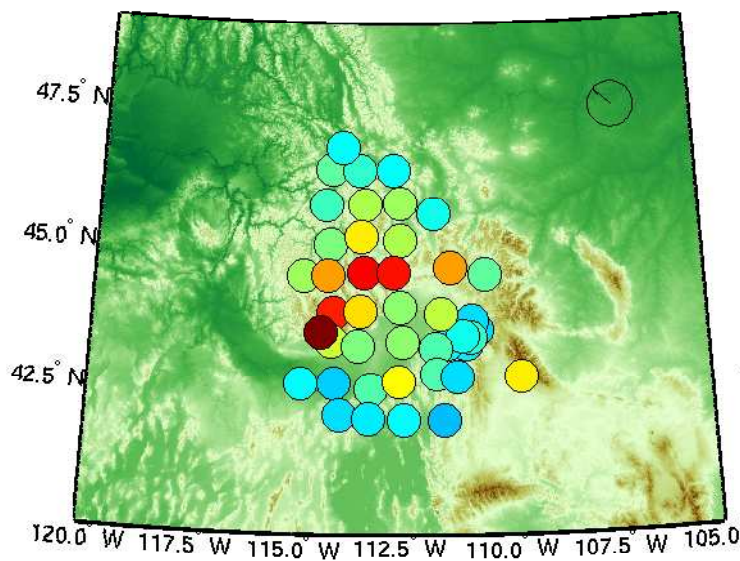
Stack  
Event\_2007\_253\_01\_49\_14



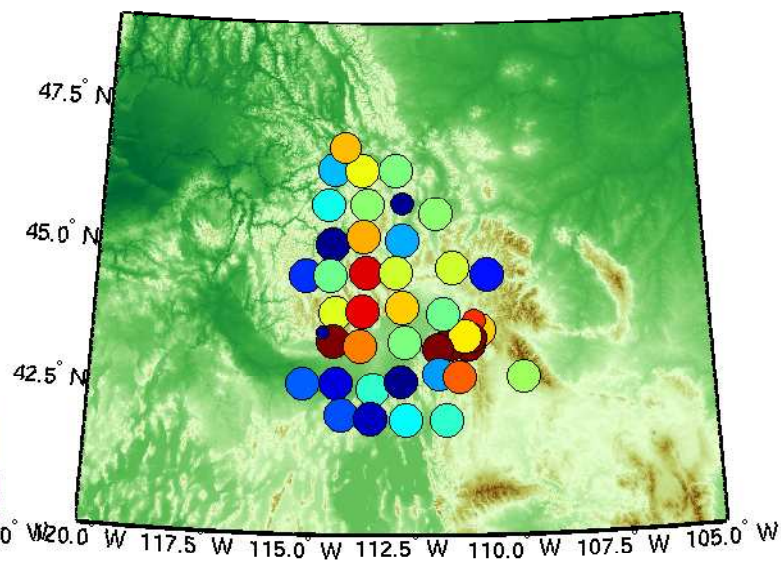
Baz = 133.3384  
Mean xcor value = 0.93523  
Range of t\* values is 2.3064  
Median t\* err is 0.17909  
Slope = -0.36445 +/- 0.18848



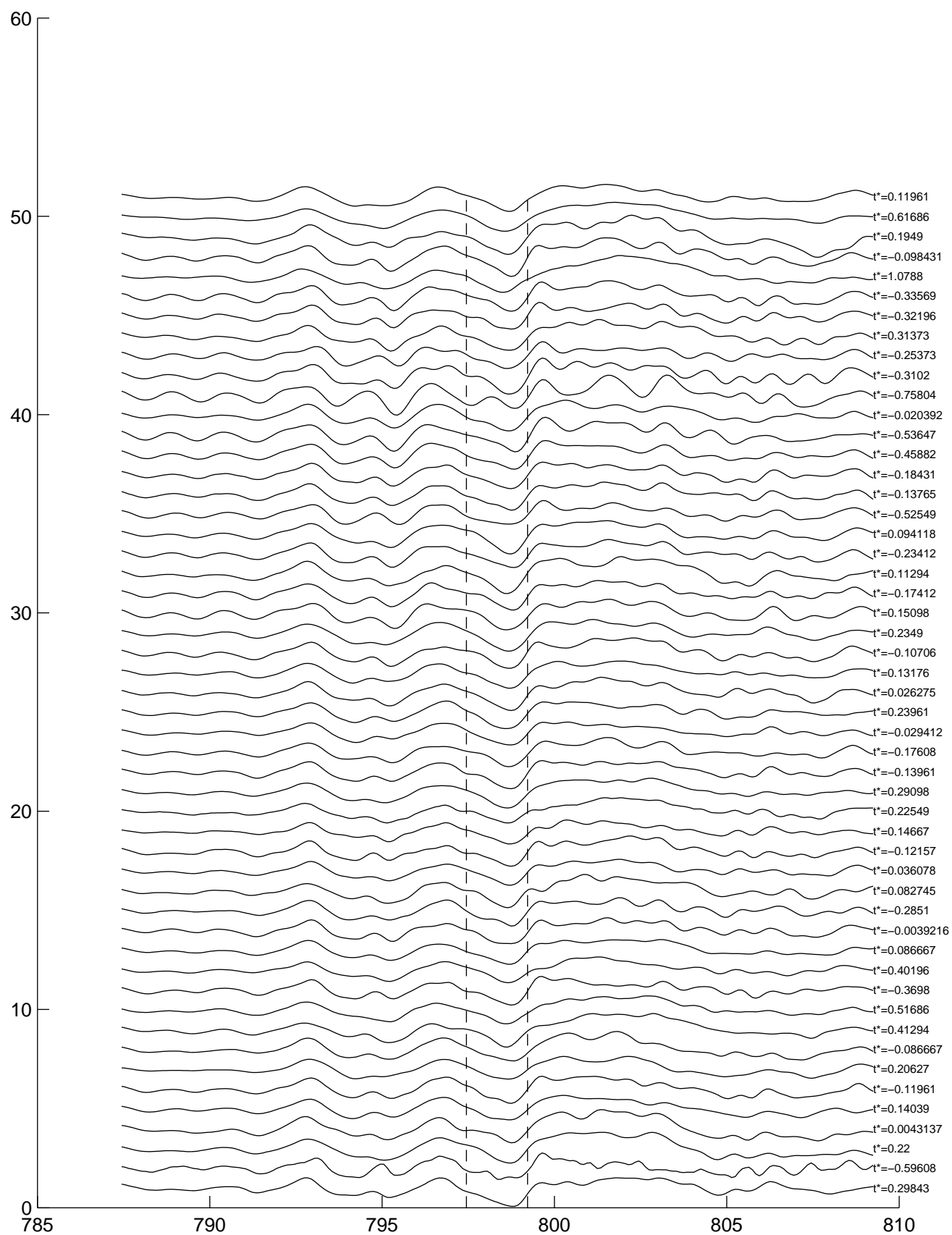
travel time residuals



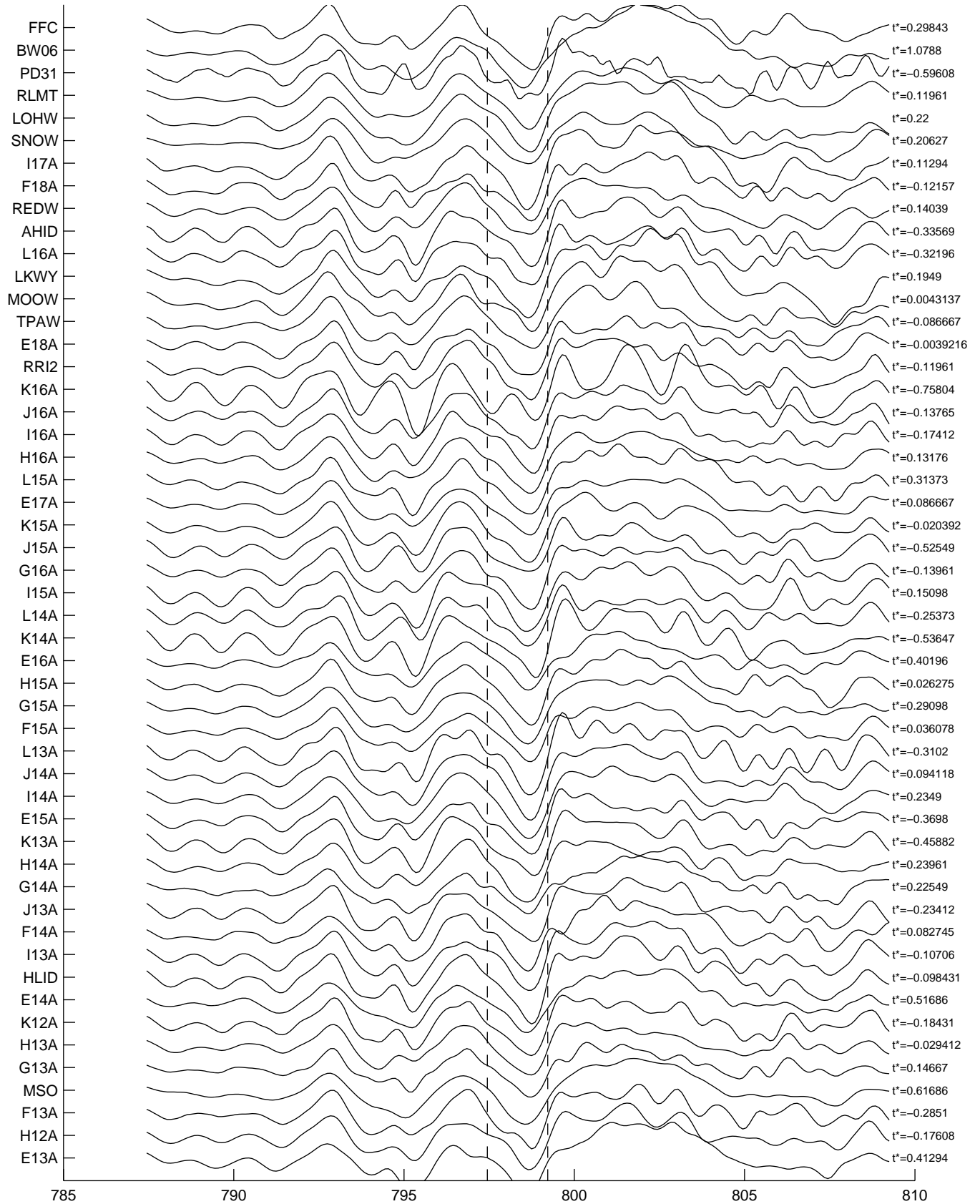
t\* values



# Event\_2007\_273\_02\_08\_30

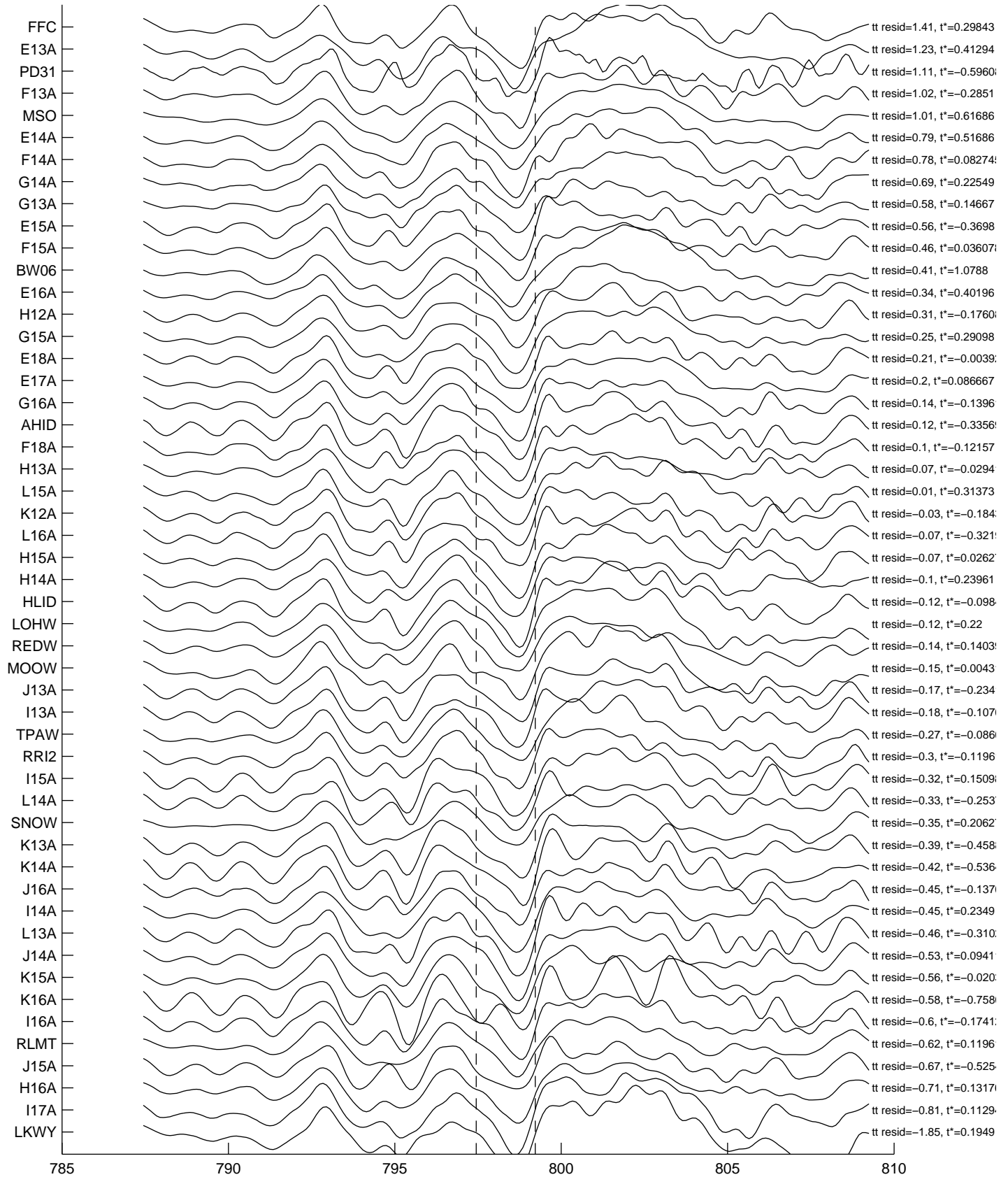


# Sorted by Delta:Event\_2007\_273\_02\_08\_30

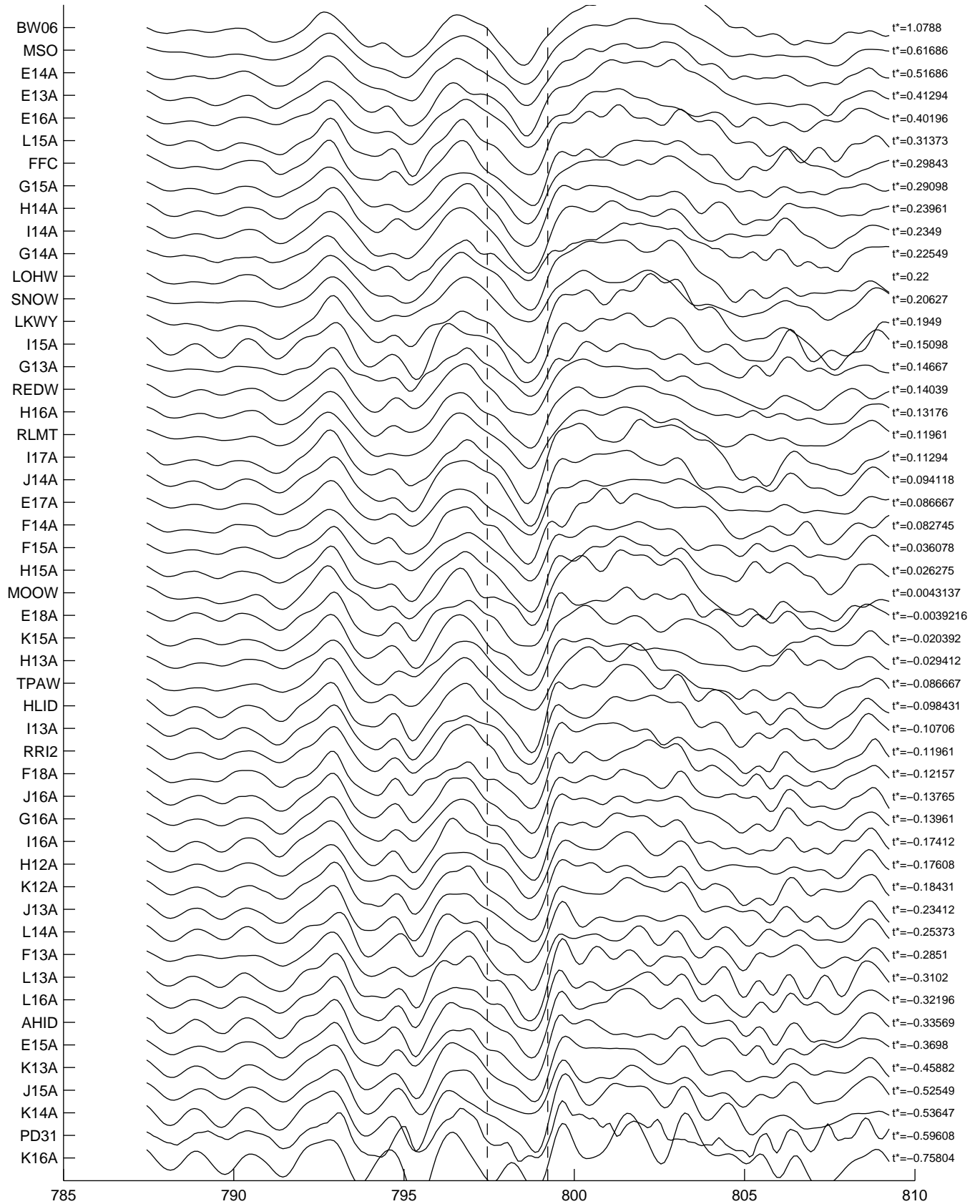




# Sorted by travel time:Event\_2007\_273\_02\_08\_30

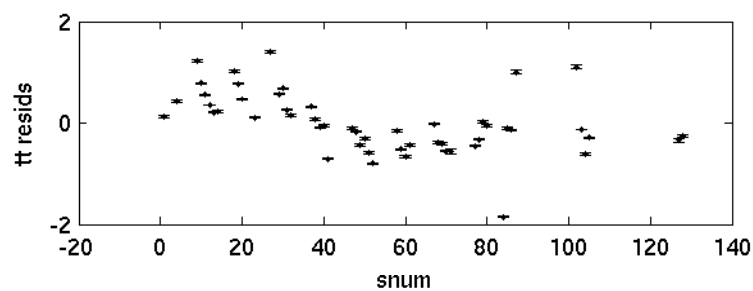
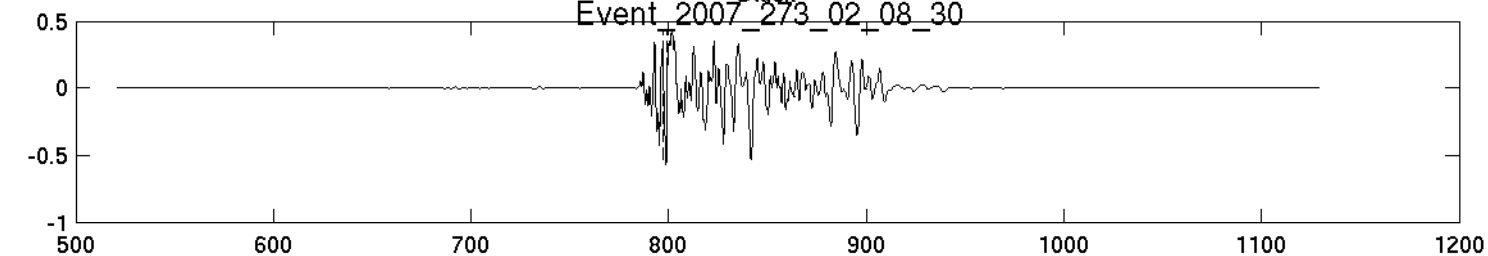


# Sorted by $t^*$ :Event\_2007\_273\_02\_08\_30

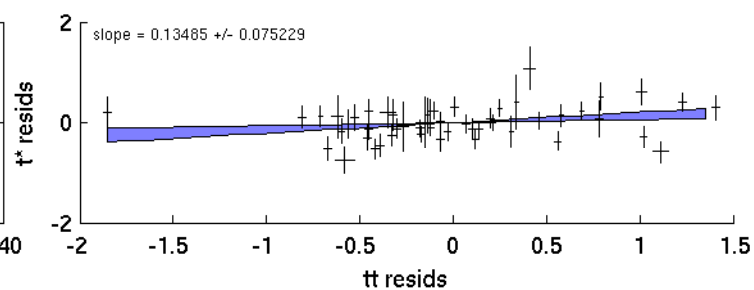
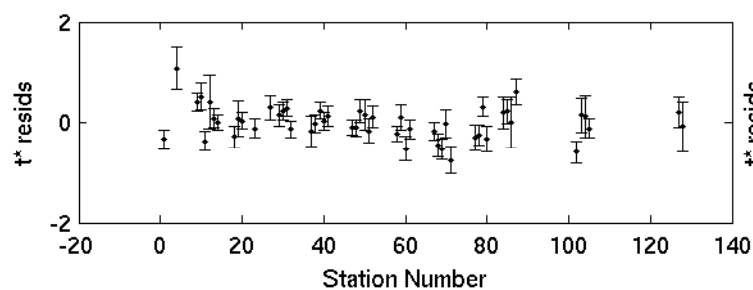


Event 2007\_273\_02\_08\_30

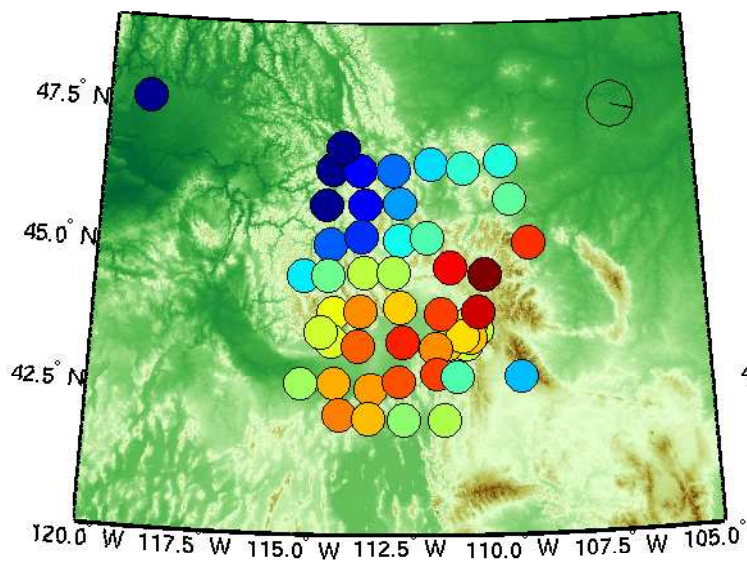
Stack



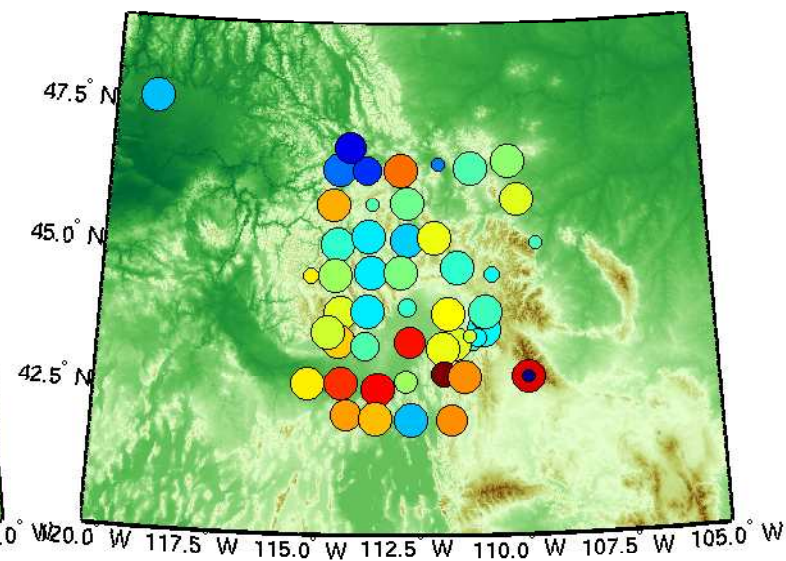
Baz = 285.9652  
Mean xcor value = 0.89529  
Range of  $t^*$  values is 1.8369  
Median  $t^*$  err is 0.21861  
Slope = 0.13485 +/- 0.075229



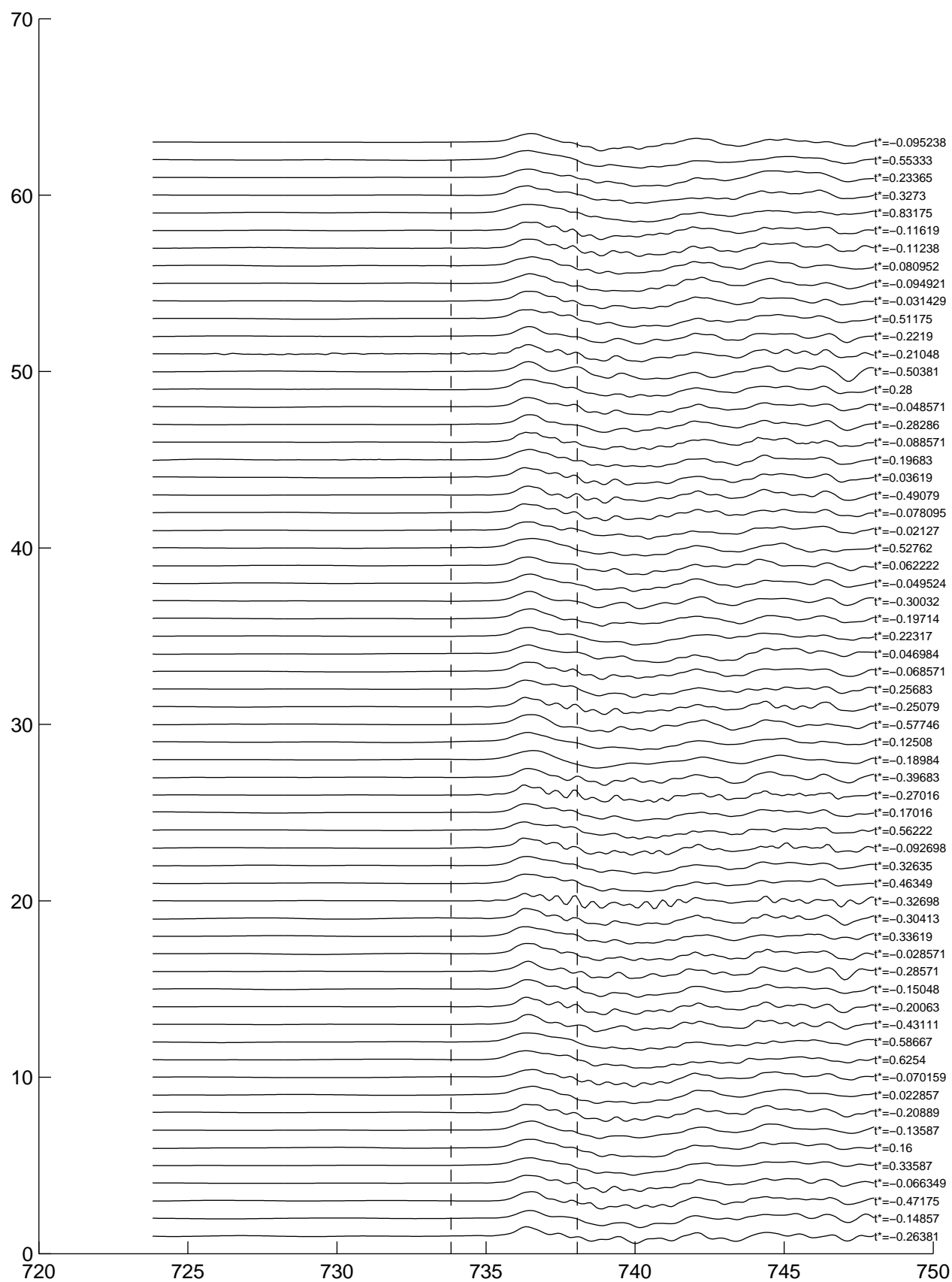
travel time residuals



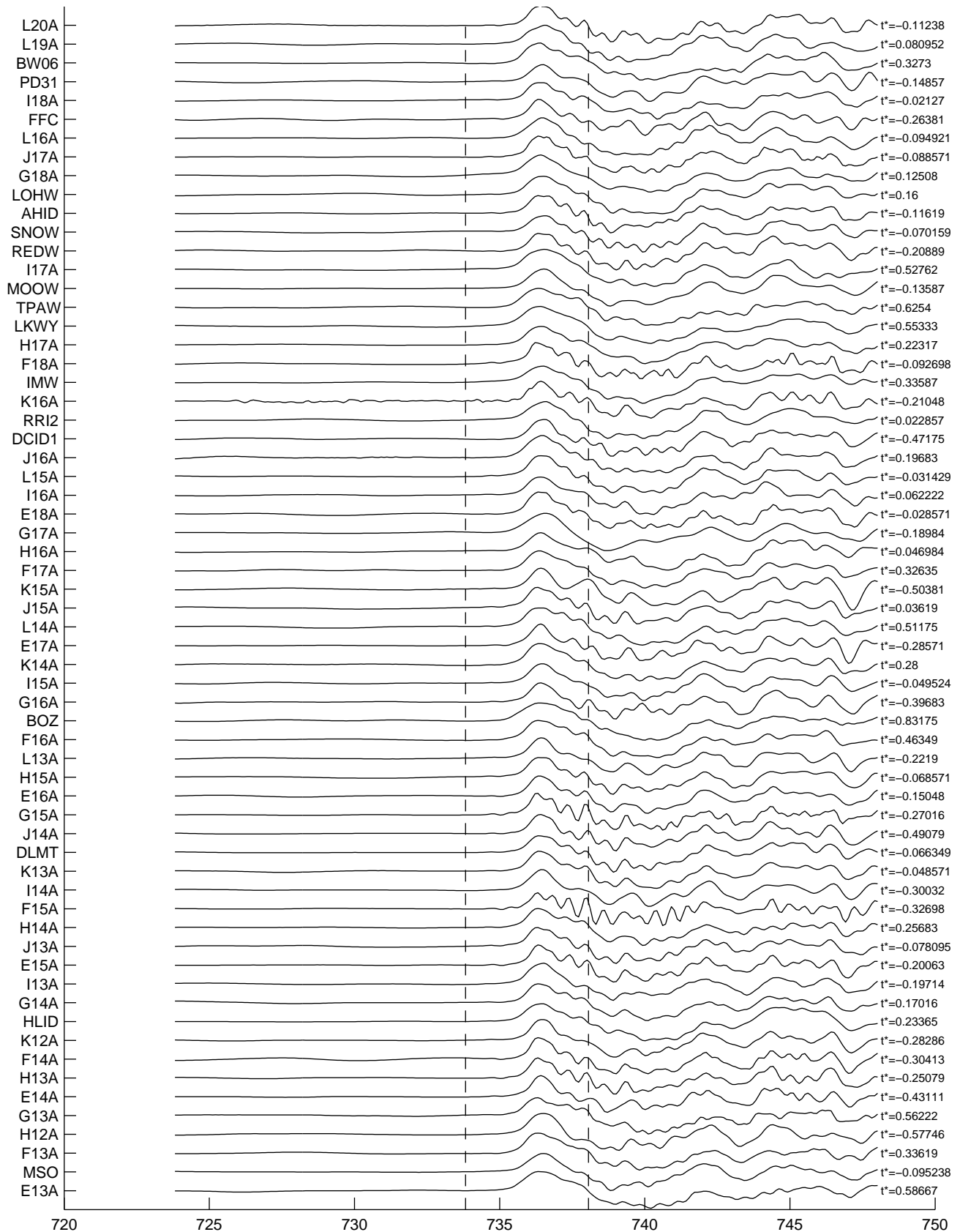
$t^*$  values



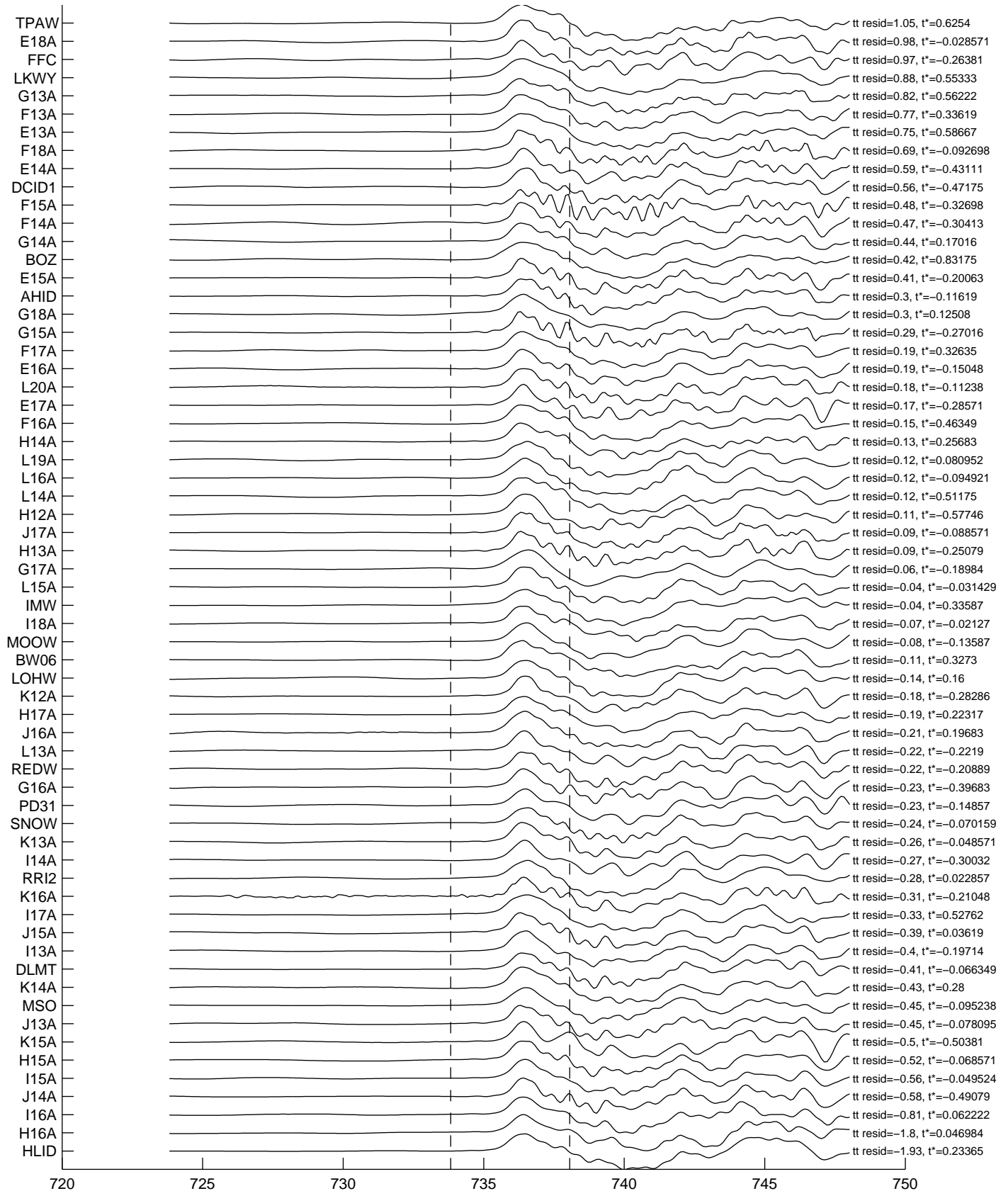
# Event\_2007\_304\_03\_30\_17



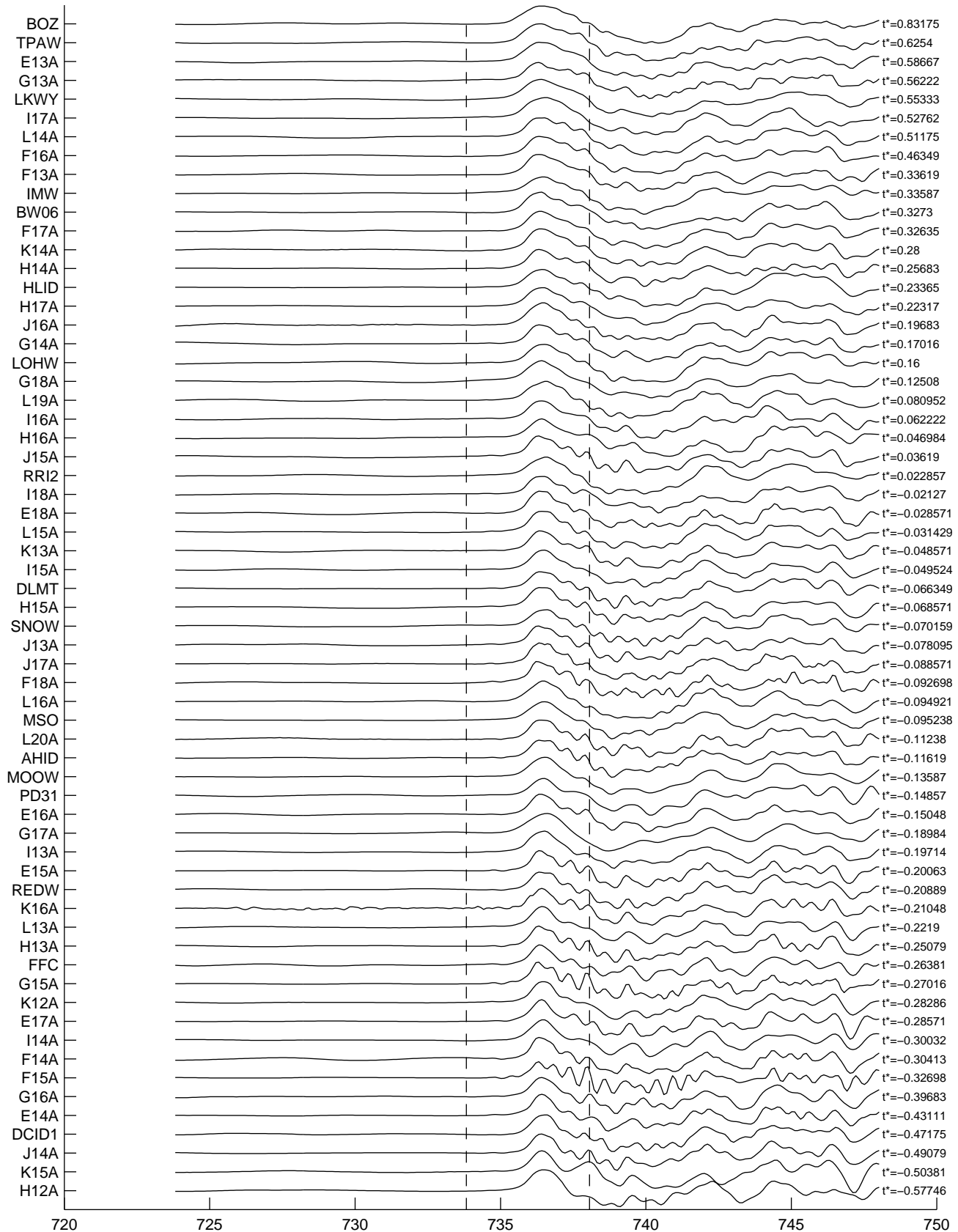
# Sorted by Delta:Event\_2007\_304\_03\_30\_17



# Sorted by travel time:Event\_2007\_304\_03\_30\_17



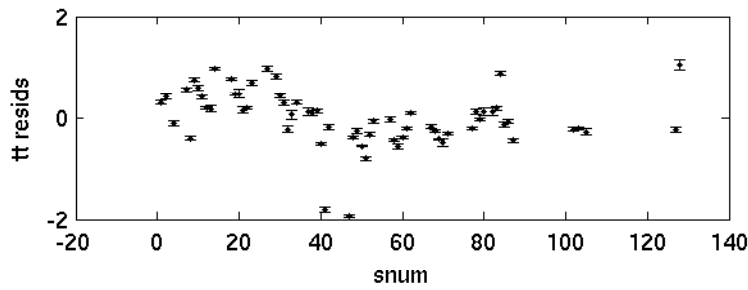
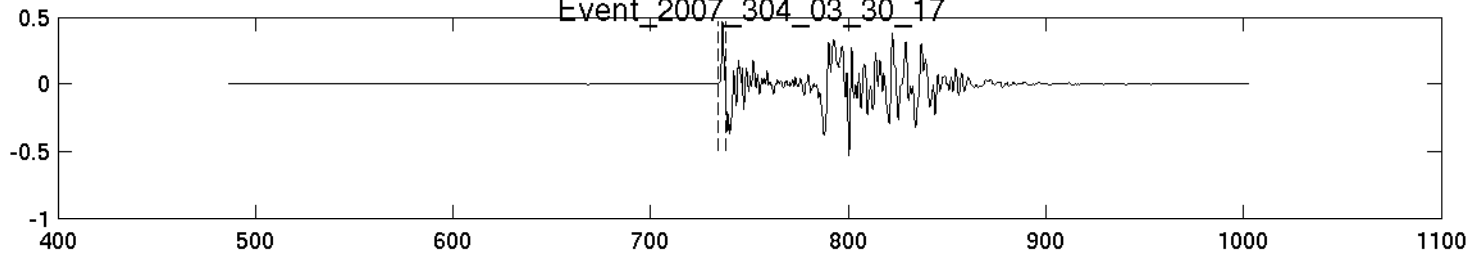
# Sorted by t\*:Event\_2007\_304\_03\_30\_17



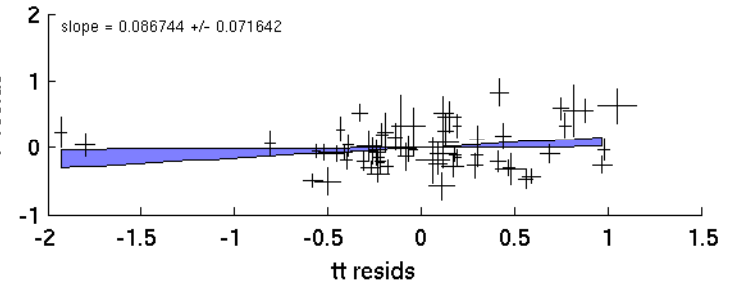
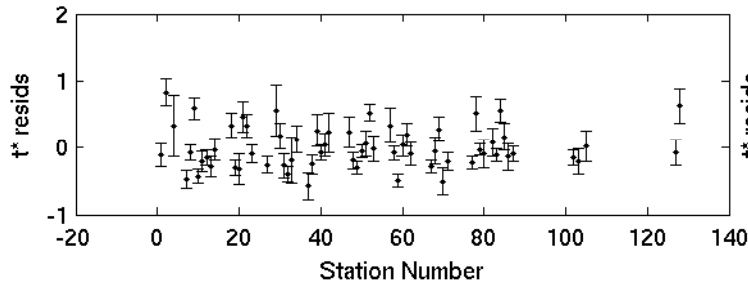


Event 2007\_304\_03\_30\_17

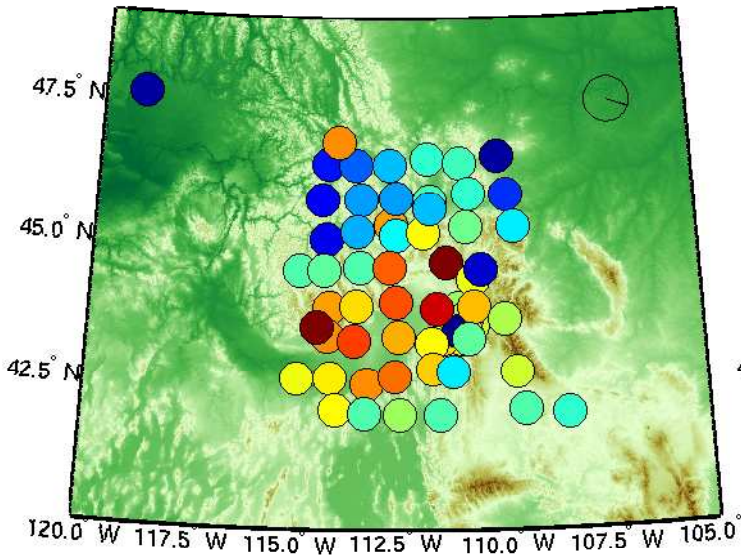
Stack



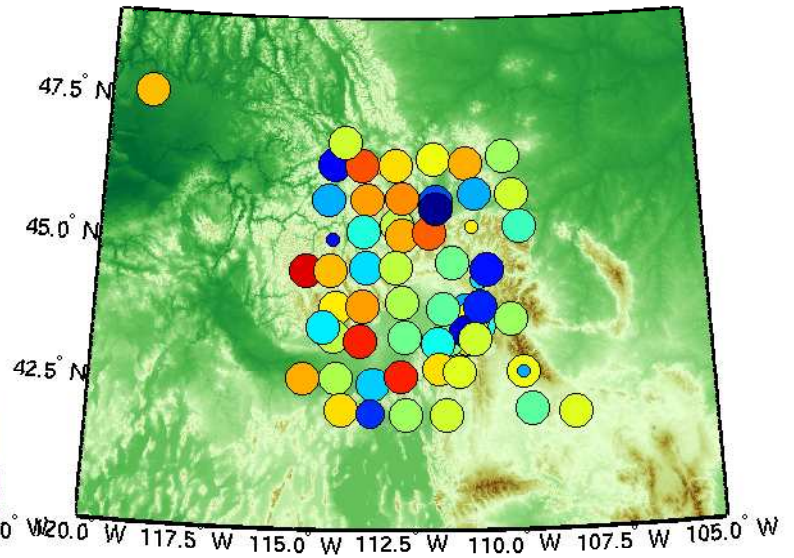
Baz = 292.3136  
Mean xcor value = 0.84619  
Range of  $t^*$  values is 1.4092  
Median  $t^*$  err is 0.17439  
Slope = 0.086744 +/- 0.071642



travel time residuals

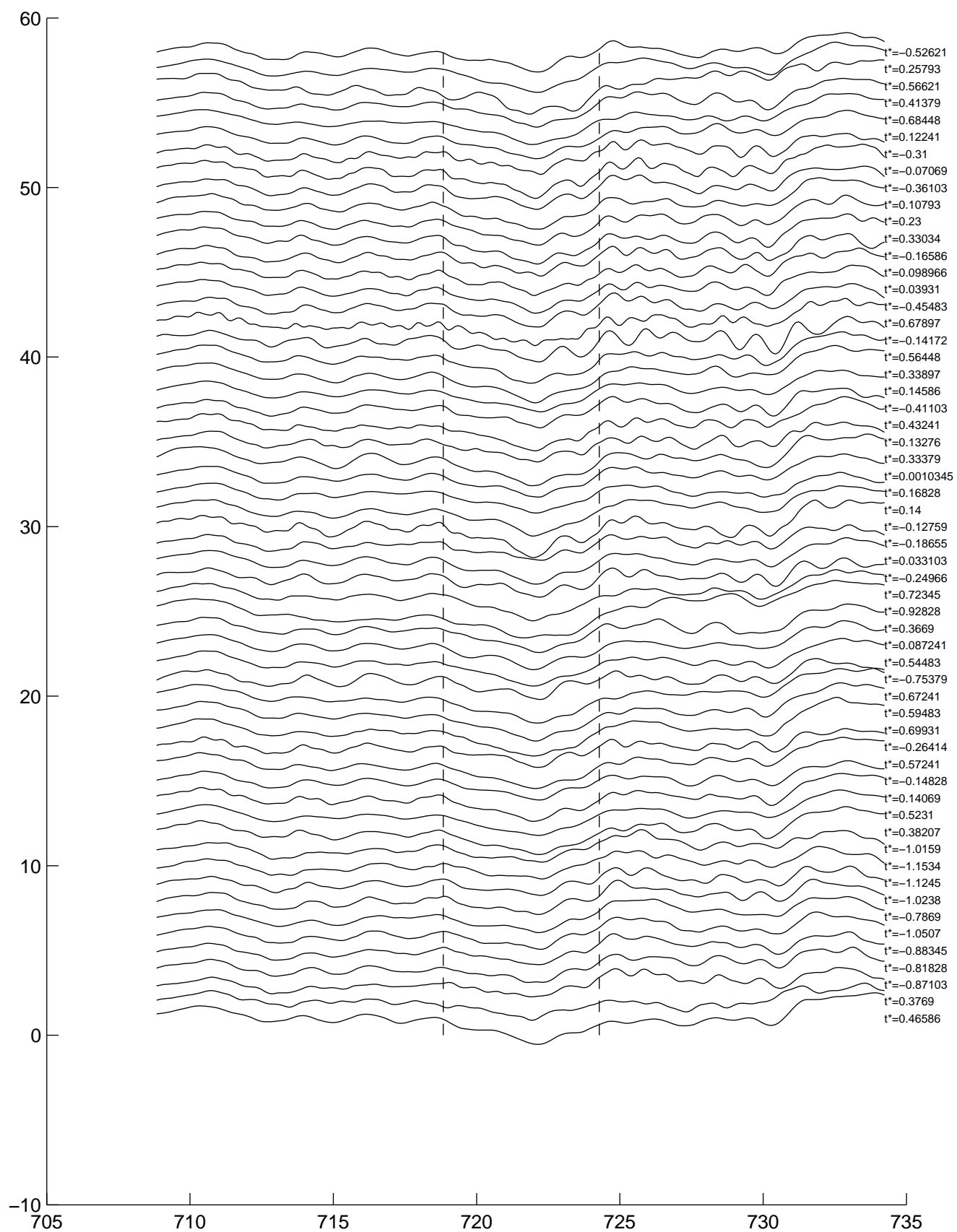


$t^*$  values

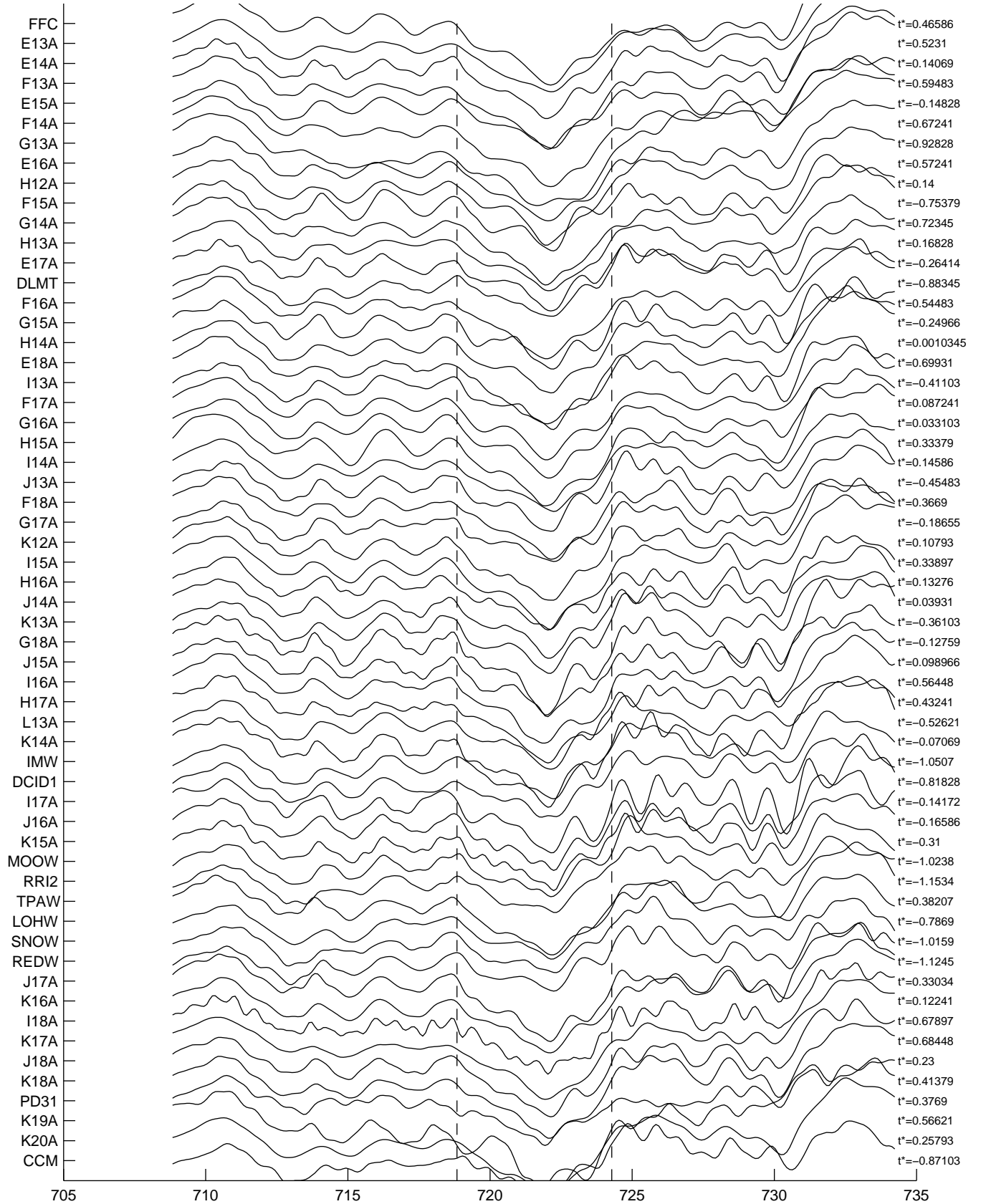




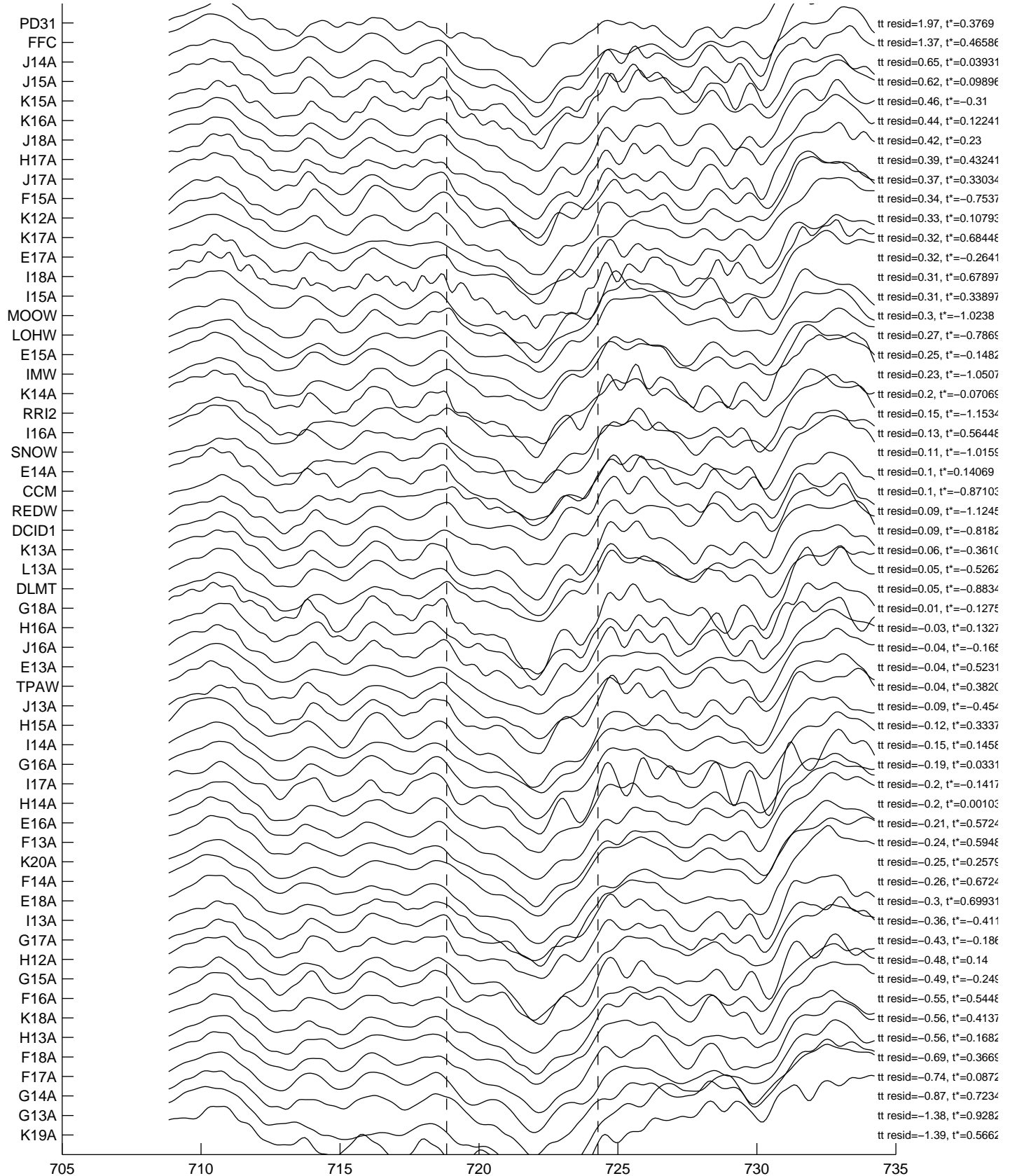
# Event\_2007\_318\_15\_40\_50



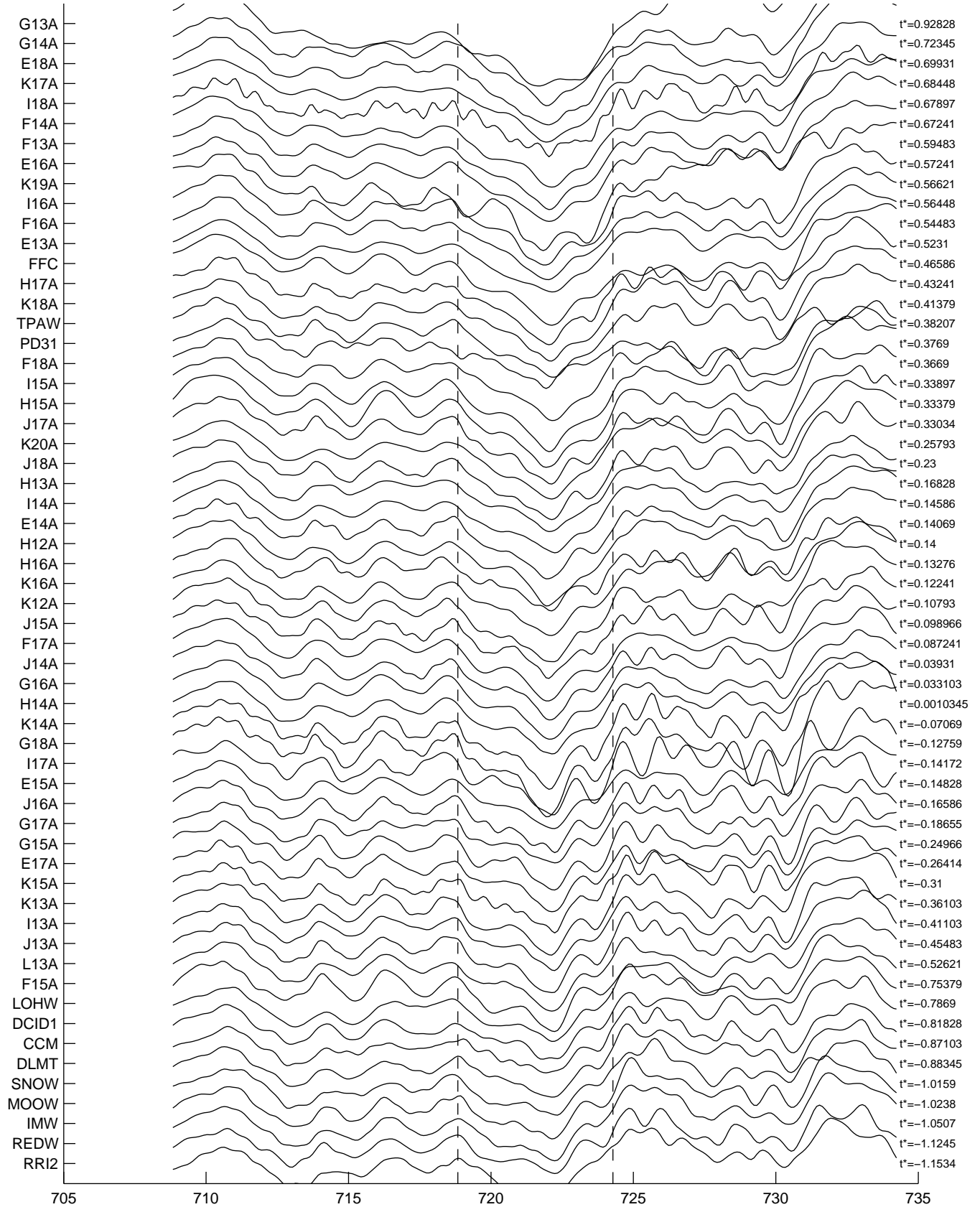
# Sorted by Delta:Event\_2007\_318\_15\_40\_50



# Sorted by travel time:Event\_2007\_318\_15\_40\_50

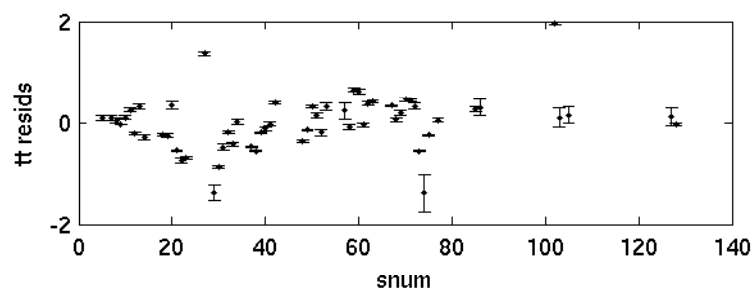
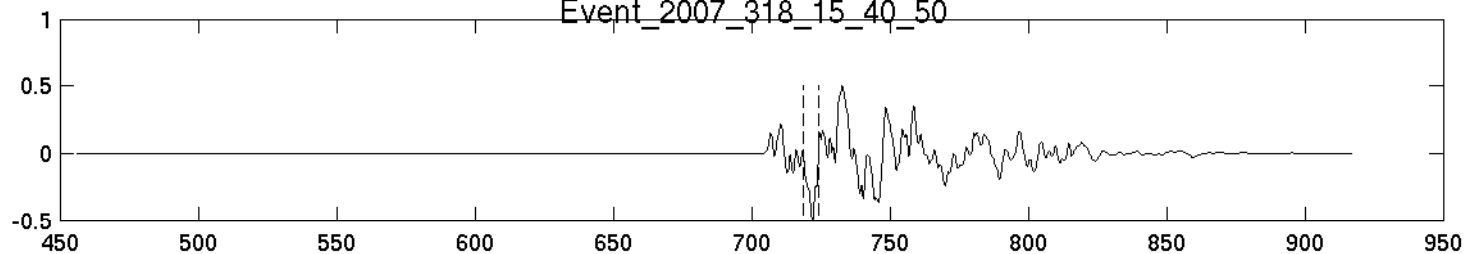


# Sorted by $t^*$ :Event\_2007\_318\_15\_40\_50

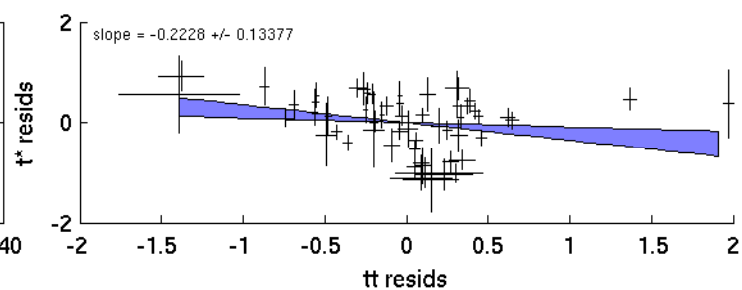
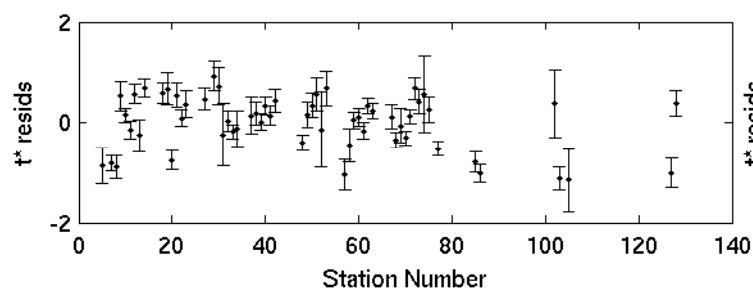


Event\_2007\_318\_15\_40\_50

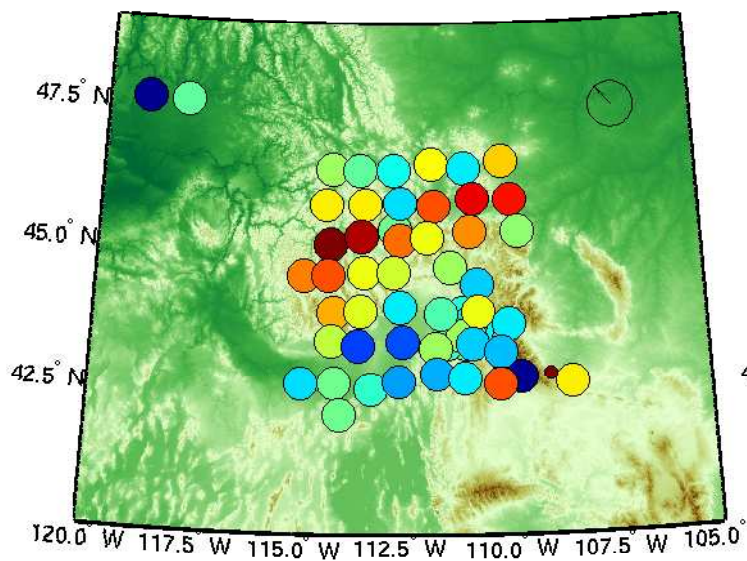
Stack



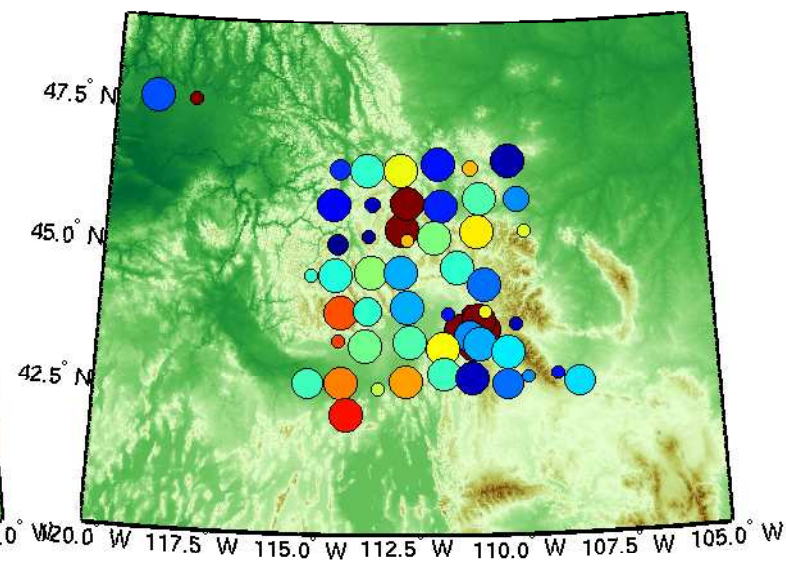
Baz = 140.9447  
Mean xcor value = 0.77741  
Range of  $t^*$  values is 2.0817  
Median  $t^*$  err is 0.2259  
Slope =  $-0.2228 \pm 0.13377$



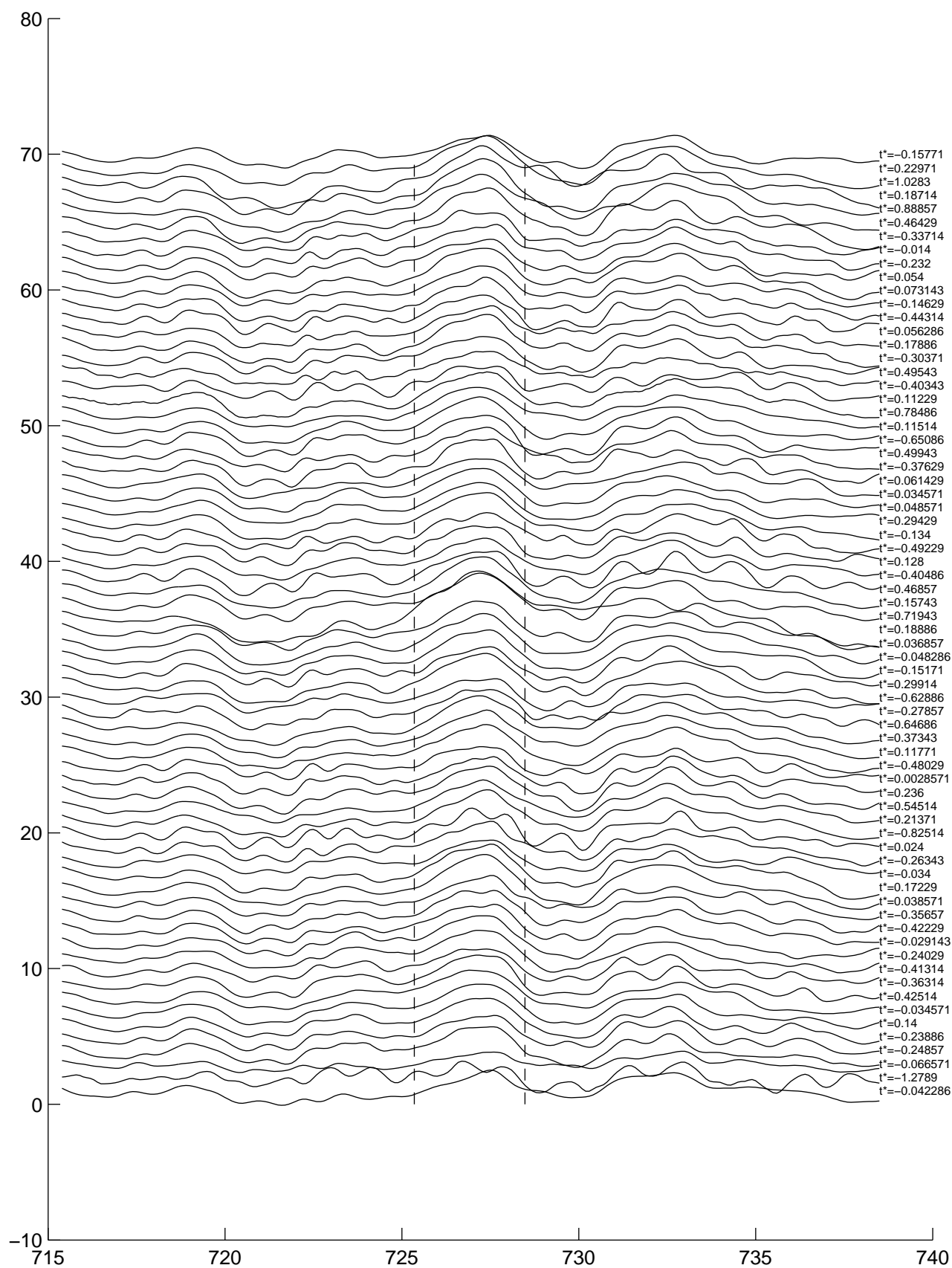
travel time residuals



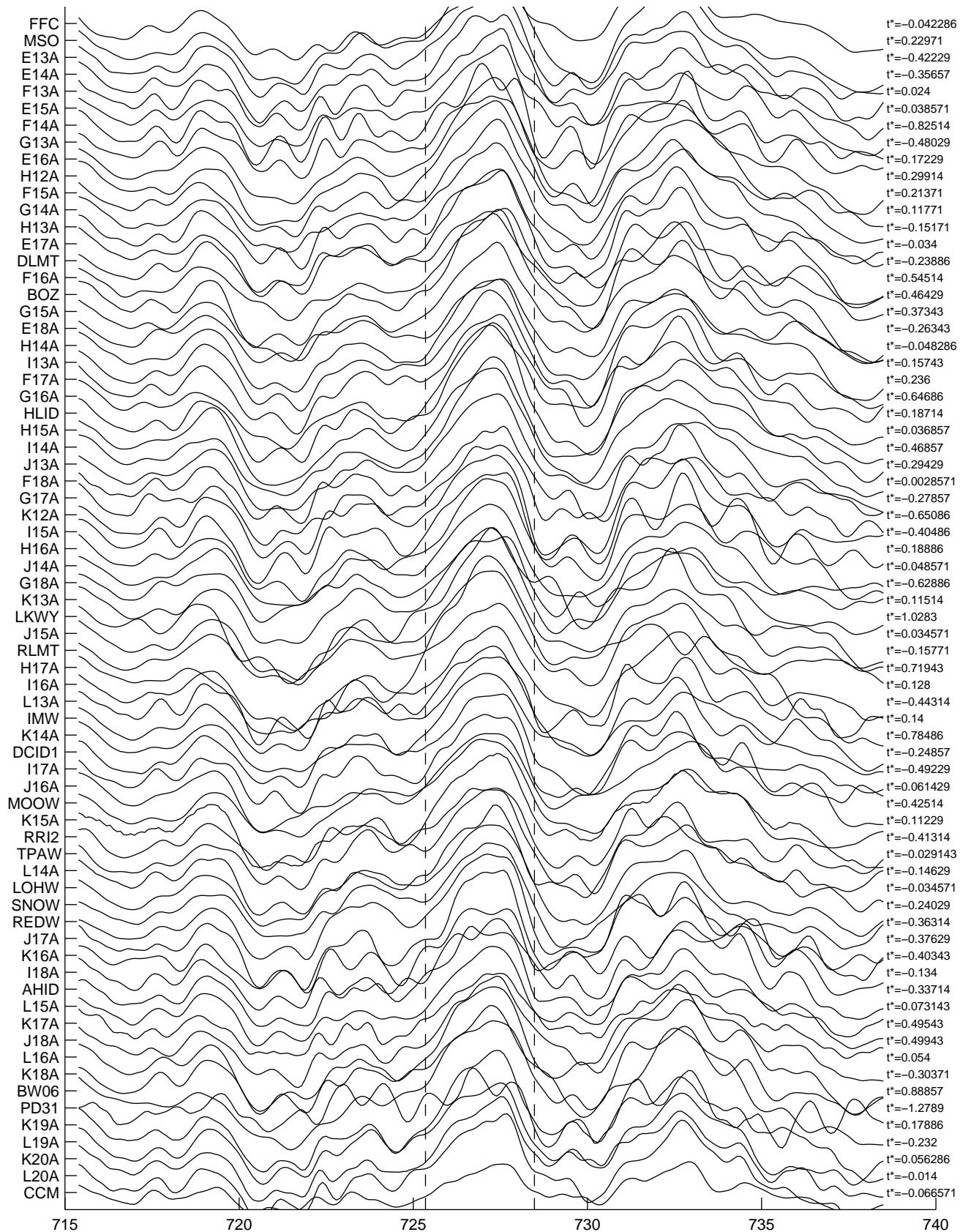
$t^*$  values



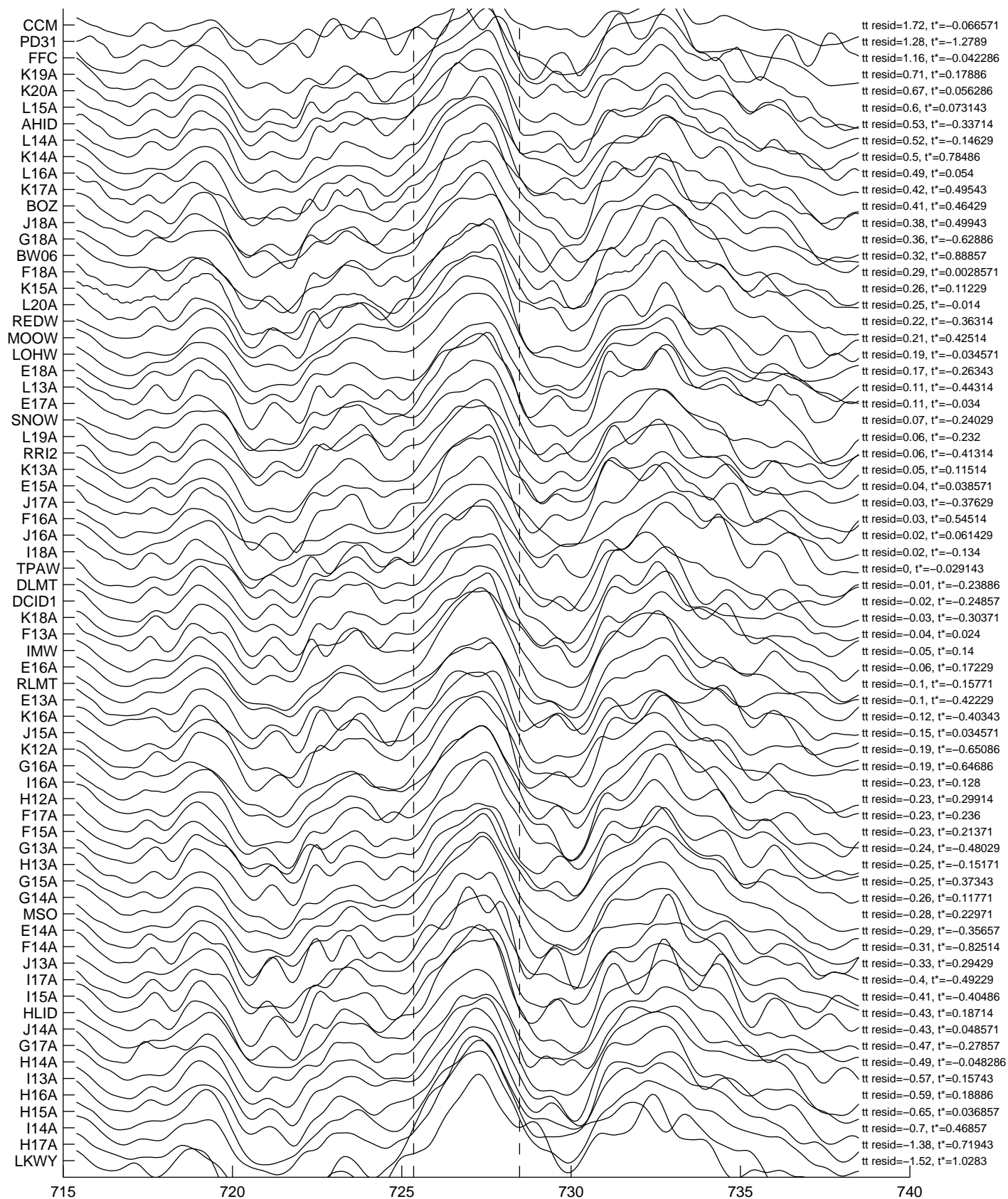
# Event\_2007\_319\_15\_05\_58



# Sorted by Delta:Event\_2007\_319\_15\_05\_58

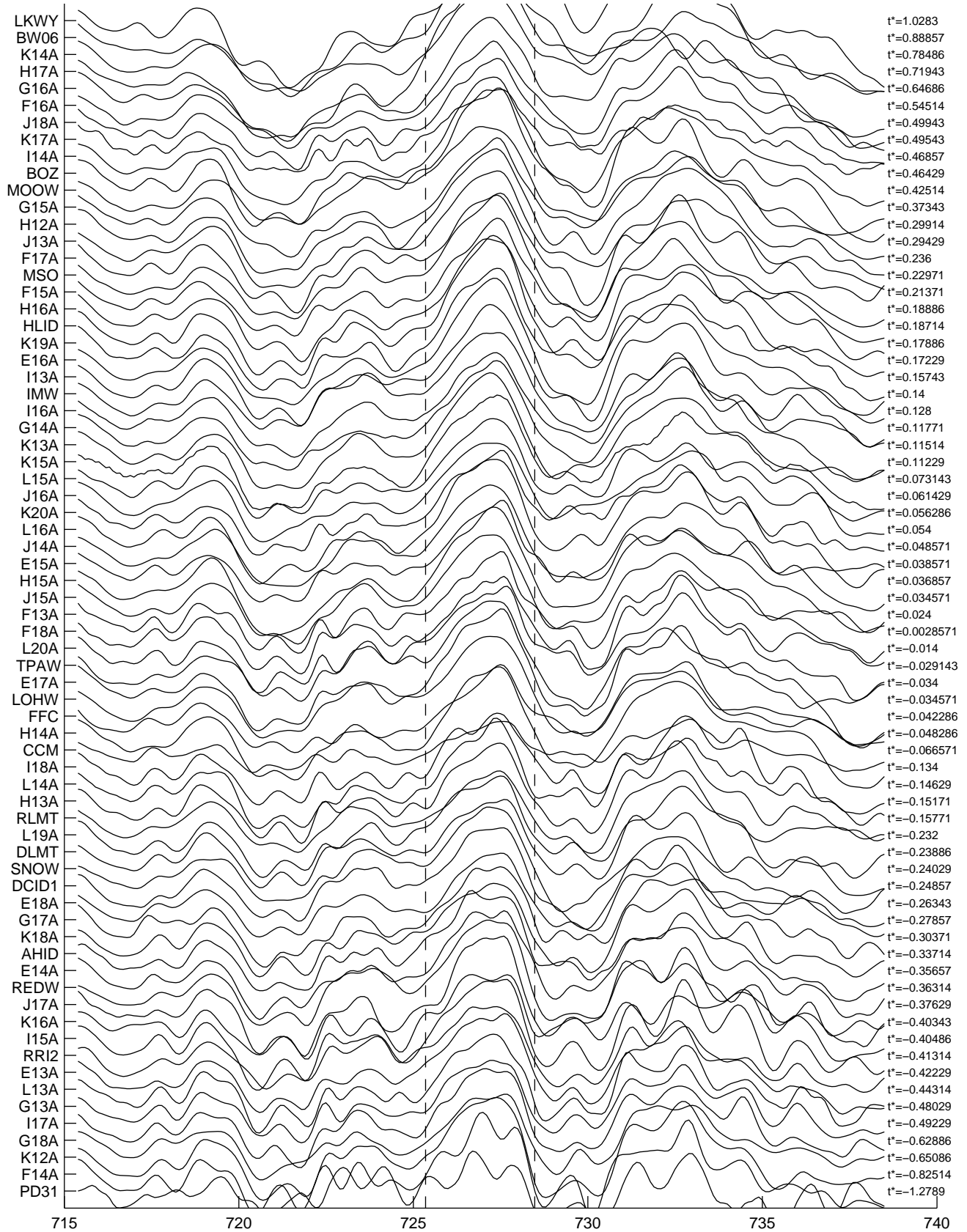


# Sorted by travel time:Event\_2007\_319\_15\_05\_58



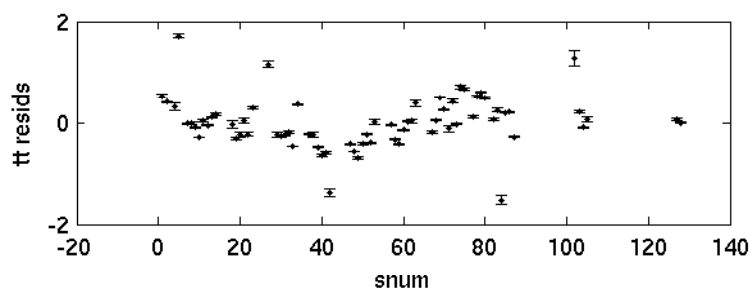
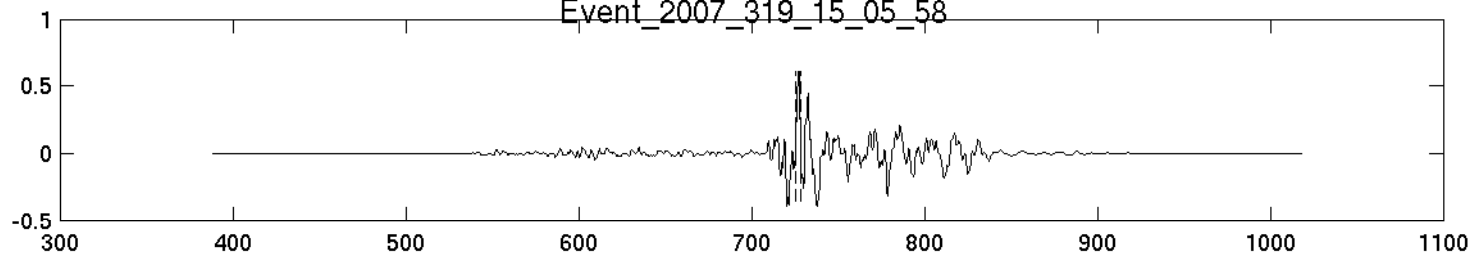


Sorted by t\*:Event\_2007\_319\_15\_05\_58

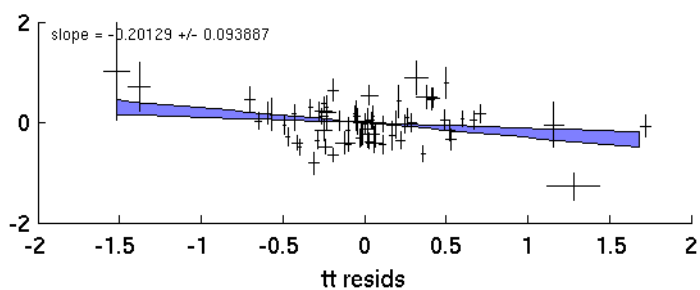
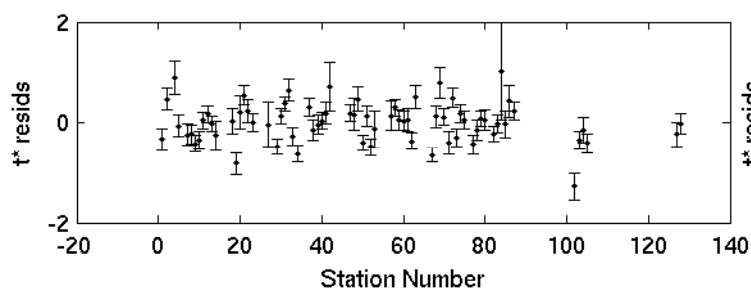


Event\_2007\_319\_15\_05\_58

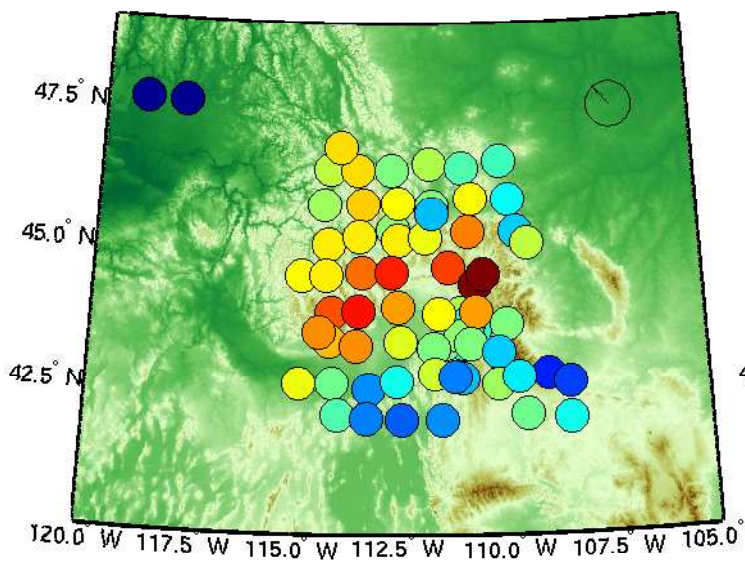
Stack



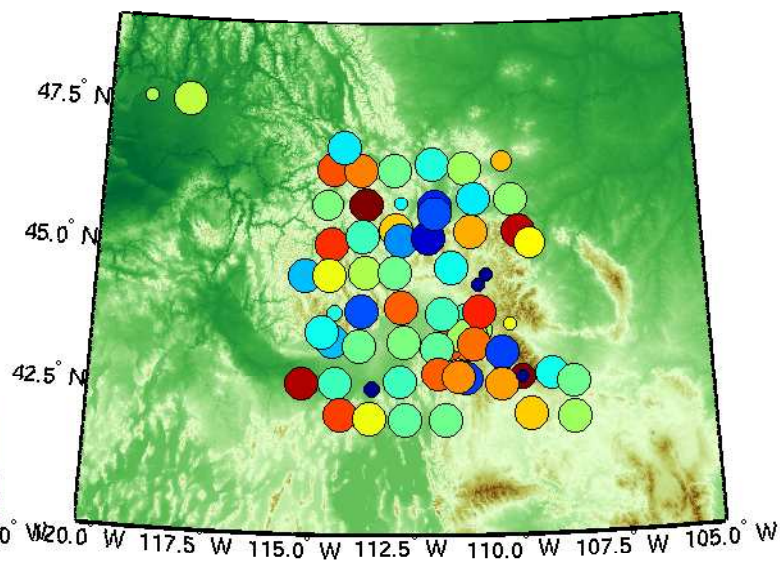
Baz = 141.5706  
Mean xcor value = 0.92557  
Range of  $t^*$  values is 2.3071  
Median  $t^*$  err is 0.19883  
Slope = -0.20129 +/- 0.093887



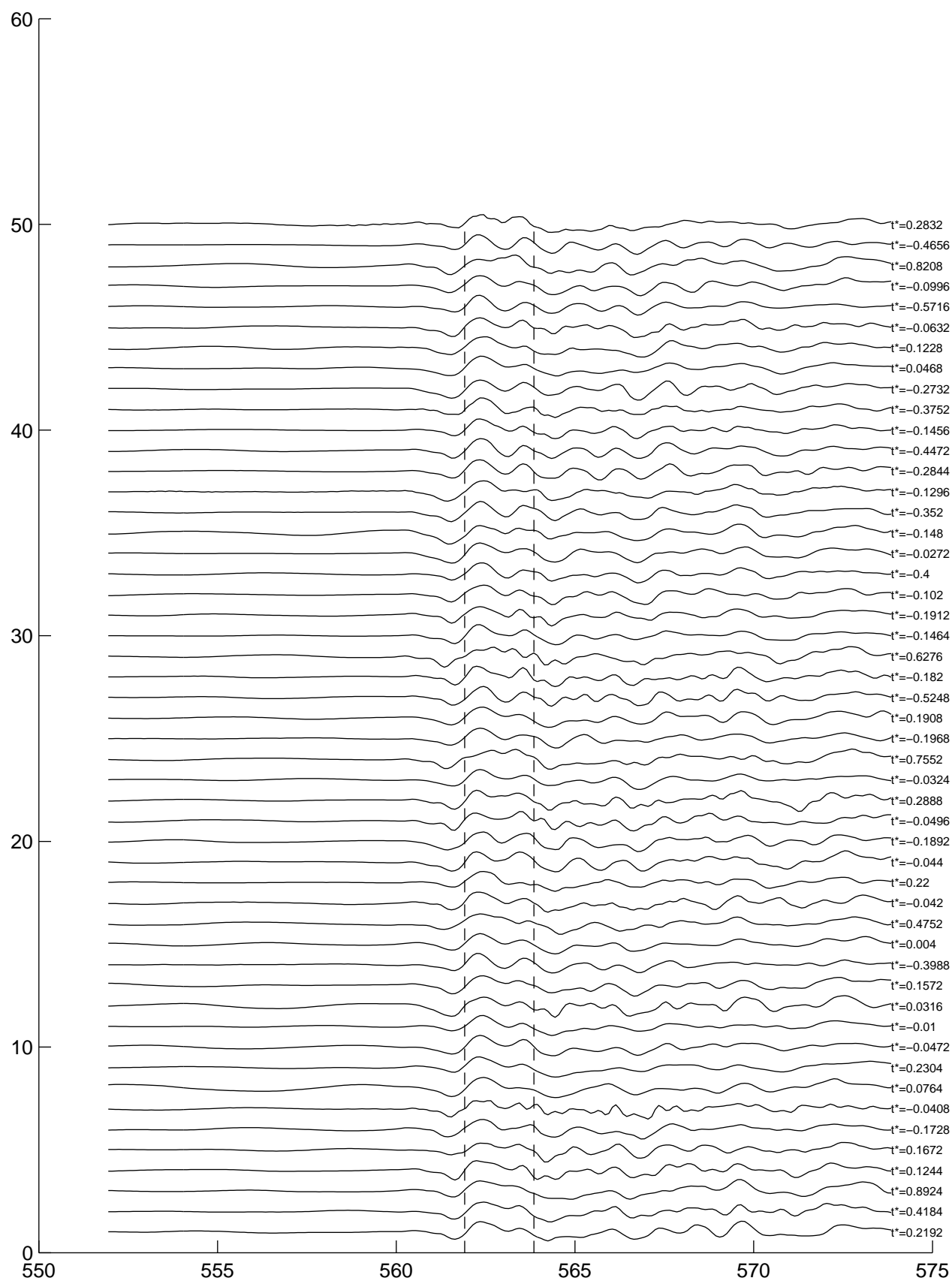
travel time residuals



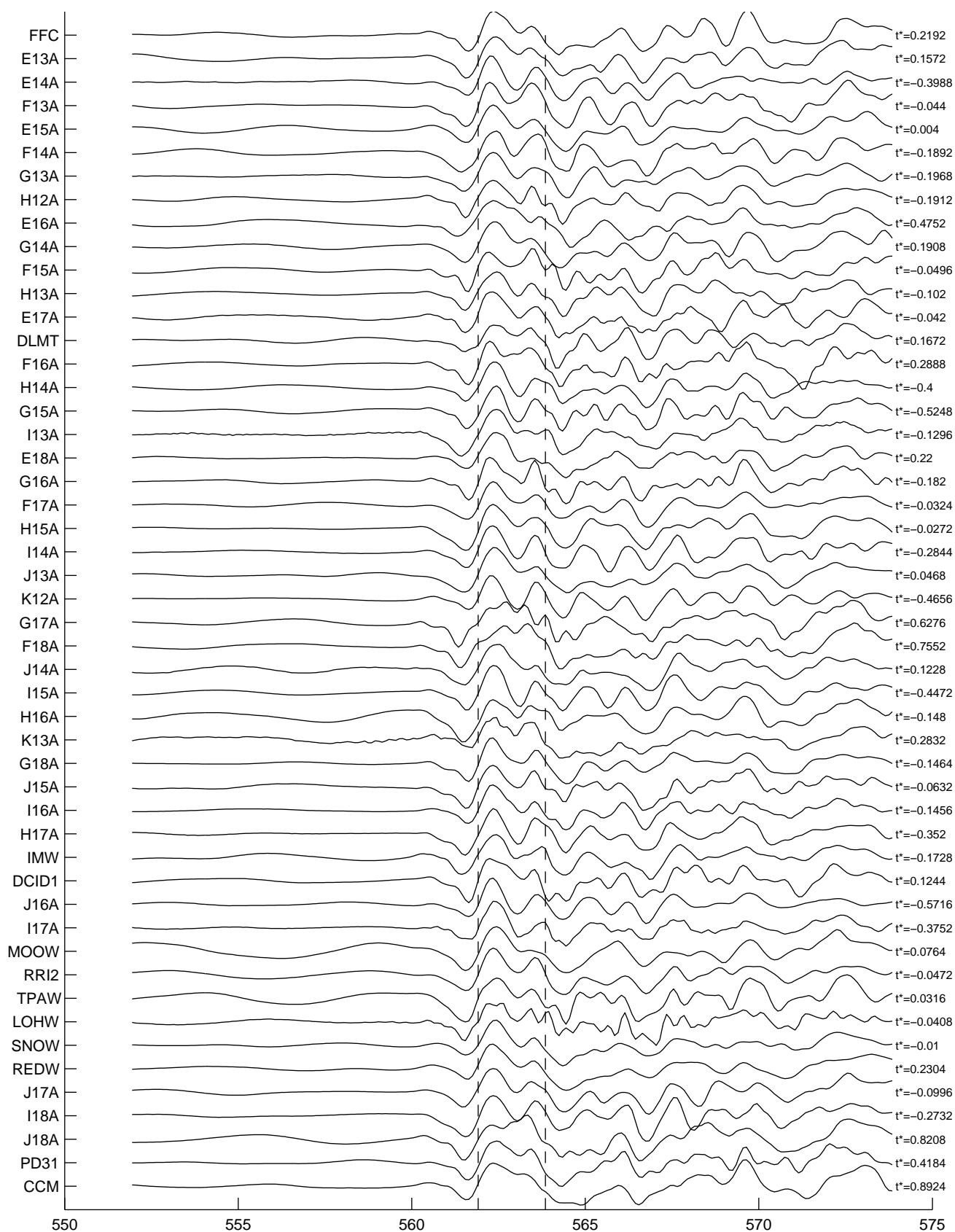
$t^*$  values



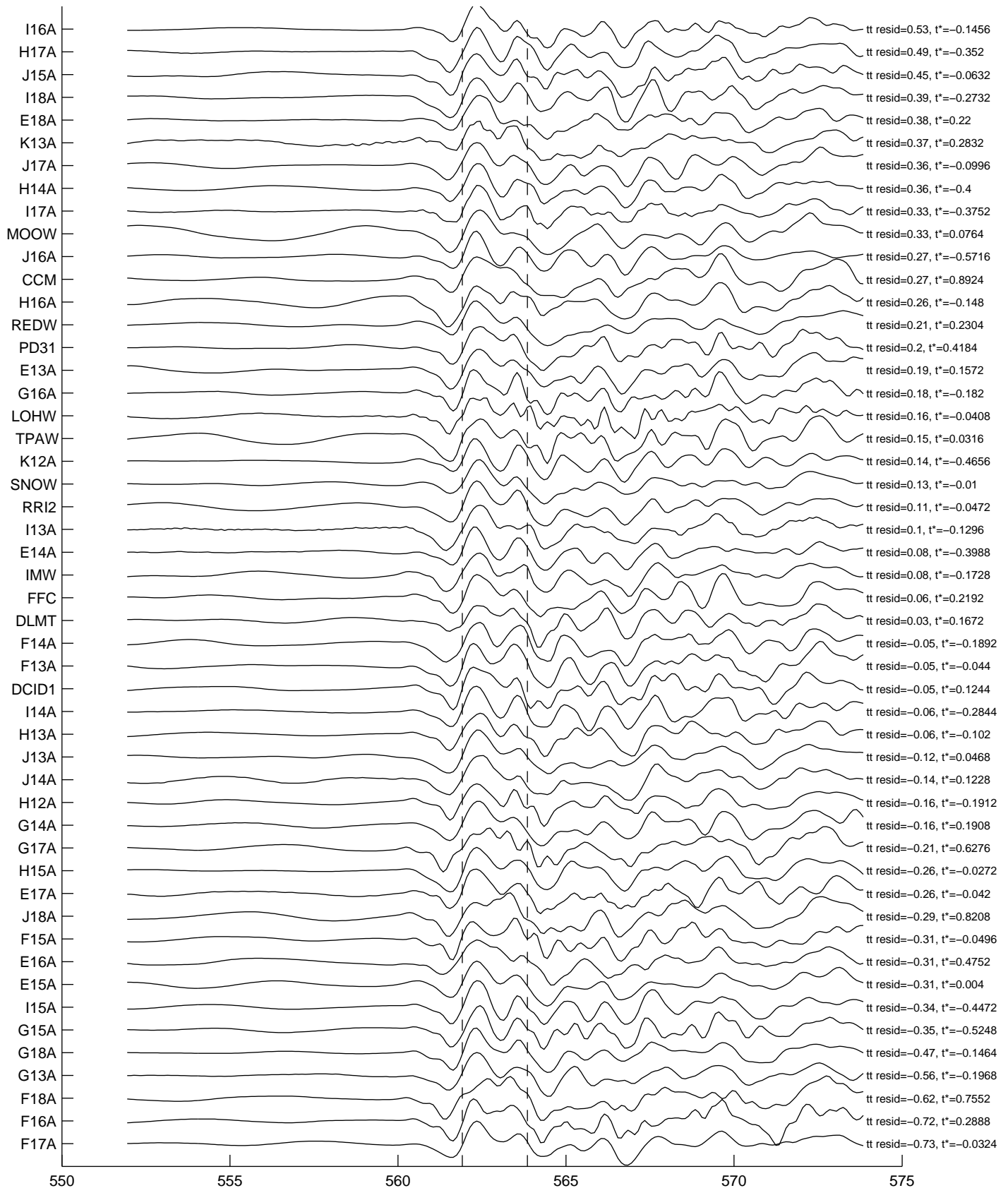
# Event\_2007\_320\_03\_13\_00



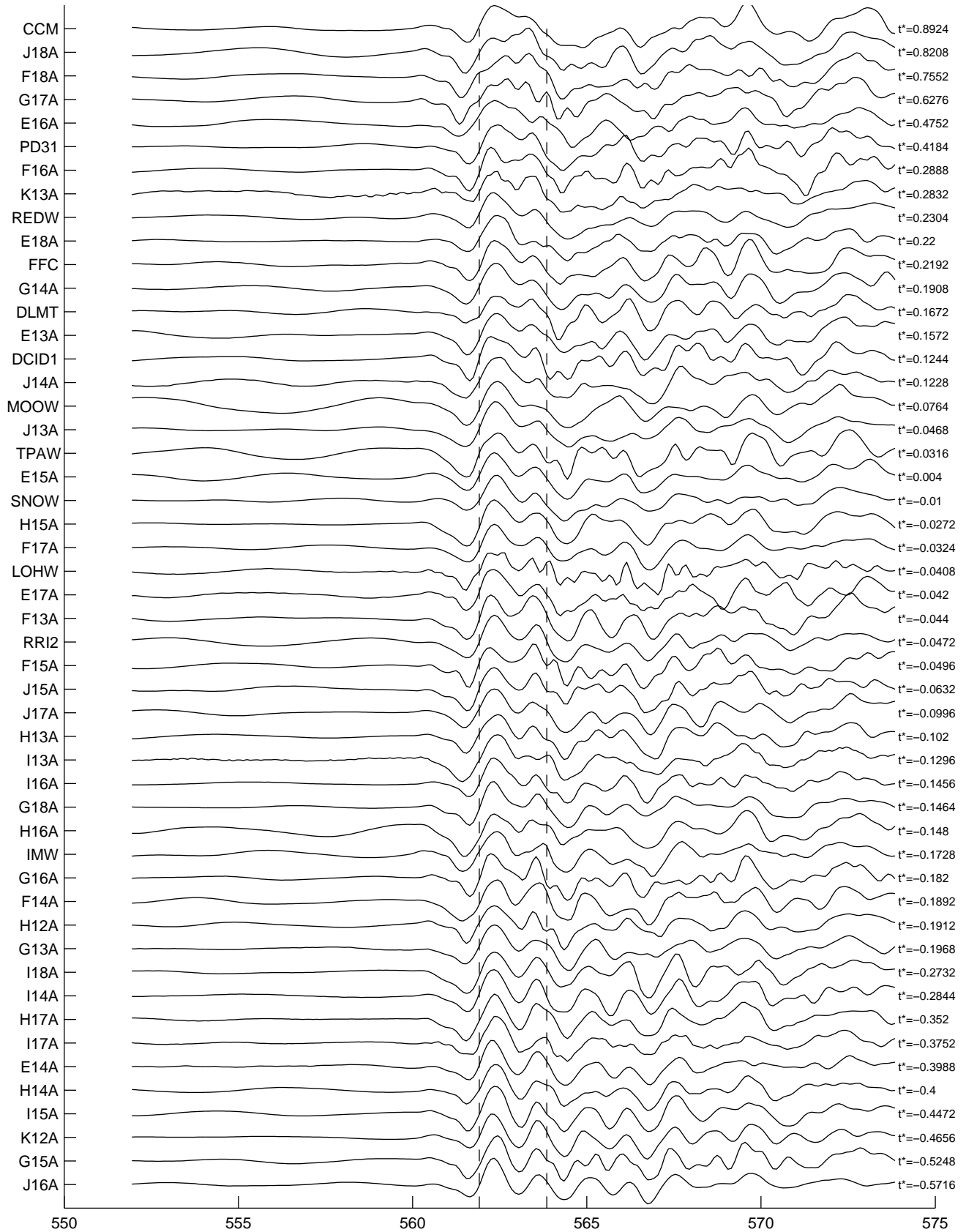
# Sorted by Delta:Event\_2007\_320\_03\_13\_00



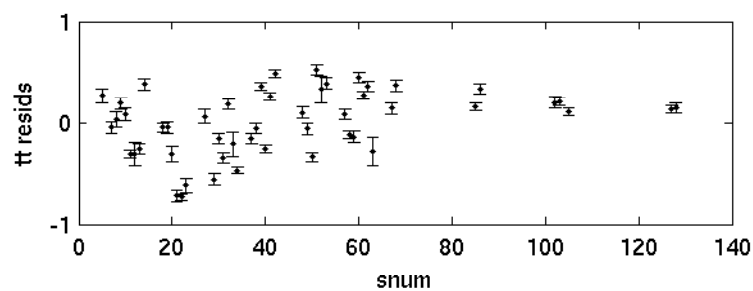
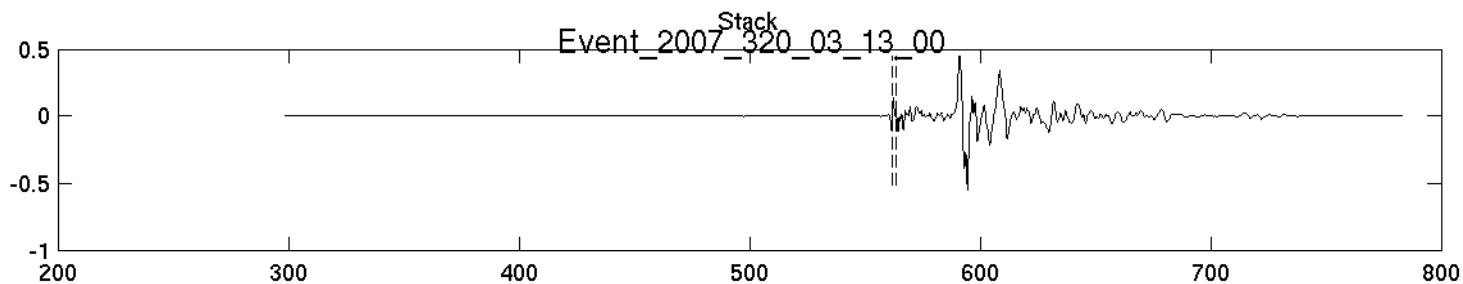
# Sorted by travel time:Event\_2007\_320\_03\_13\_00



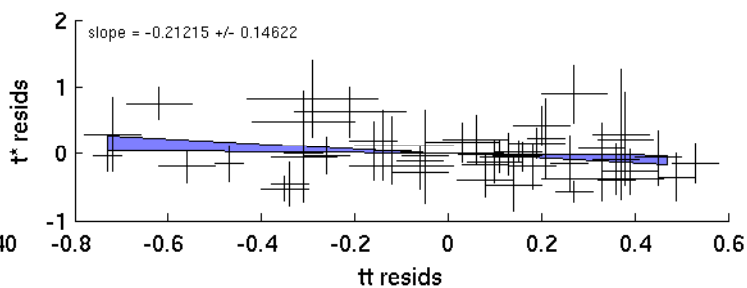
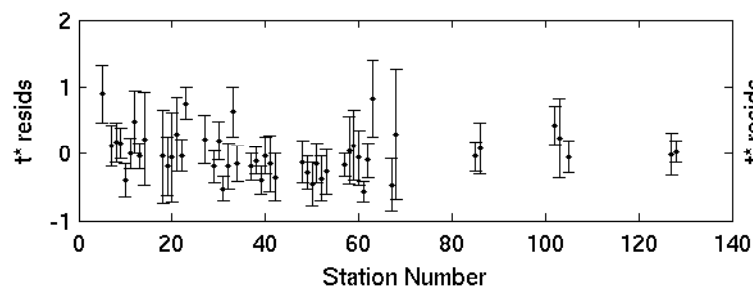
# Sorted by $t^*$ :Event\_2007\_320\_03\_13\_00



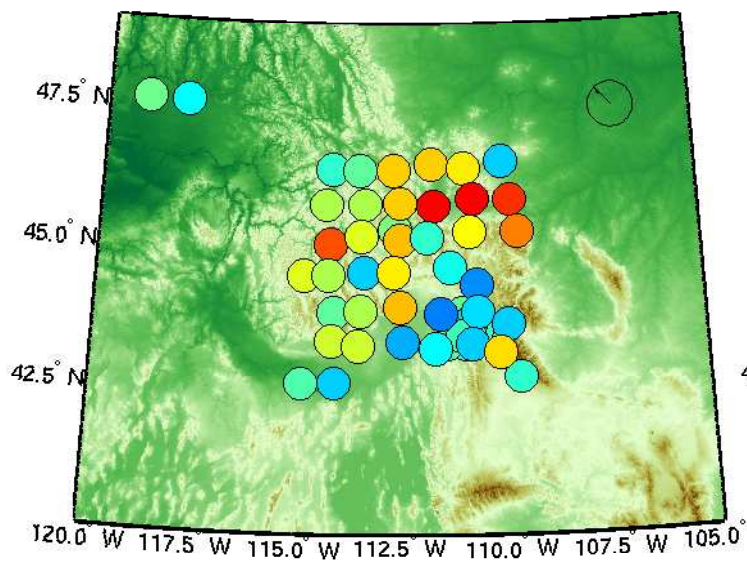
Event\_2007\_320\_03\_13\_00



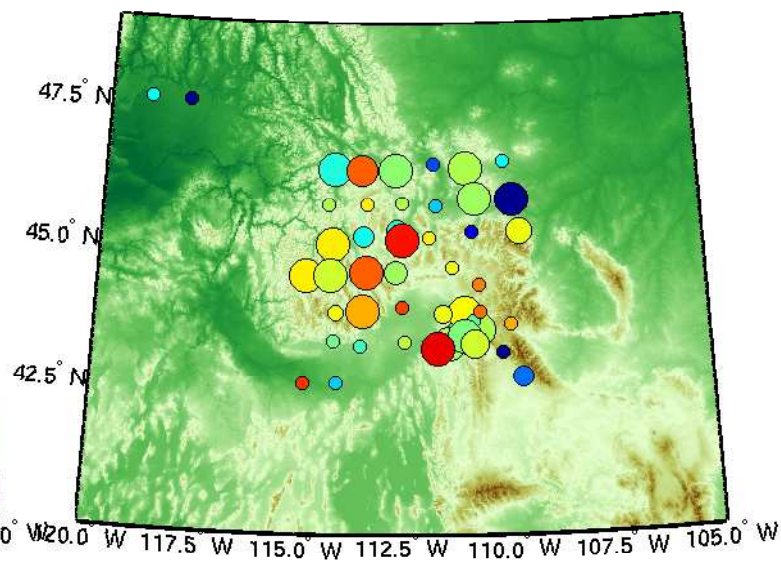
Baz = 137.8943  
 Mean xcor value = 0.6606  
 Range of  $t^*$  values is 1.464  
 Median  $t^*$  err is 0.31107  
 Slope = -0.21215 +/- 0.14622



travel time residuals

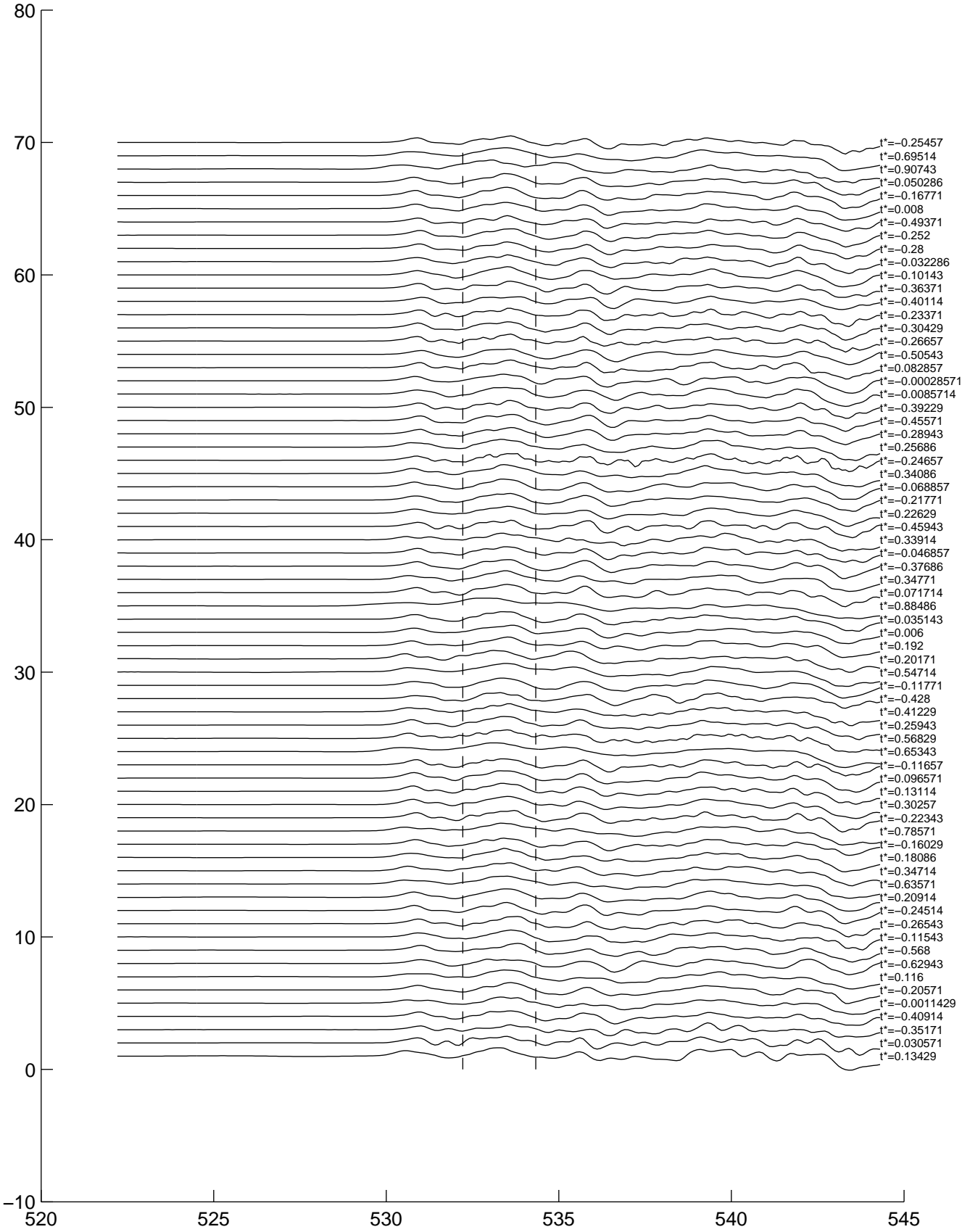


$t^*$  values



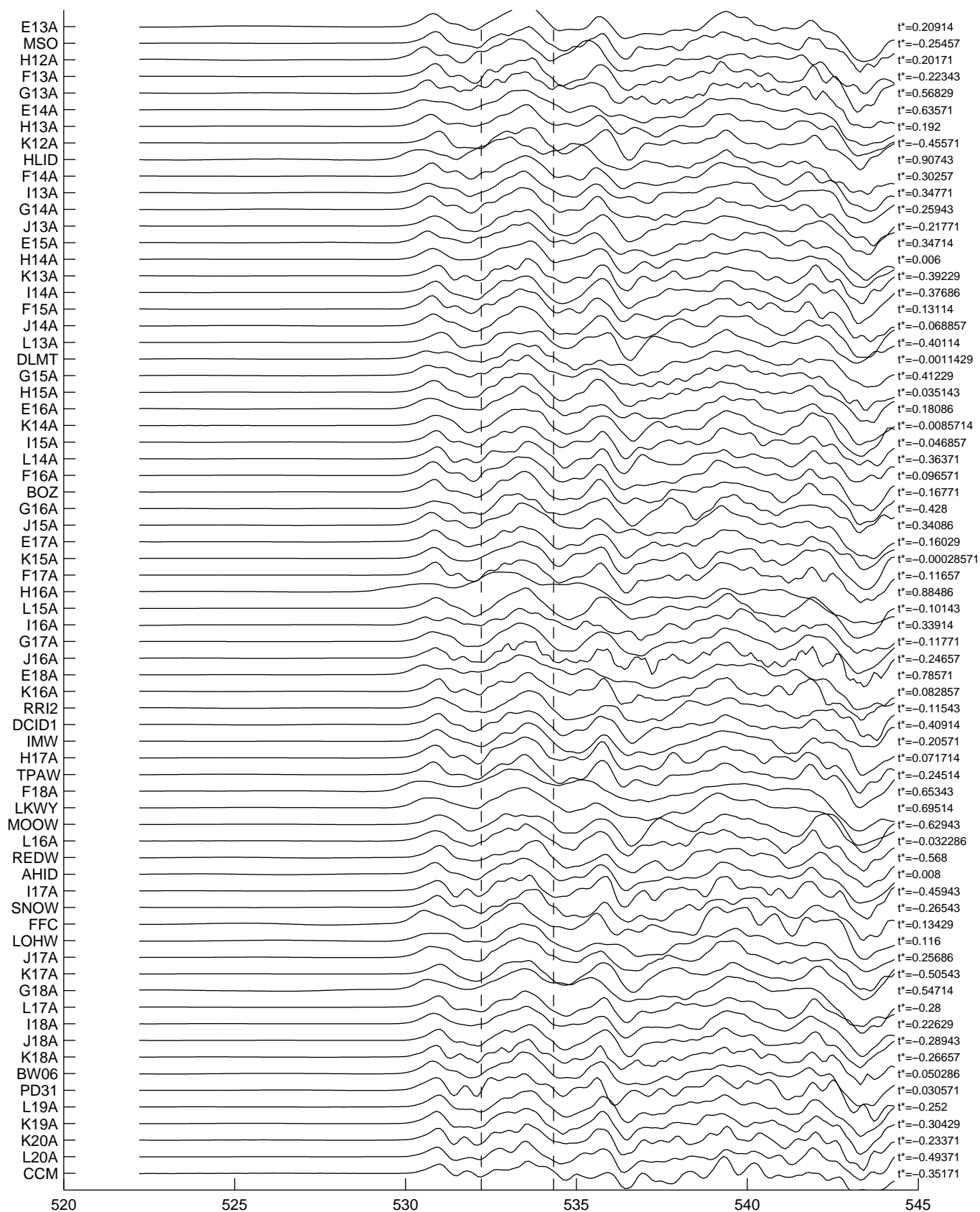


Event\_2007\_333\_19\_00\_19

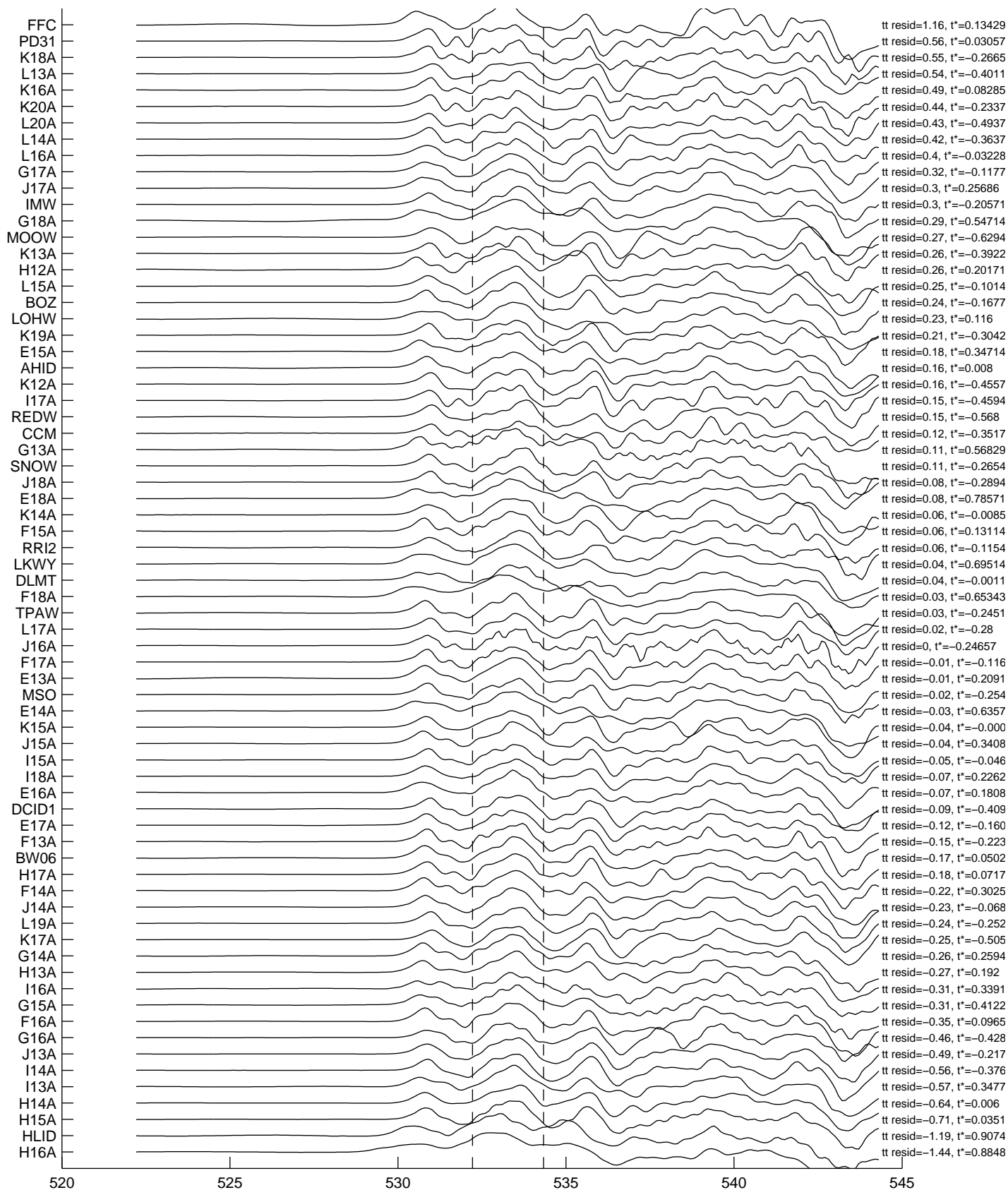




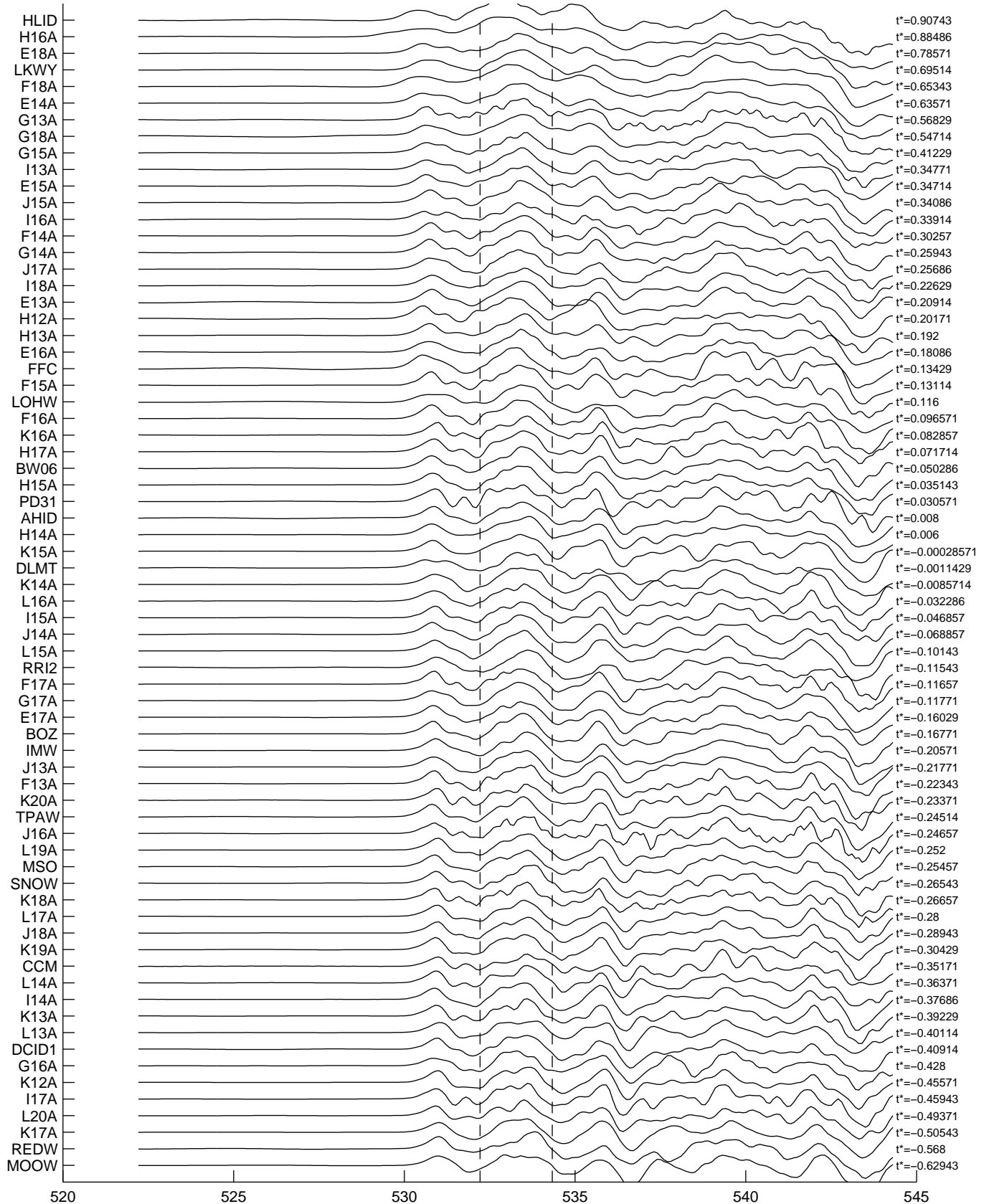
# Sorted by Delta:Event\_2007\_333\_19\_00\_19



# Sorted by travel time:Event\_2007\_333\_19\_00\_19

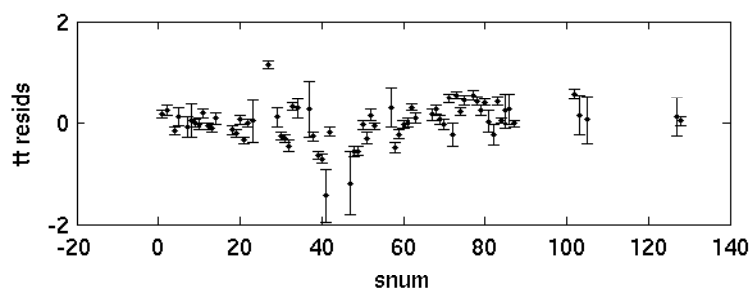
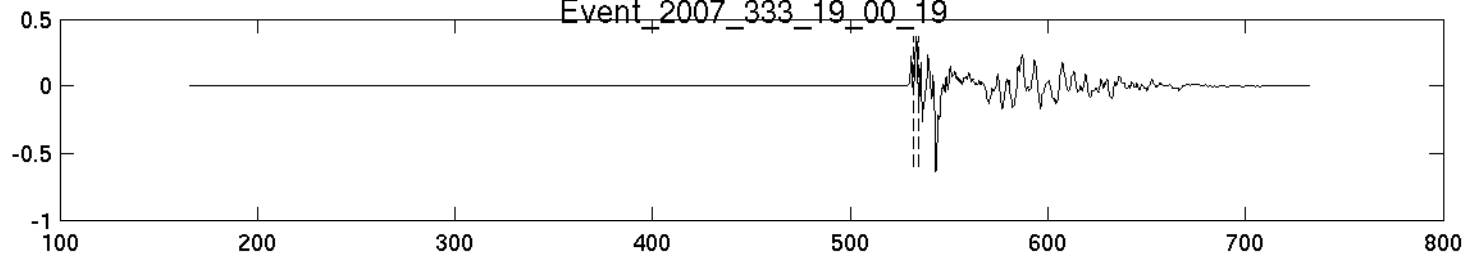


Sorted by t\*:Event\_2007\_333\_19\_00\_19

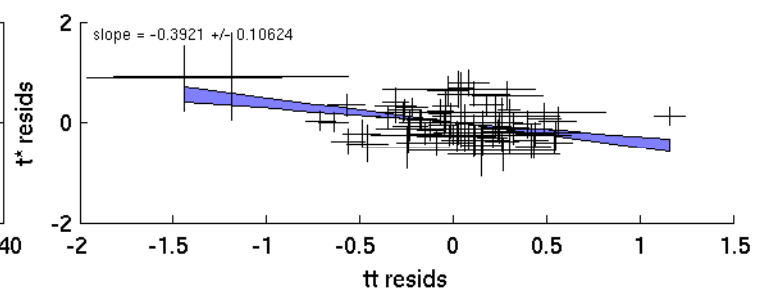
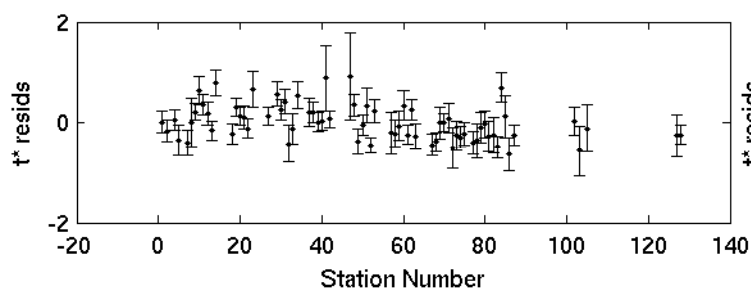


Event\_2007\_333\_19\_00\_19

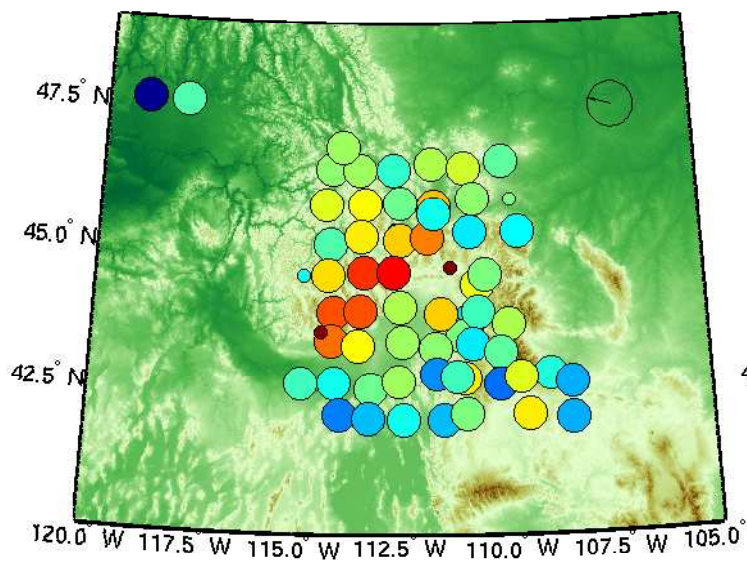
Stack



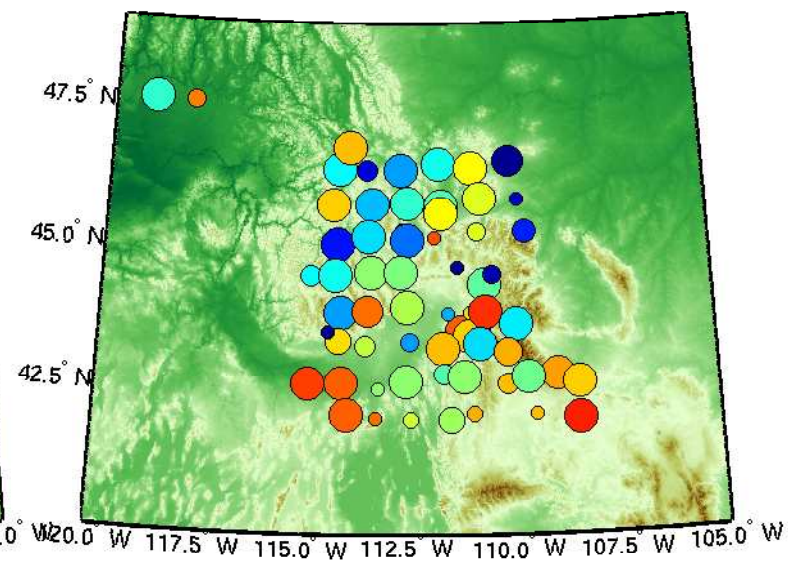
Baz = 108.4341  
Mean xcor value = 0.81186  
Range of  $t^*$  values is 1.5369  
Median  $t^*$  err is 0.24583  
Slope =  $-0.3921 \pm 0.10624$



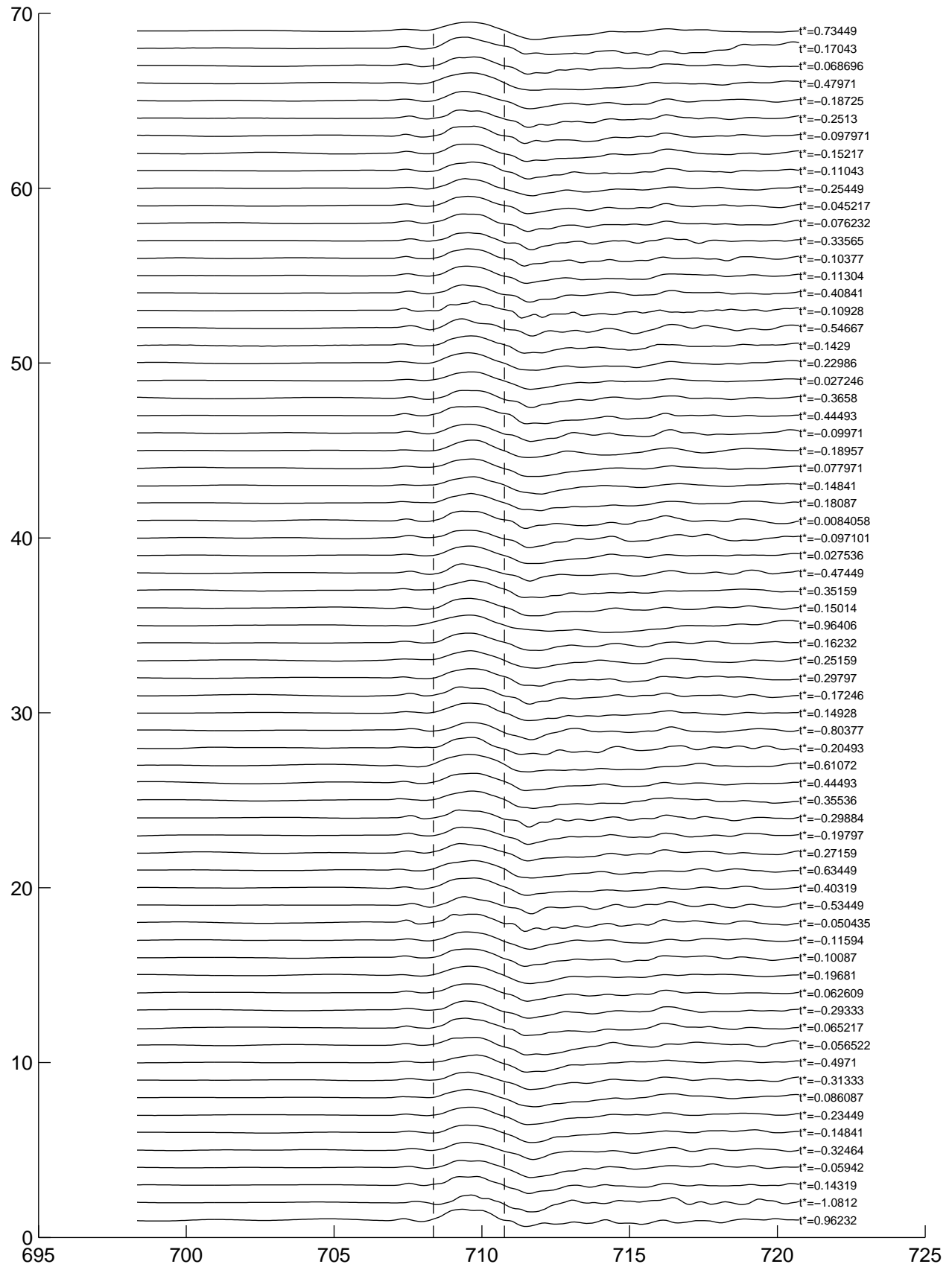
travel time residuals



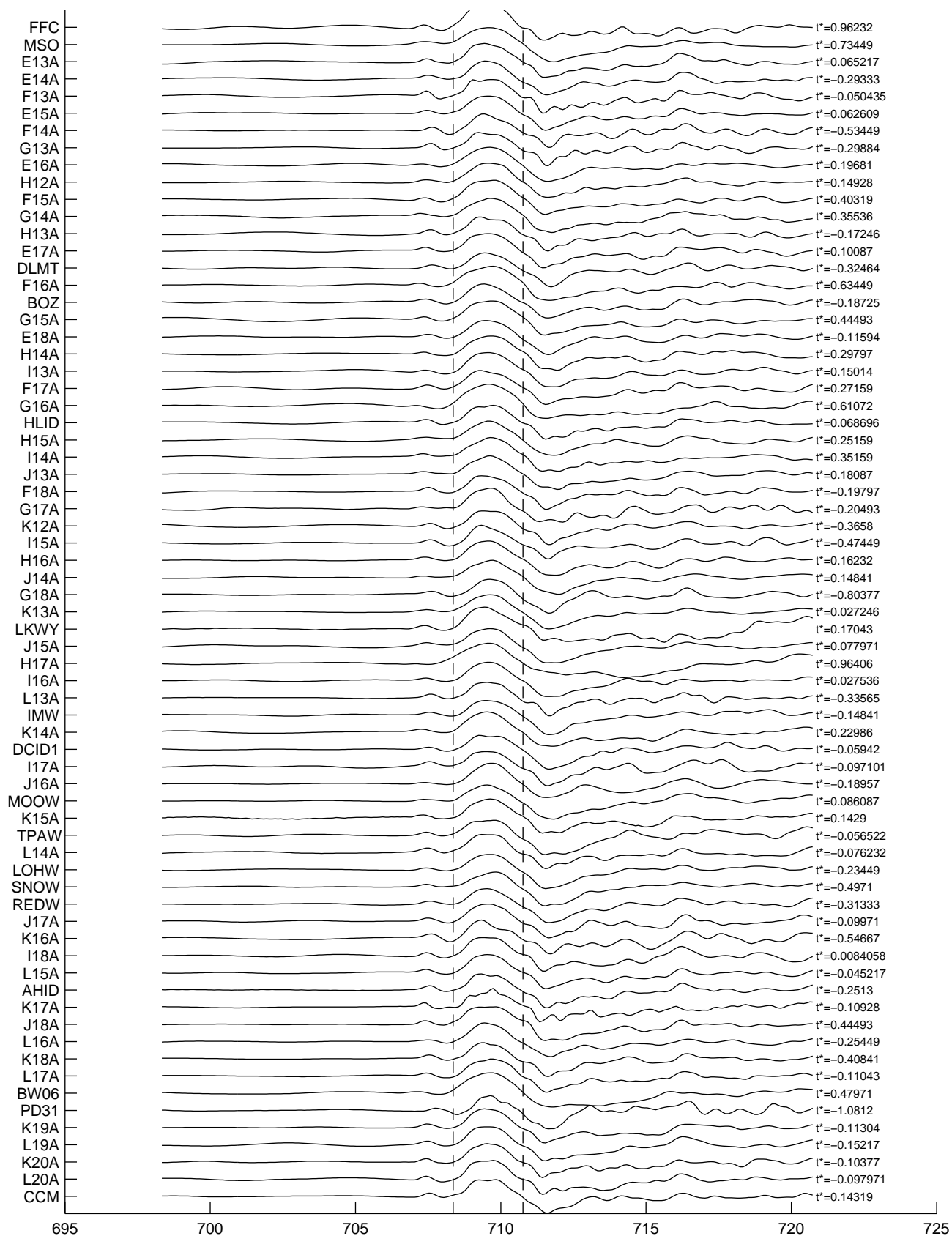
$t^*$  values



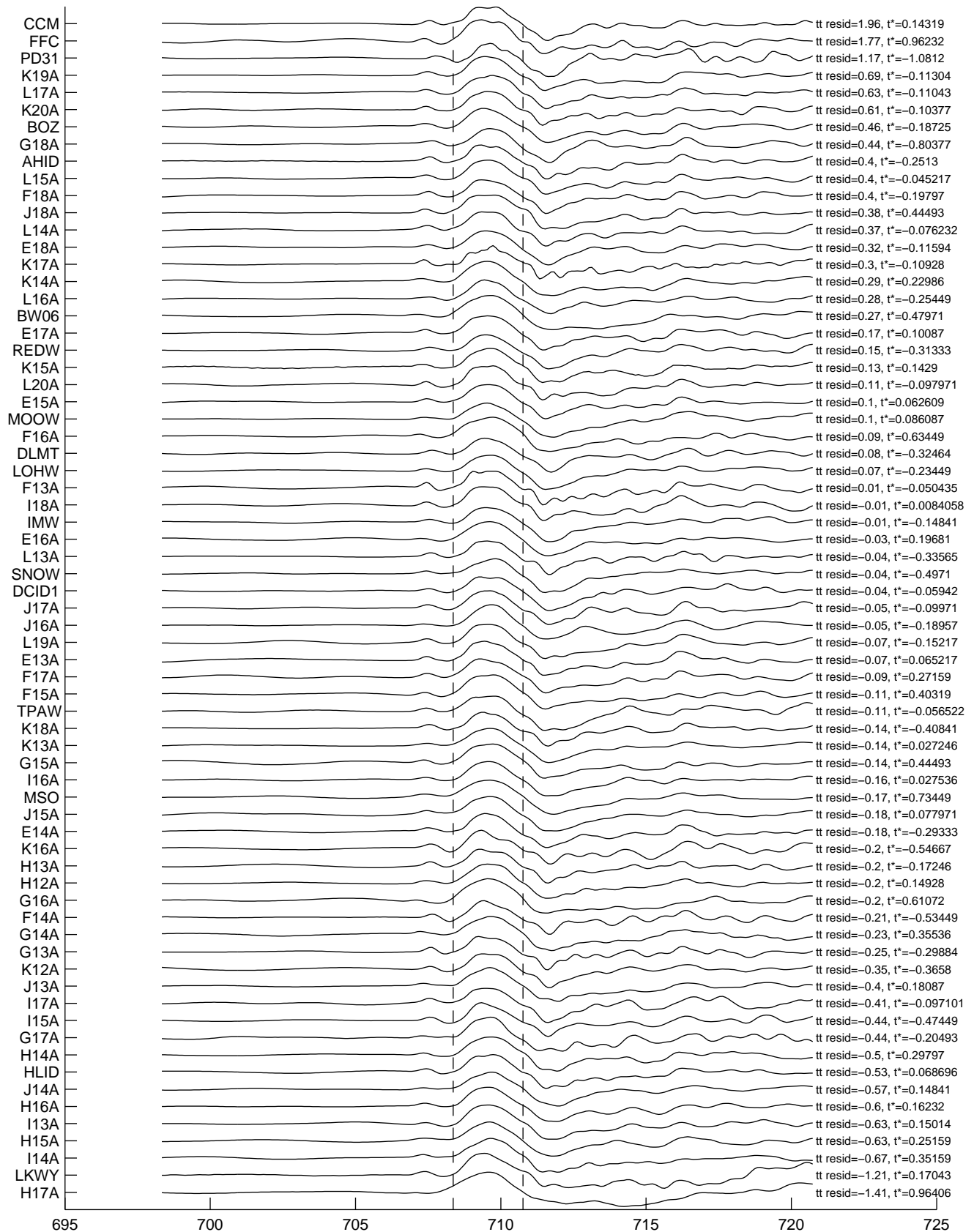
# Event\_2007\_350\_08\_09\_17



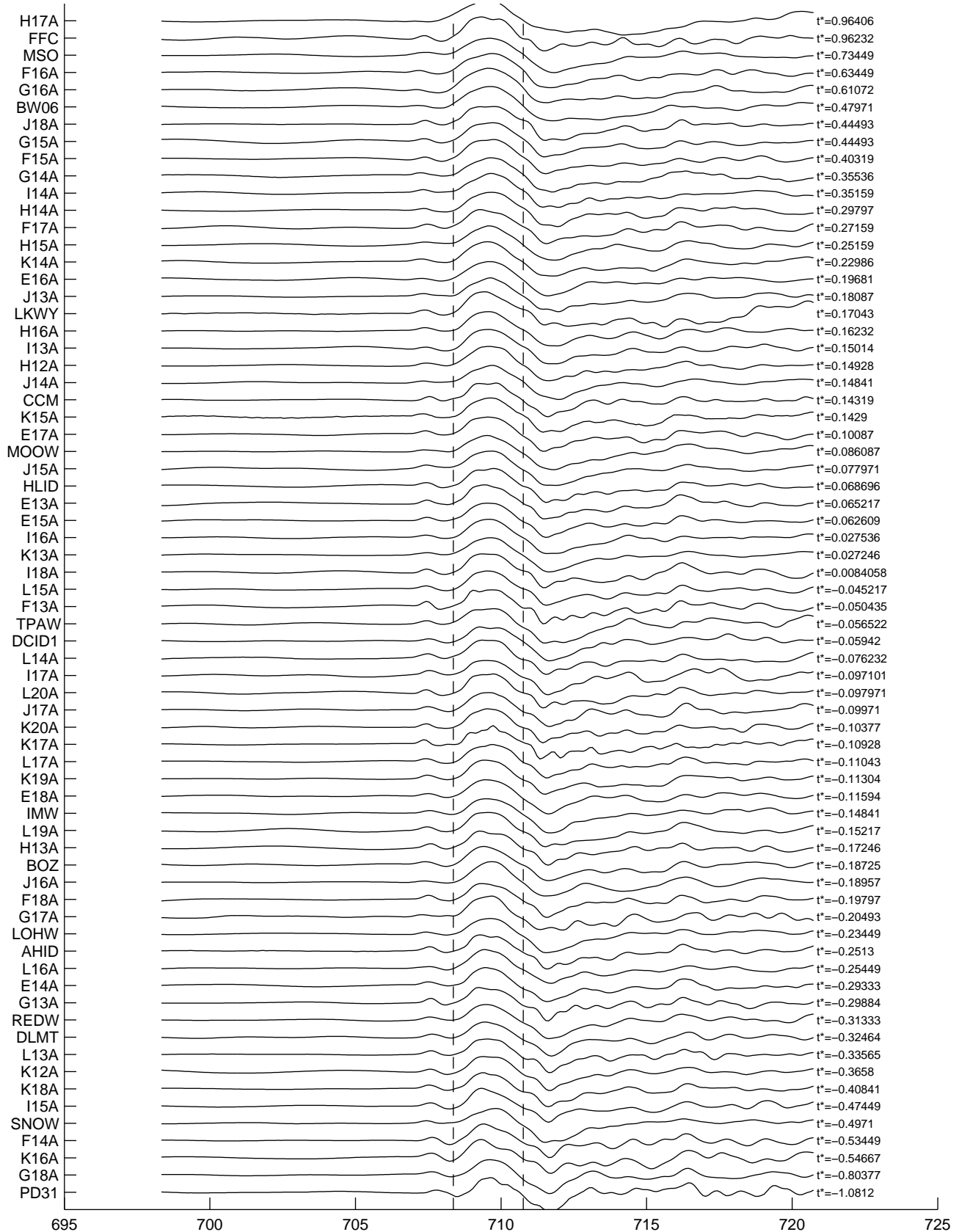
# Sorted by Delta:Event\_2007\_350\_08\_09\_17



# Sorted by travel time: Event\_2007\_350\_08\_09\_17



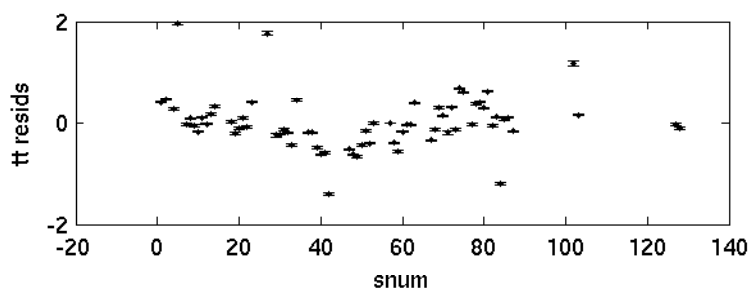
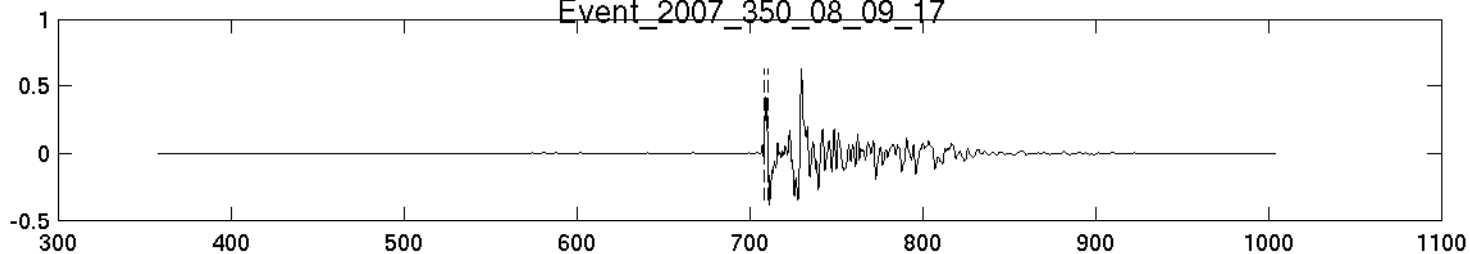
# Sorted by t\*:Event\_2007\_350\_08\_09\_17



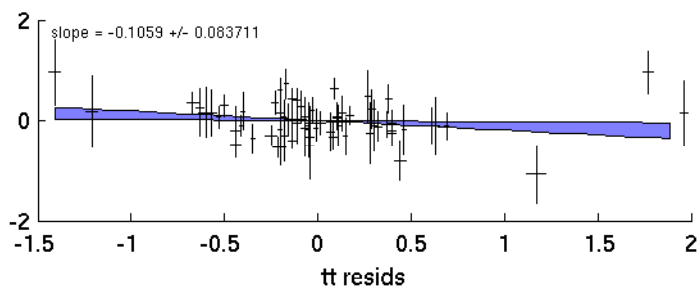
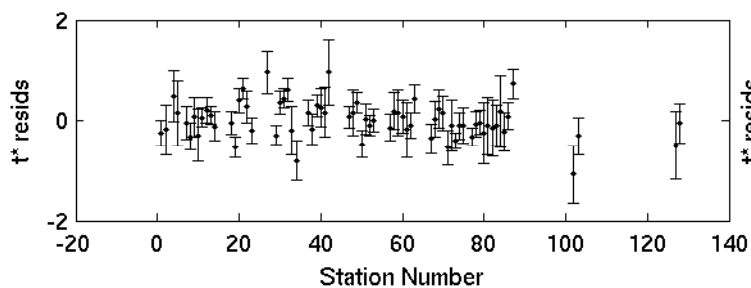


# Event\_2007\_350\_08\_09\_17

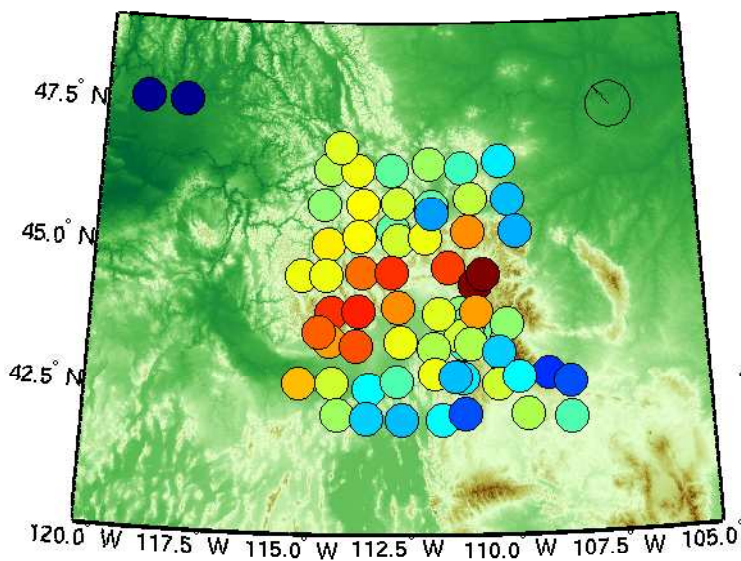
Stack



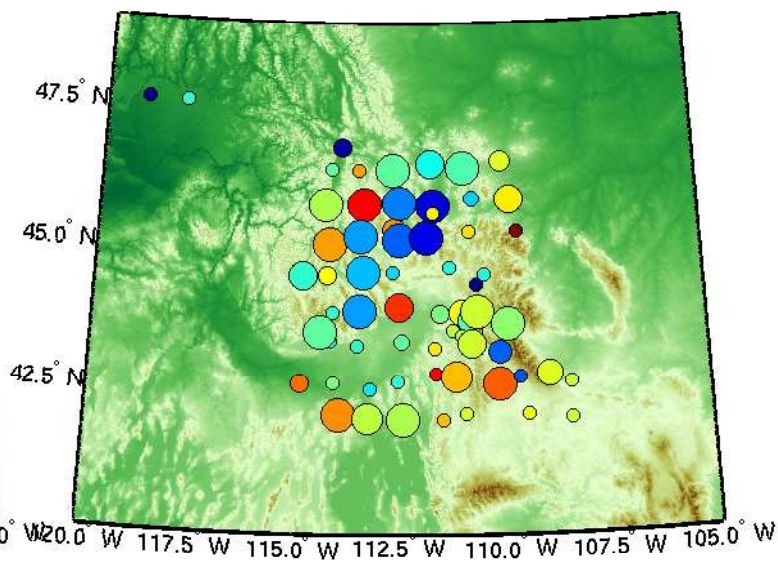
Baz = 141.5151  
Mean xcor value = 0.86797  
Range of  $t^*$  values is 2.0452  
Median  $t^*$  err is 0.30027  
Slope =  $-0.1059 \pm 0.083711$



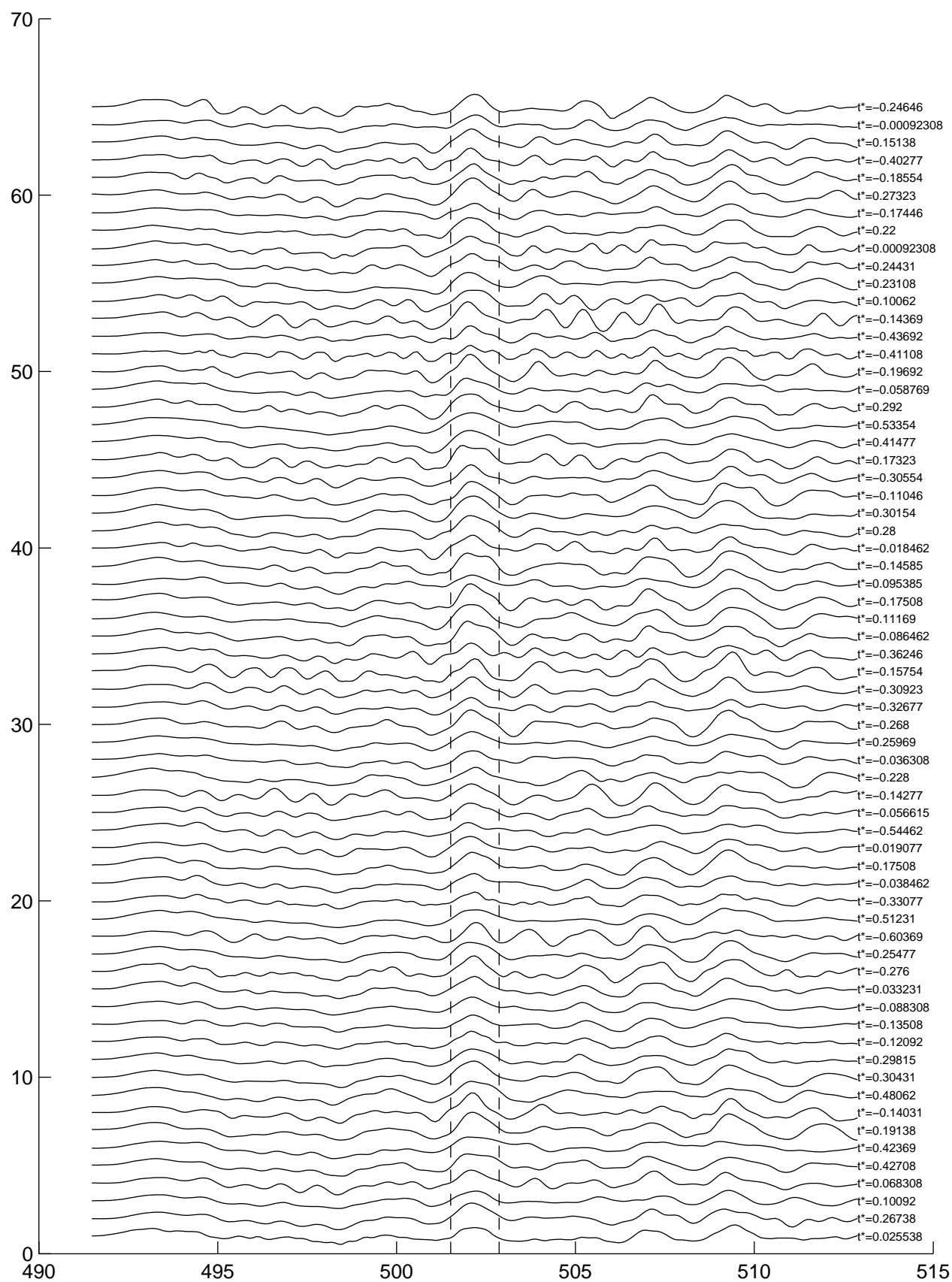
travel time residuals



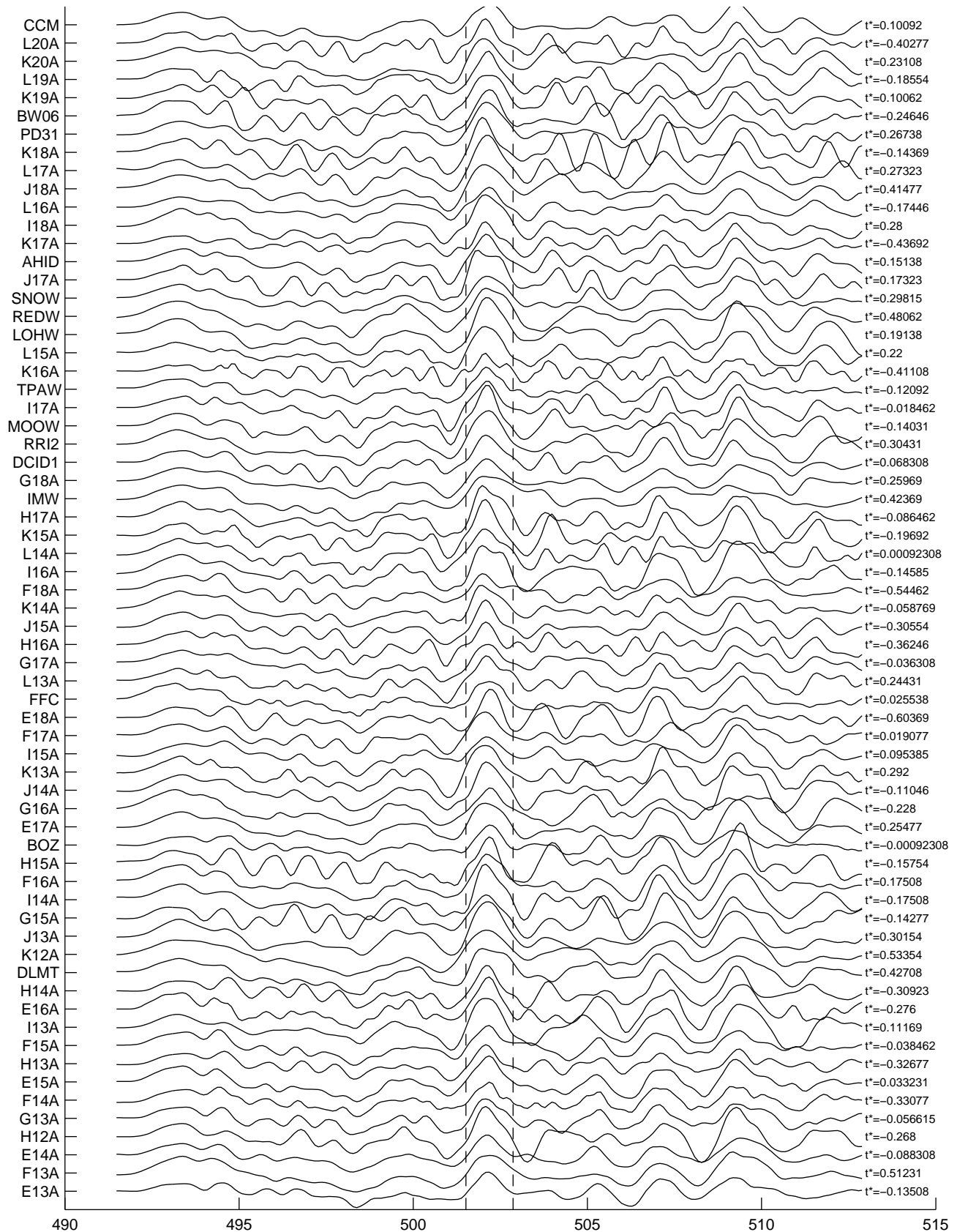
$t^*$  values



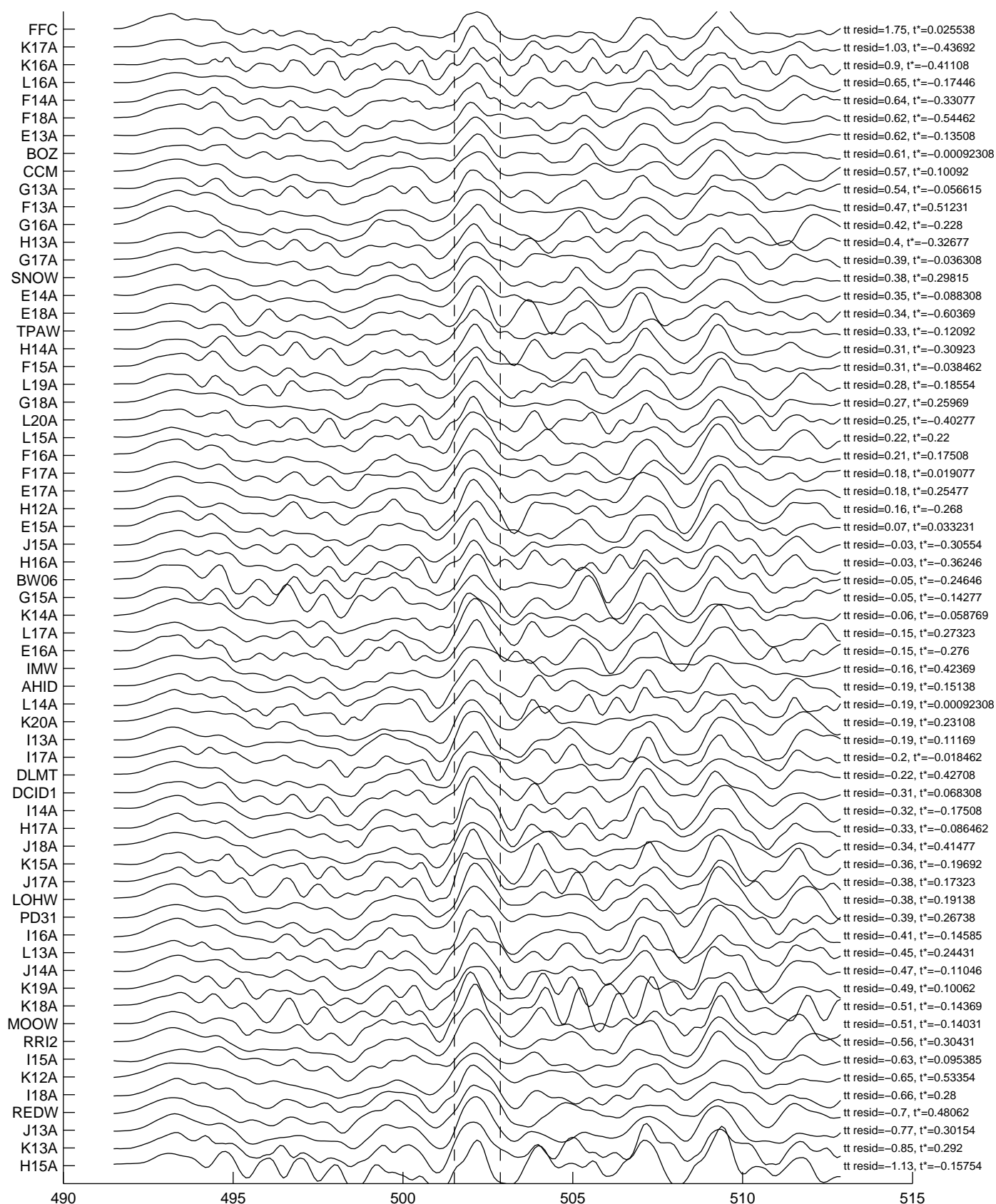
# Event\_2007\_353\_09\_30\_27



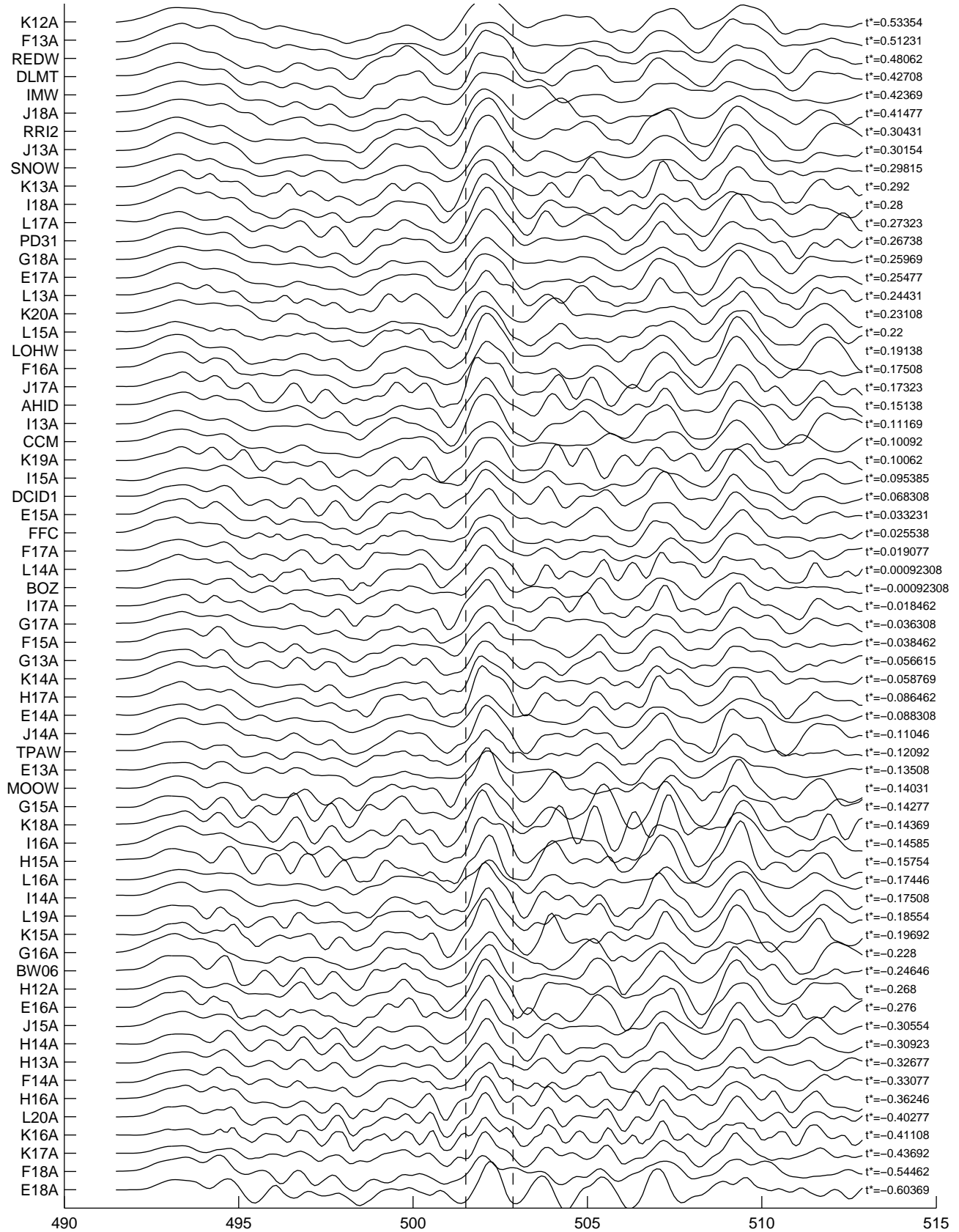
# Sorted by Delta:Event\_2007\_353\_09\_30\_27



# Sorted by travel time:Event\_2007\_353\_09\_30\_27

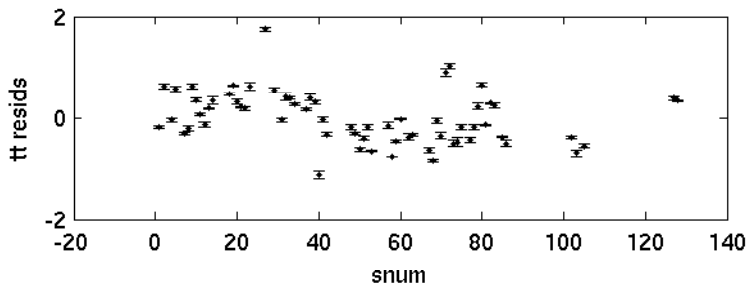
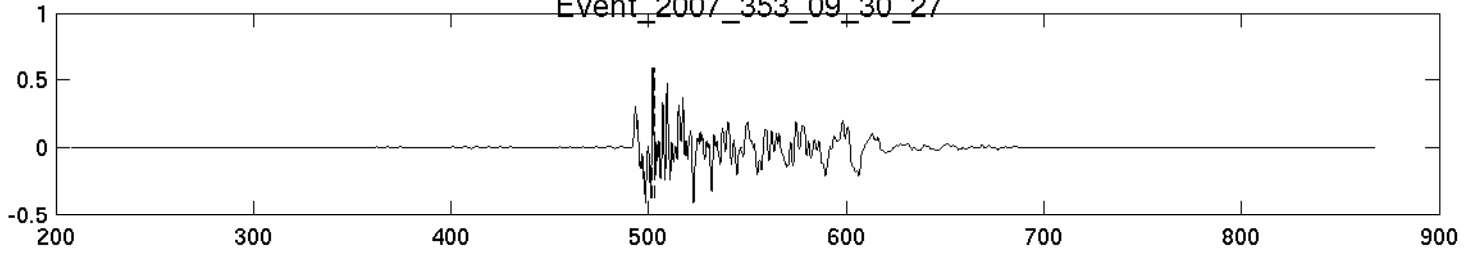


# Sorted by $t^*$ :Event\_2007\_353\_09\_30\_27

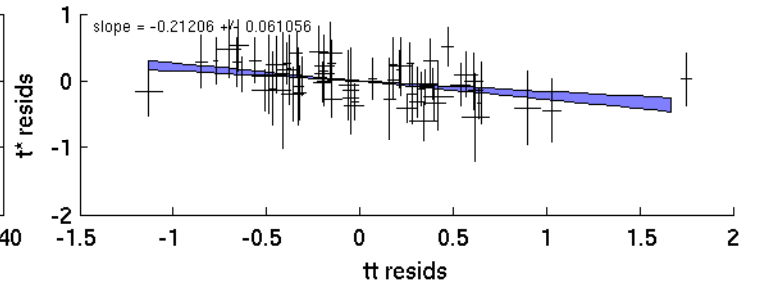
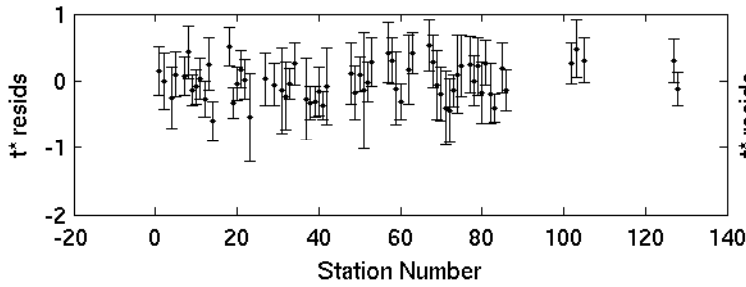


# Event\_2007\_353\_09\_30\_27

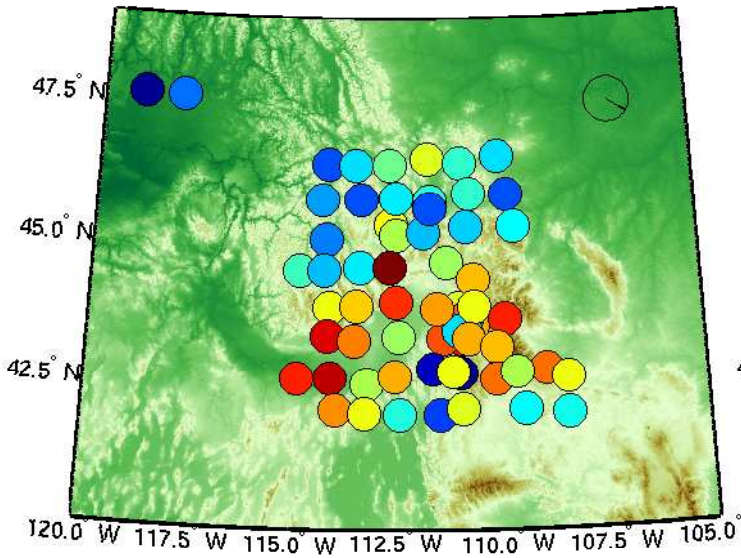
Stack



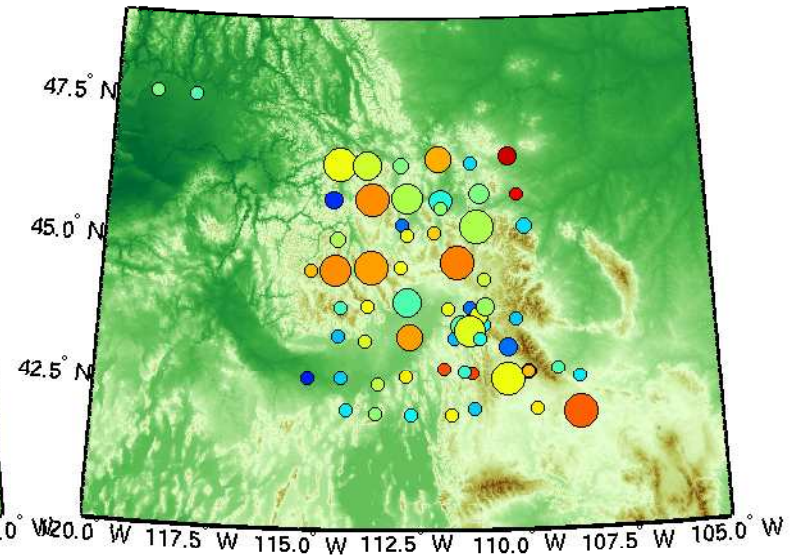
Baz = 304.503  
Mean xcor value = 0.77477  
Range of  $t^*$  values is 1.1372  
Median  $t^*$  err is 0.36604  
Slope = -0.21206 +/- 0.061056



travel time residuals

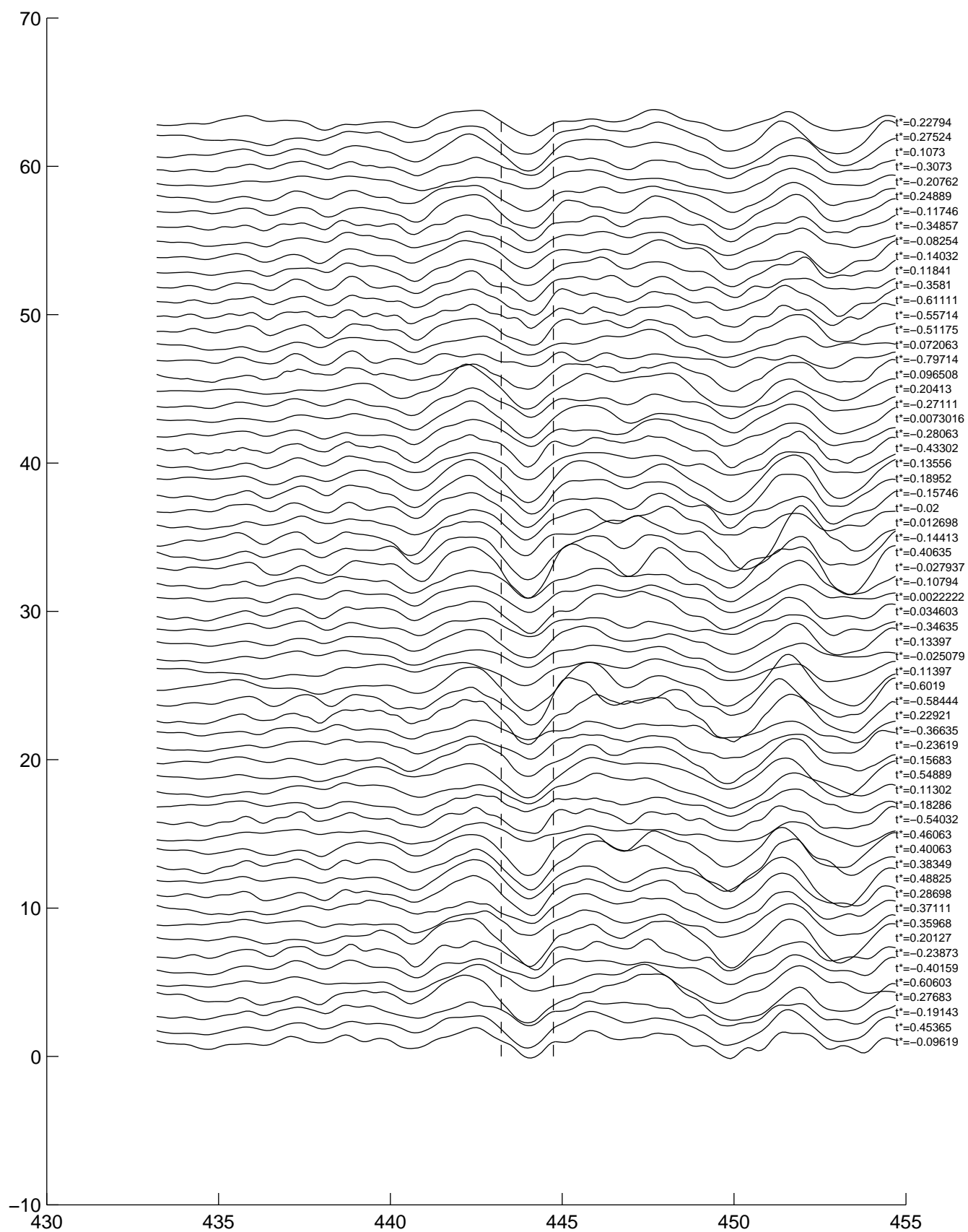


$t^*$  values

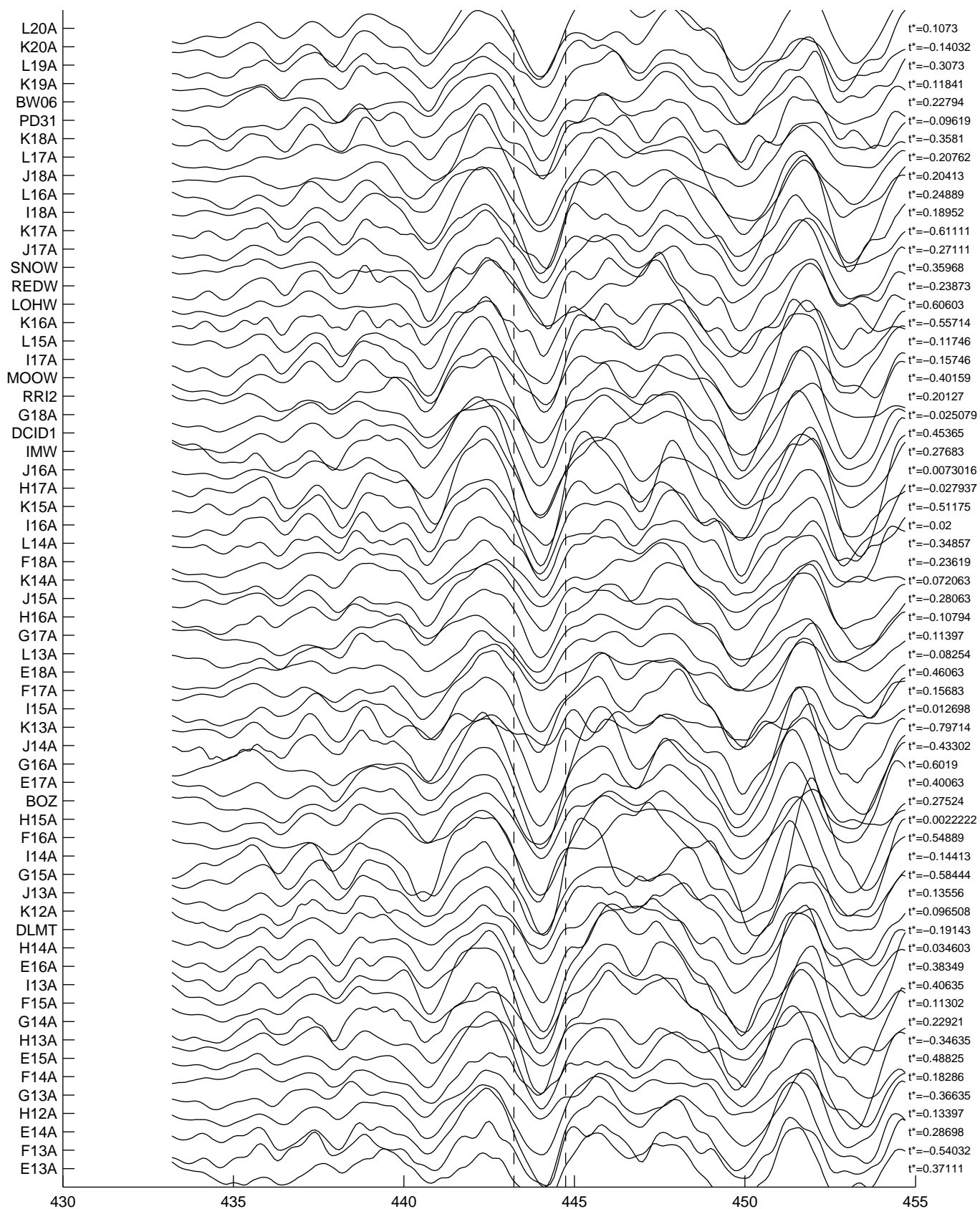




# Event\_2007\_360\_22\_04\_56

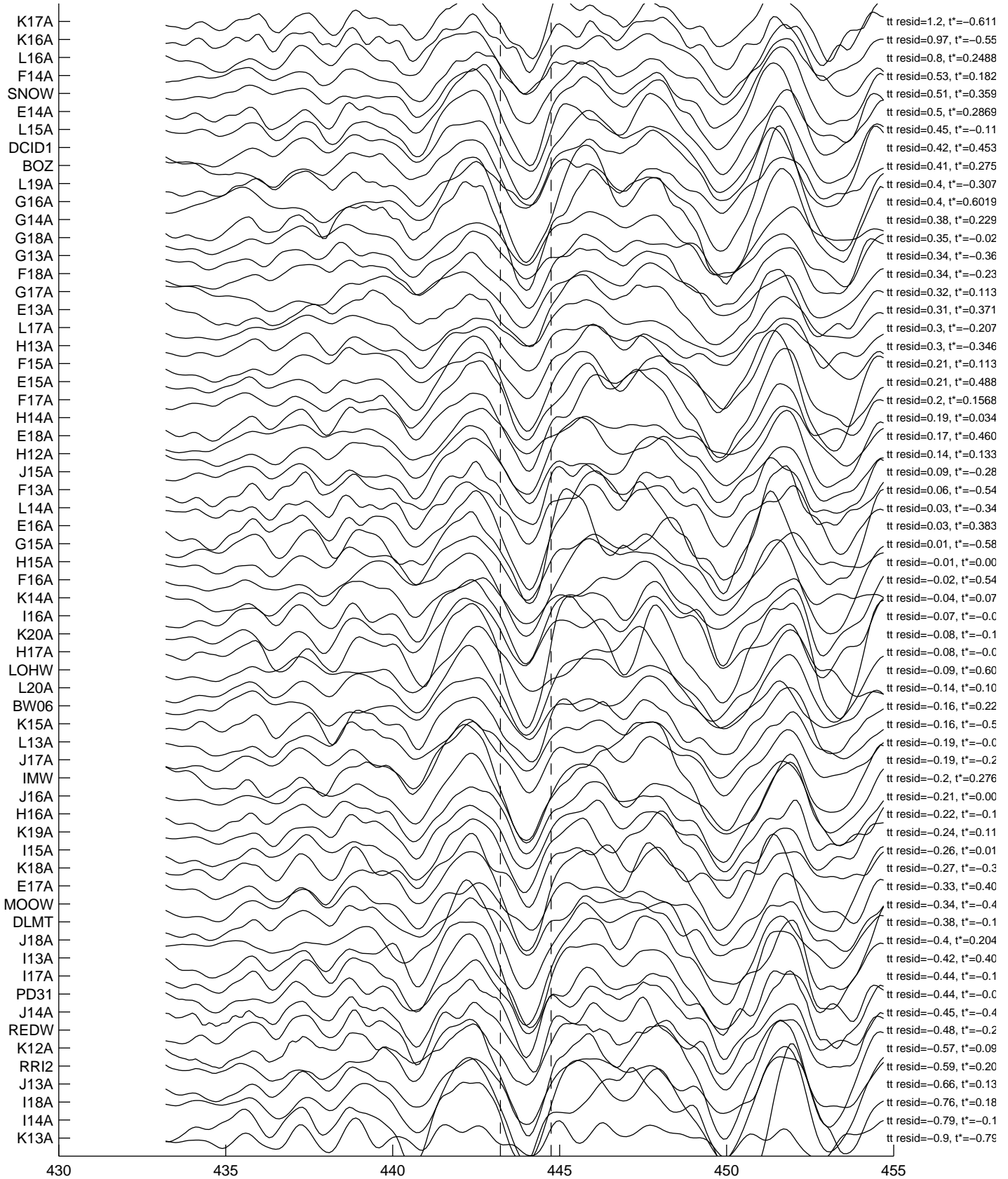


# Sorted by Delta:Event\_2007\_360\_22\_04\_56

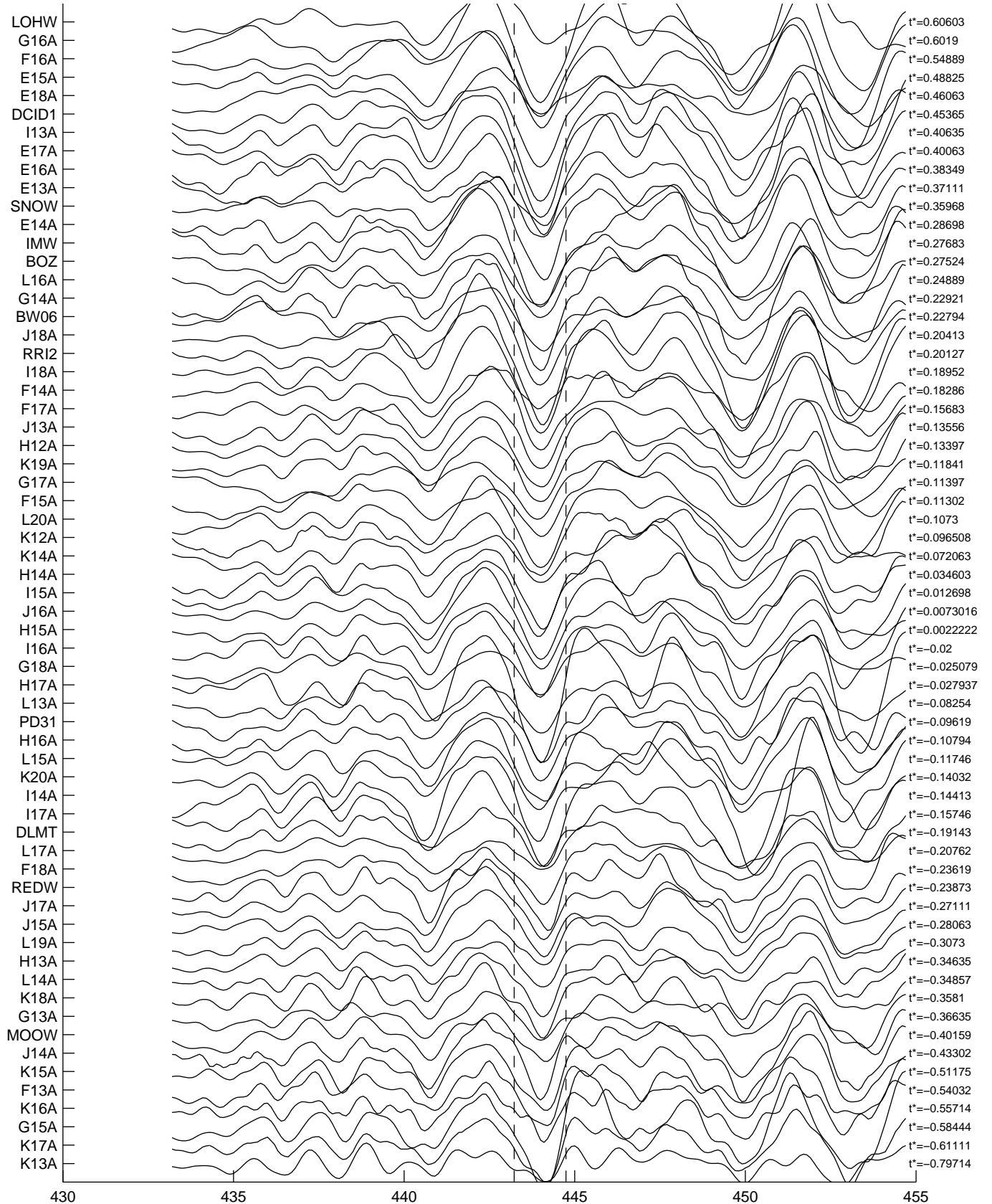




# Sorted by travel time:Event\_2007\_360\_22\_04\_56

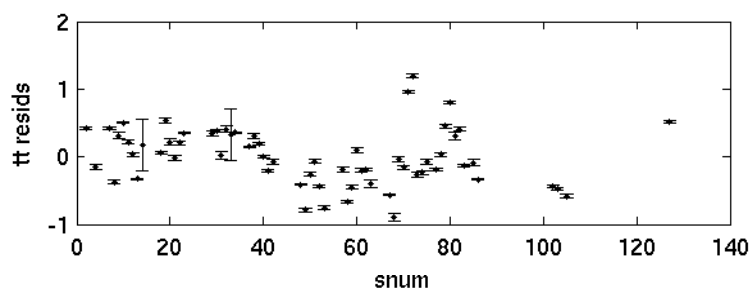
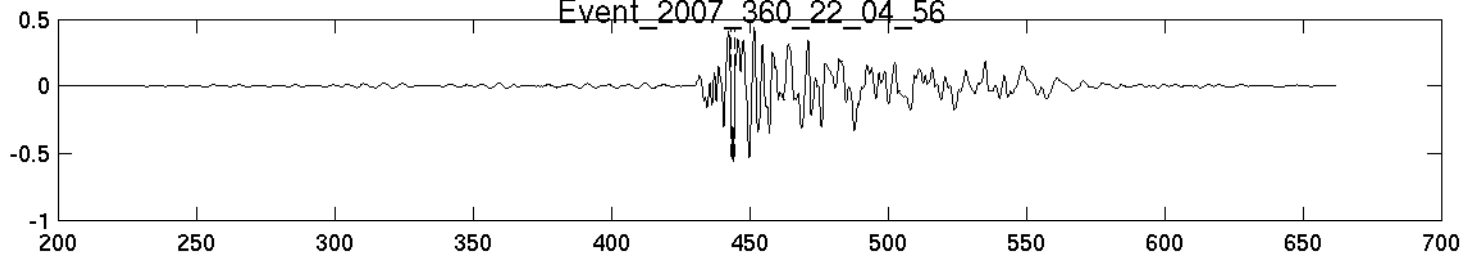


# Sorted by t\*:Event\_2007\_360\_22\_04\_56

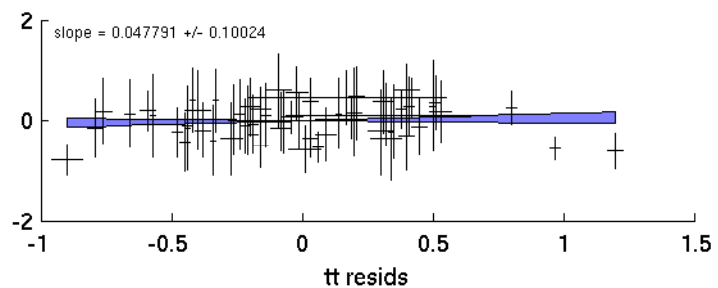
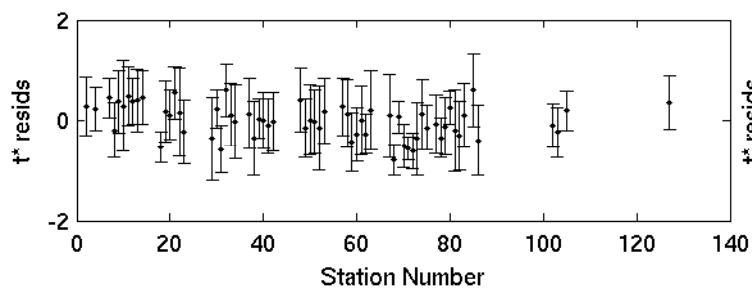


Event\_2007\_360\_22\_04\_56

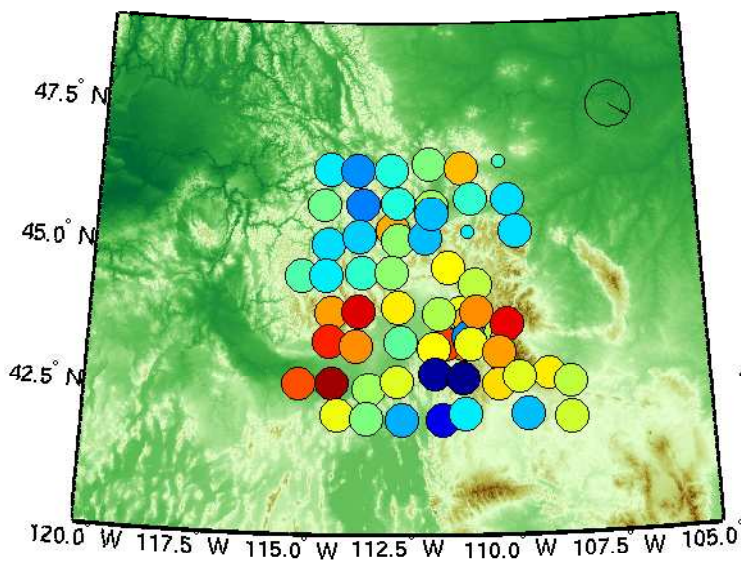
Stack



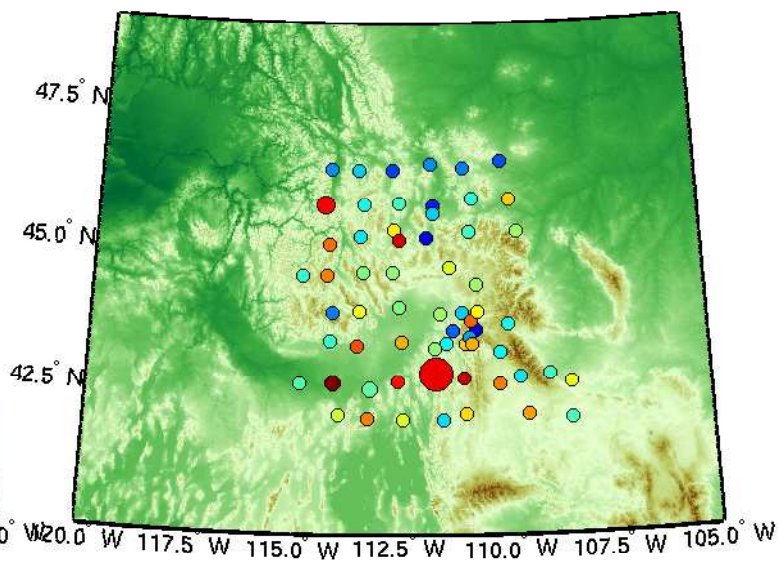
Baz = 303.5472  
Mean xcor value = 0.78397  
Range of  $t^*$  values is 1.4032  
Median  $t^*$  err is 0.58247  
Slope = 0.047791 +/- 0.10024



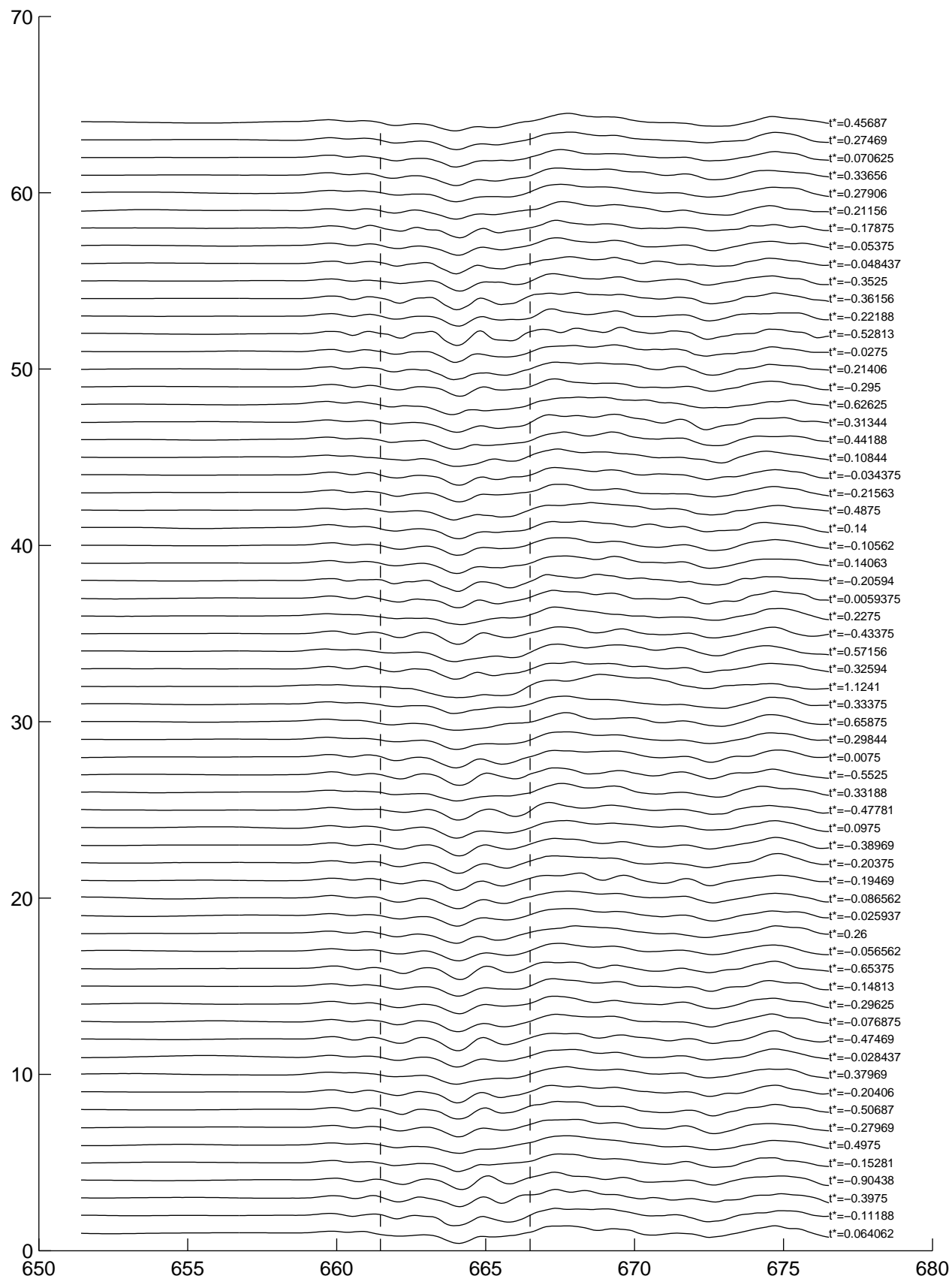
travel time residuals



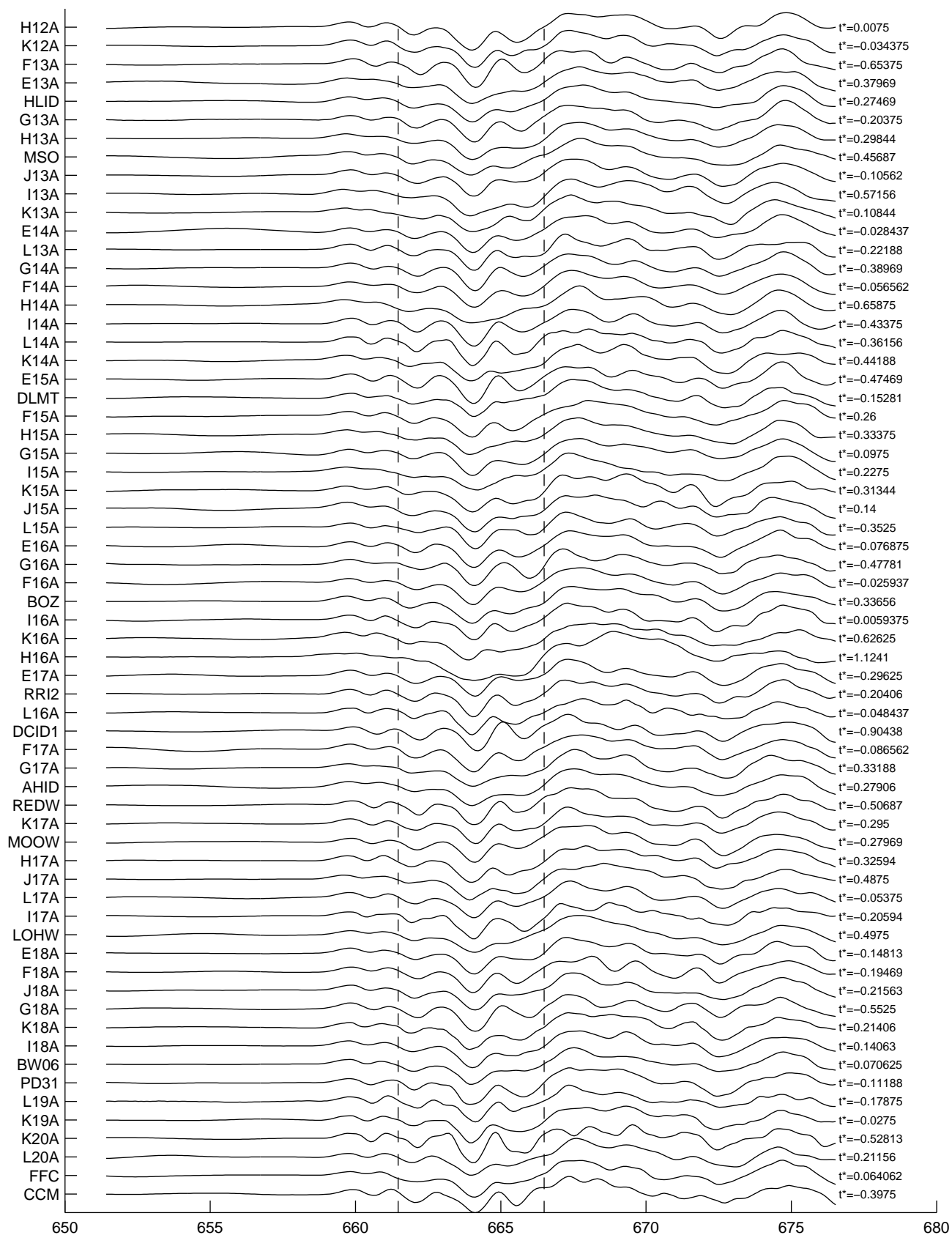
$t^*$  values



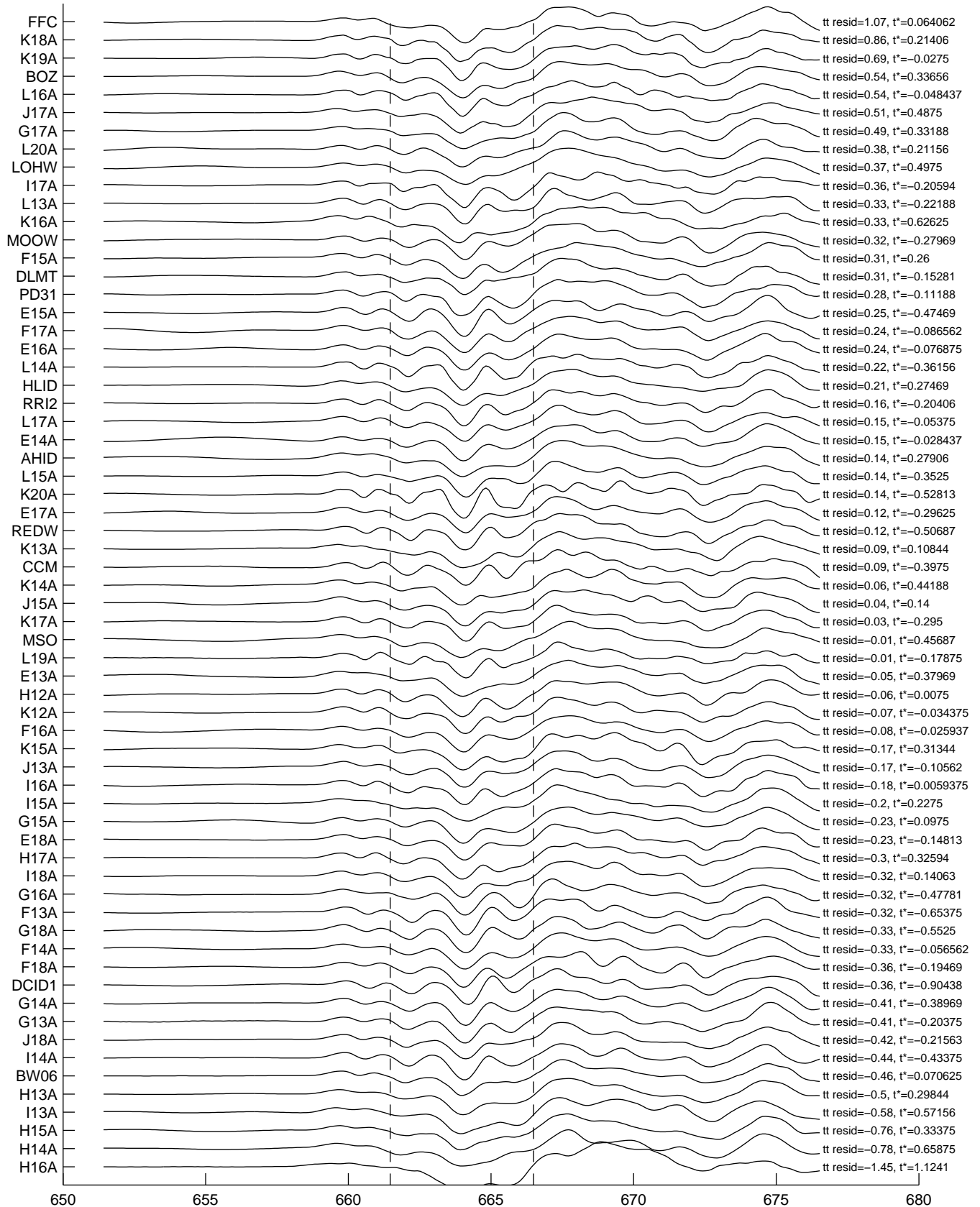
# Event\_2008\_039\_09\_38\_14



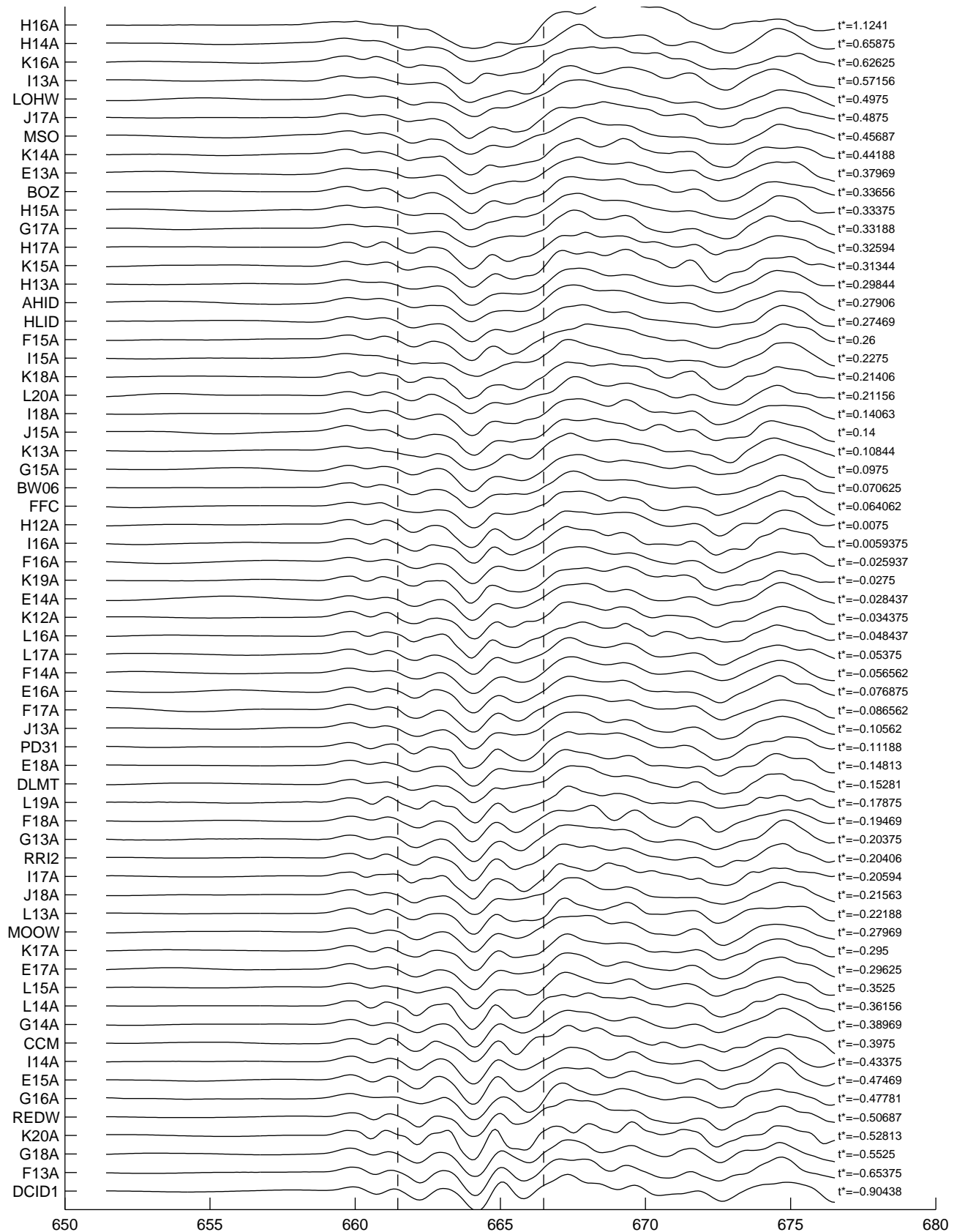
# Sorted by Delta:Event\_2008\_039\_09\_38\_14



# Sorted by travel time:Event\_2008\_039\_09\_38\_14

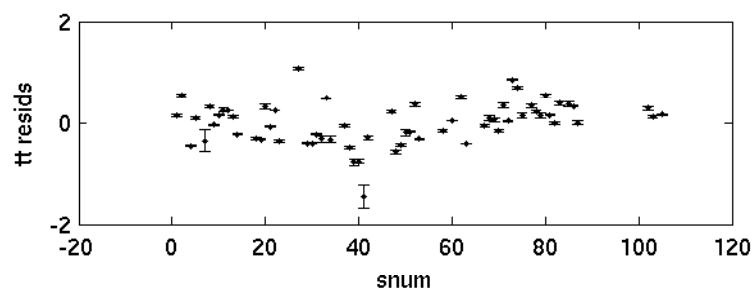
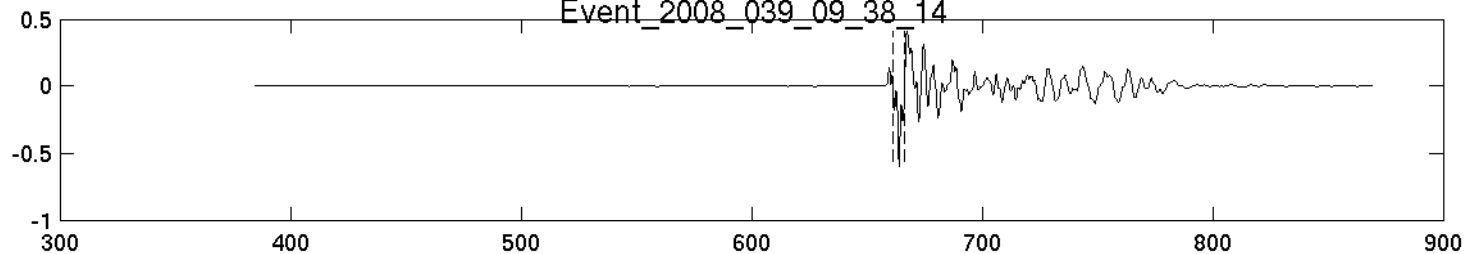


# Sorted by t\*:Event\_2008\_039\_09\_38\_14

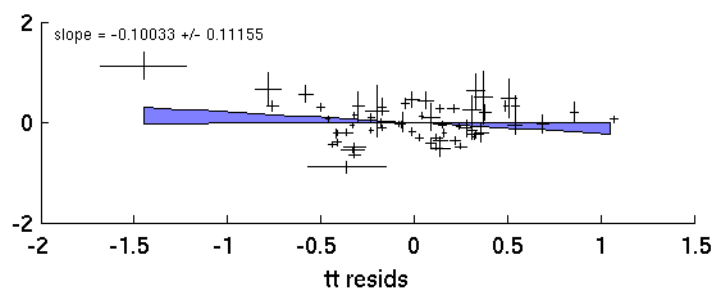
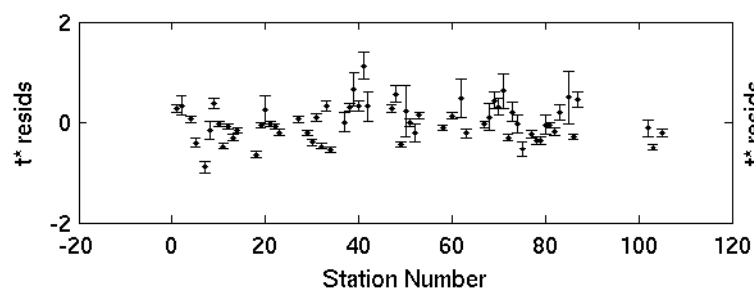




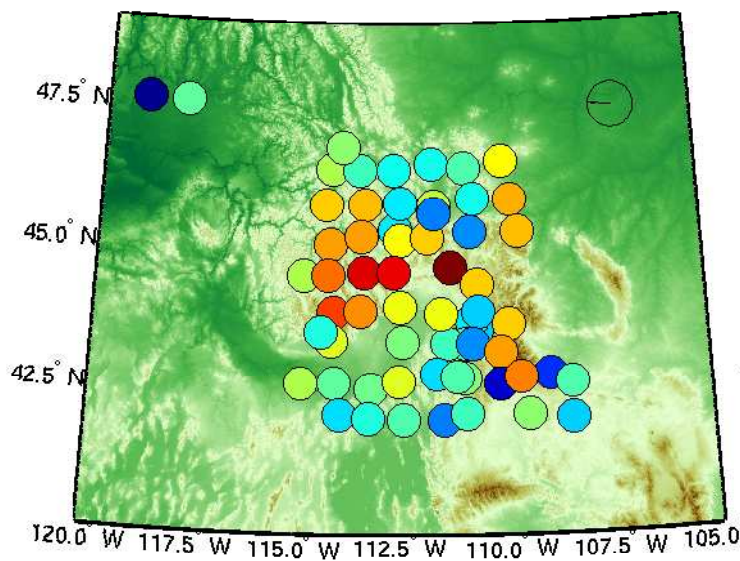
Stack  
Event\_2008\_039\_09\_38\_14



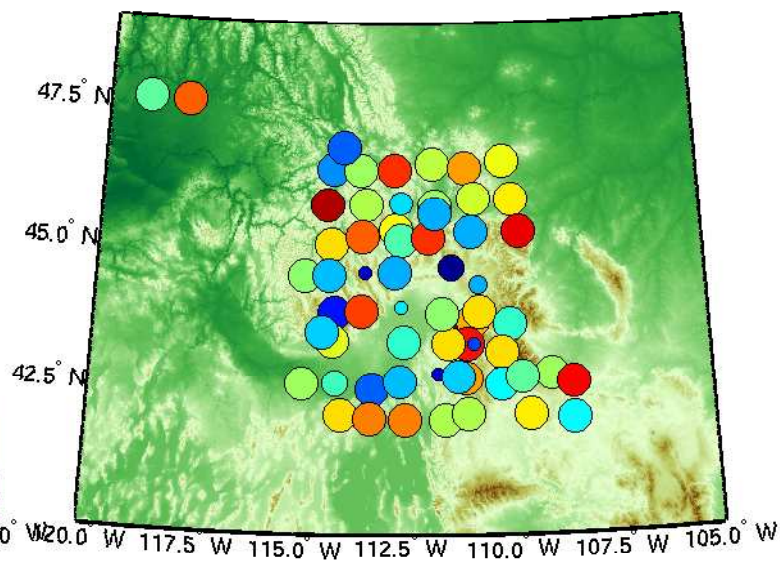
Baz = 96.693  
Mean xcor value = 0.89078  
Range of  $t^*$  values is 2.0284  
Median  $t^*$  err is 0.079257  
Slope =  $-0.10033 \pm 0.11155$



travel time residuals

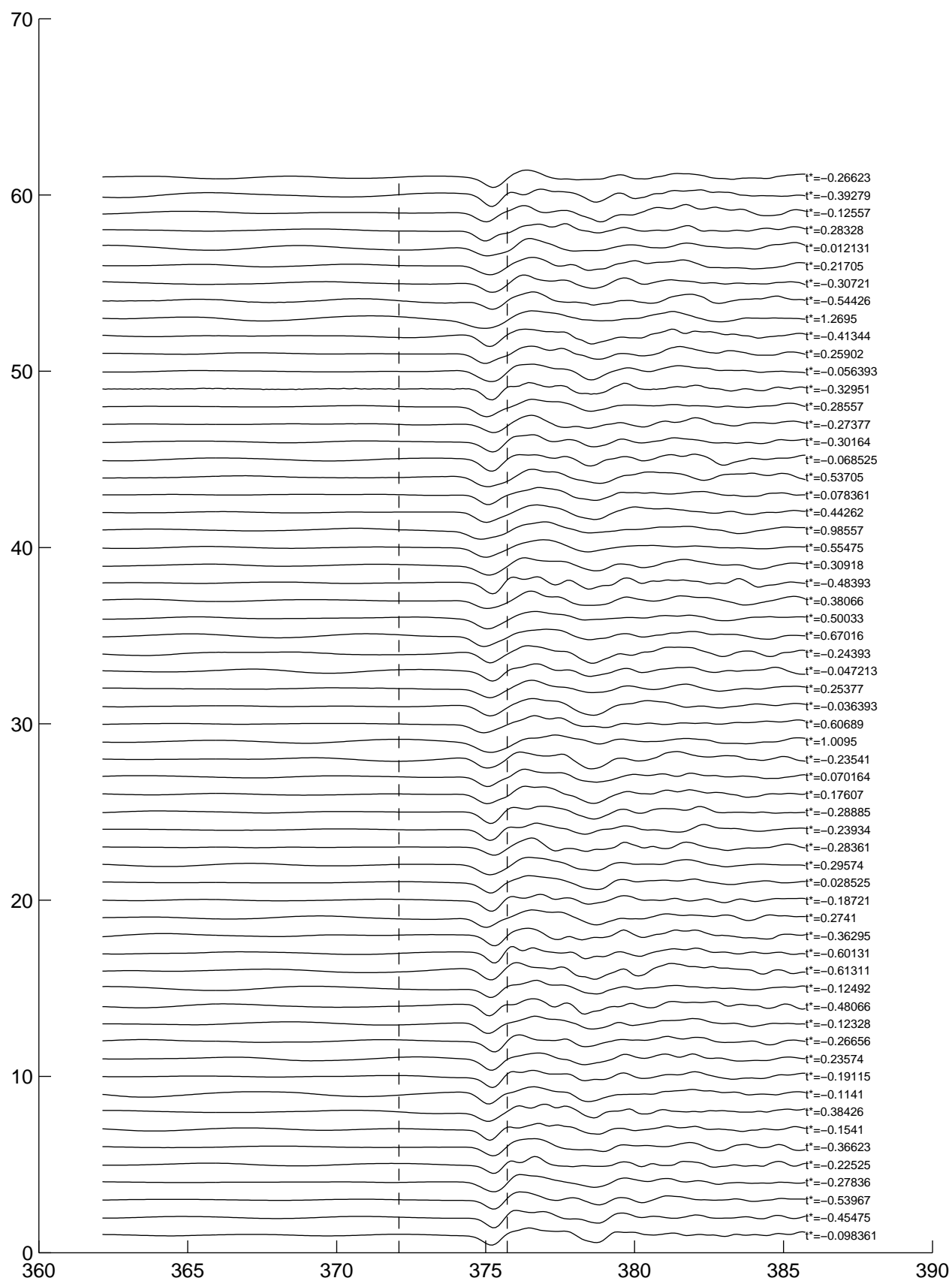


$t^*$  values

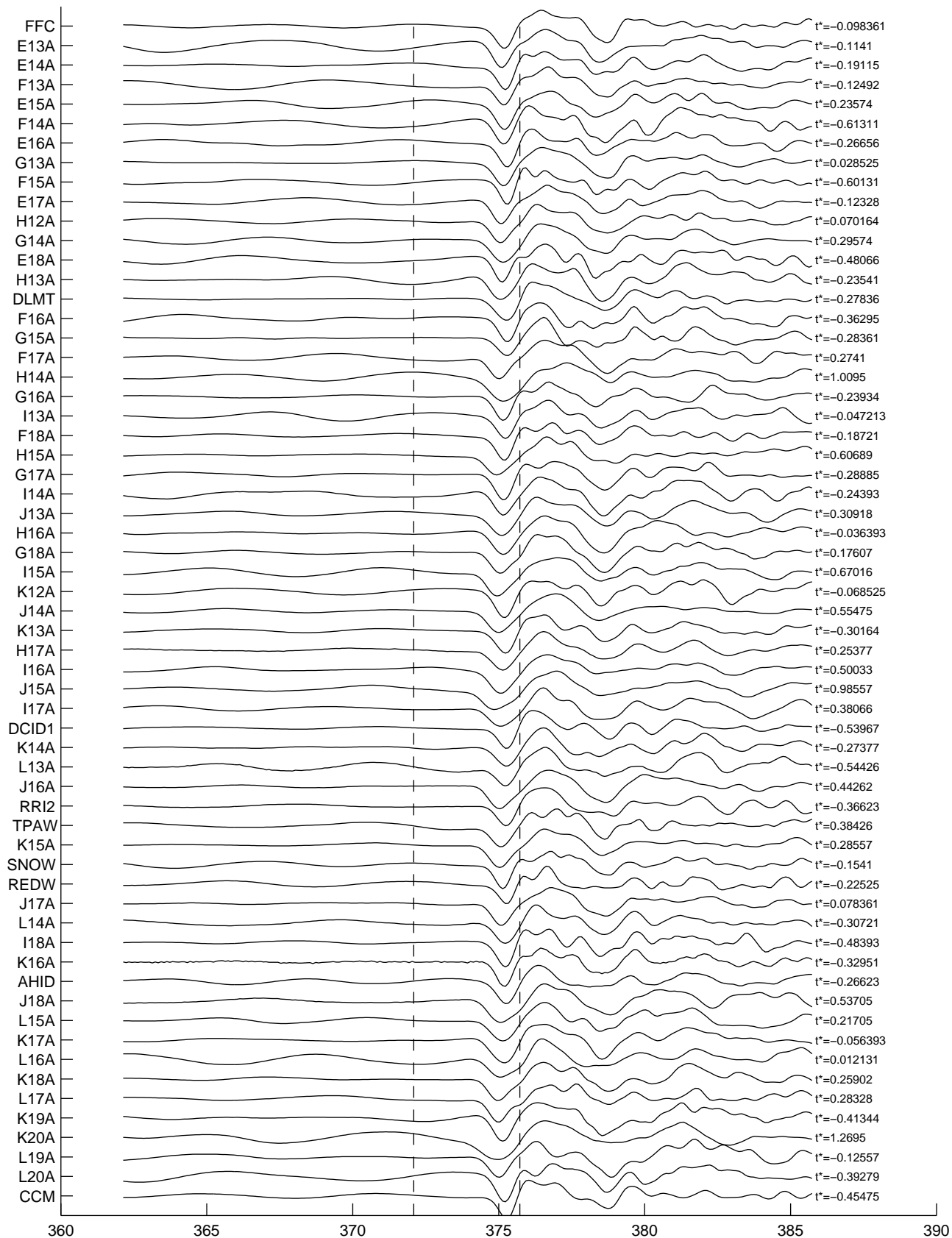




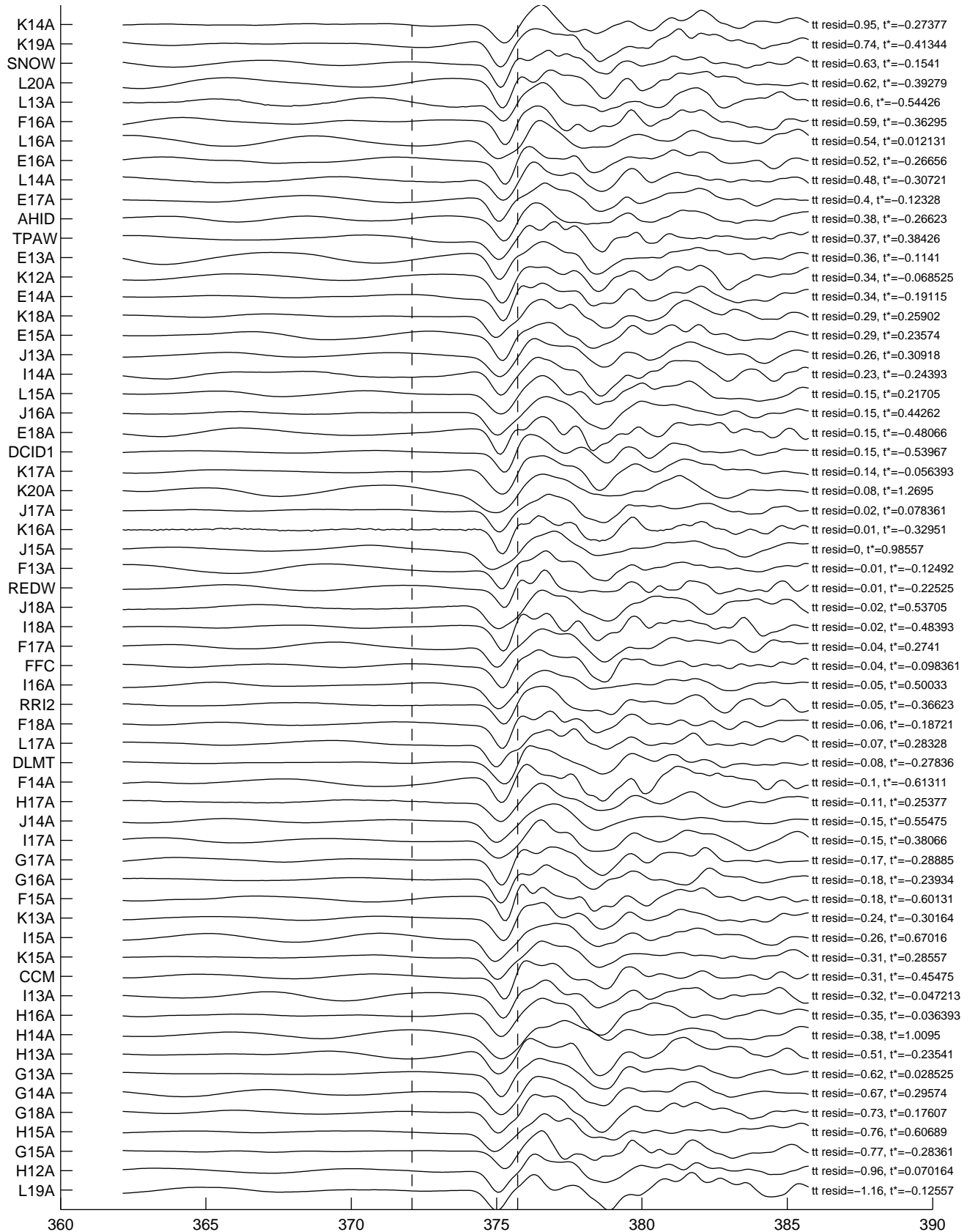
# Event\_2008\_043\_12\_50\_18



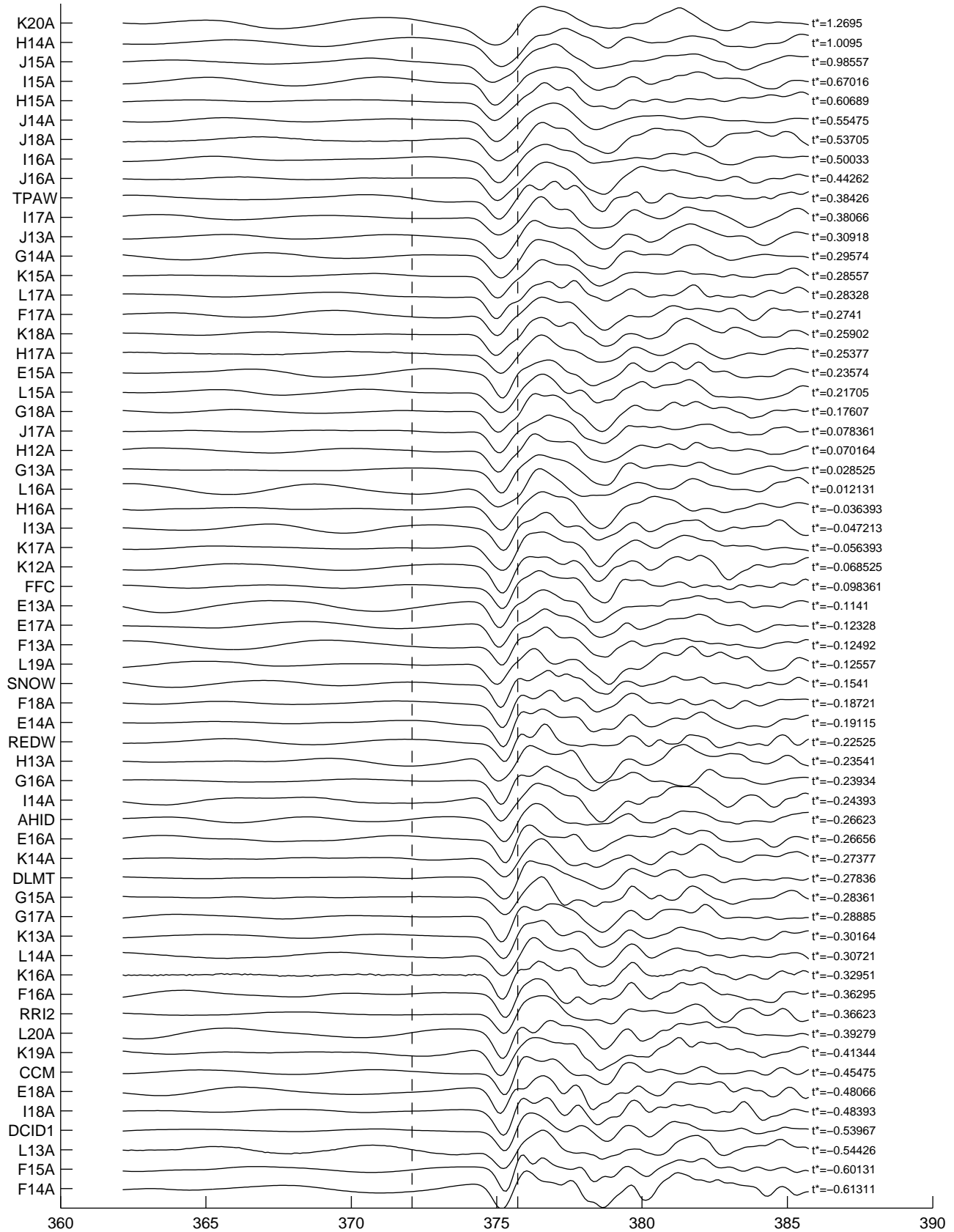
# Sorted by Delta:Event\_2008\_043\_12\_50\_18



# Sorted by travel time:Event\_2008\_043\_12\_50\_18

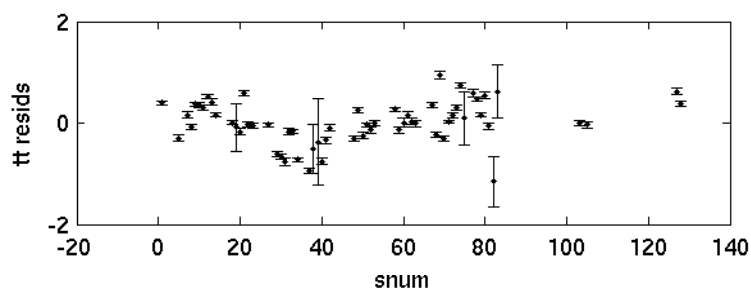
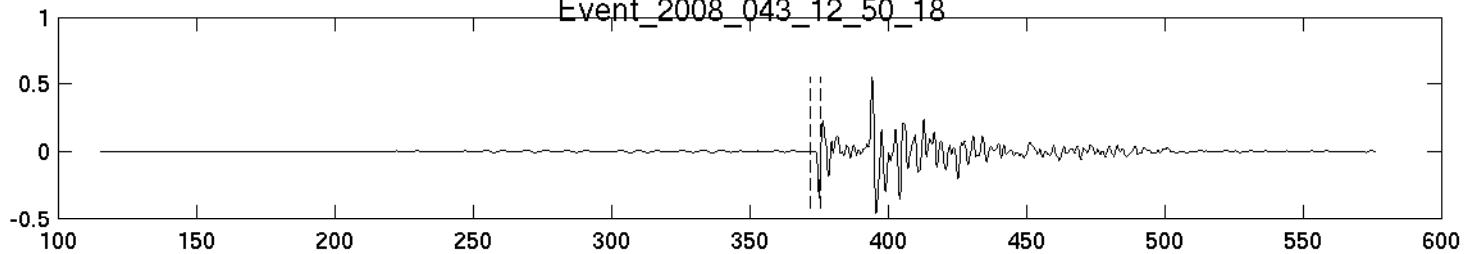


# Sorted by $t^*$ :Event\_2008\_043\_12\_50\_18

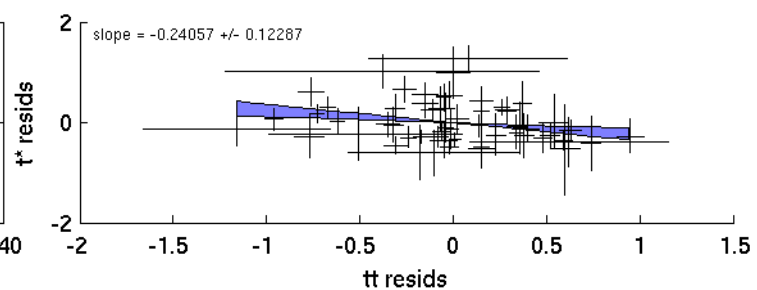
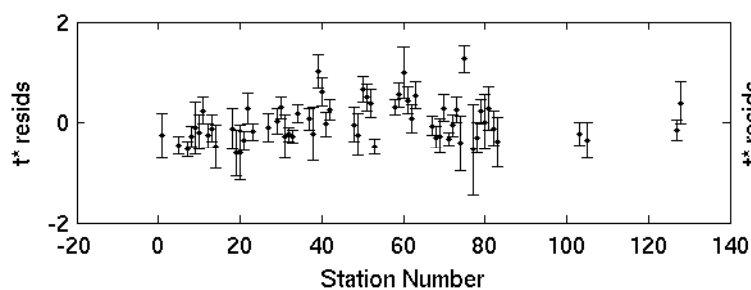


# Event\_2008\_043\_12\_50\_18

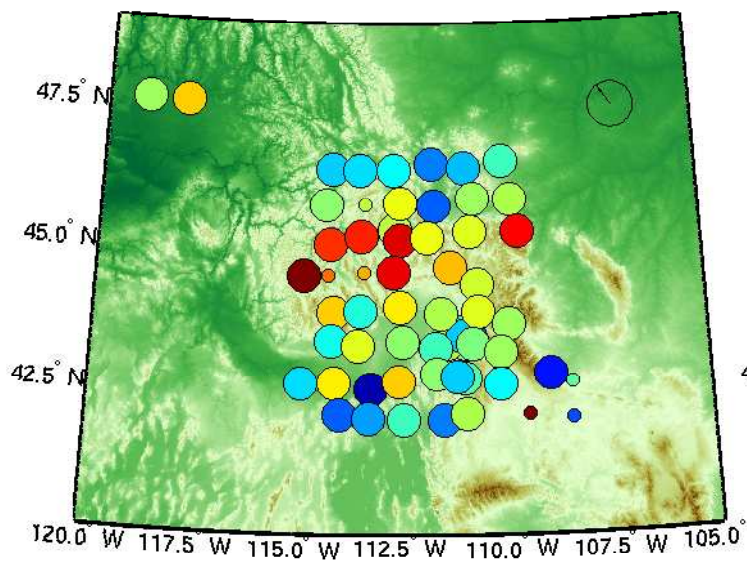
Stack



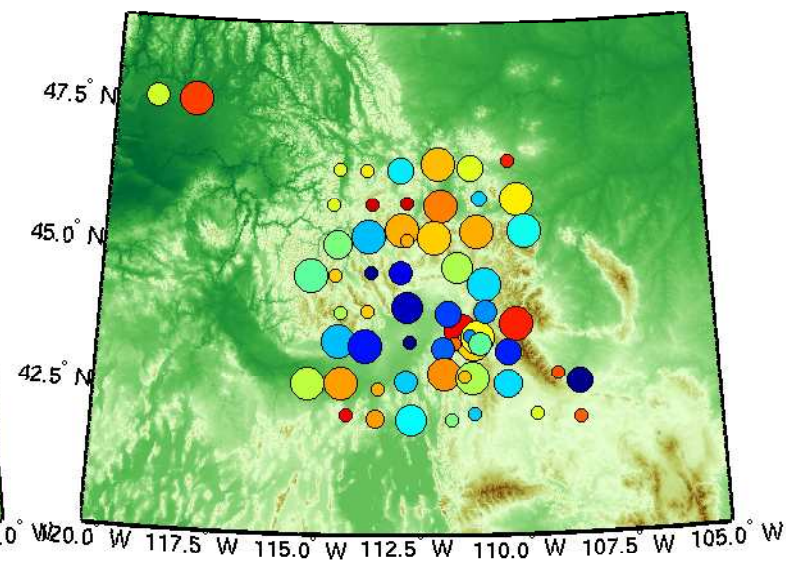
Baz = 147.3172  
Mean xcor value = 0.69033  
Range of  $t^*$  values is 1.8826  
Median  $t^*$  err is 0.26909  
Slope = -0.24057  $\pm$  0.12287



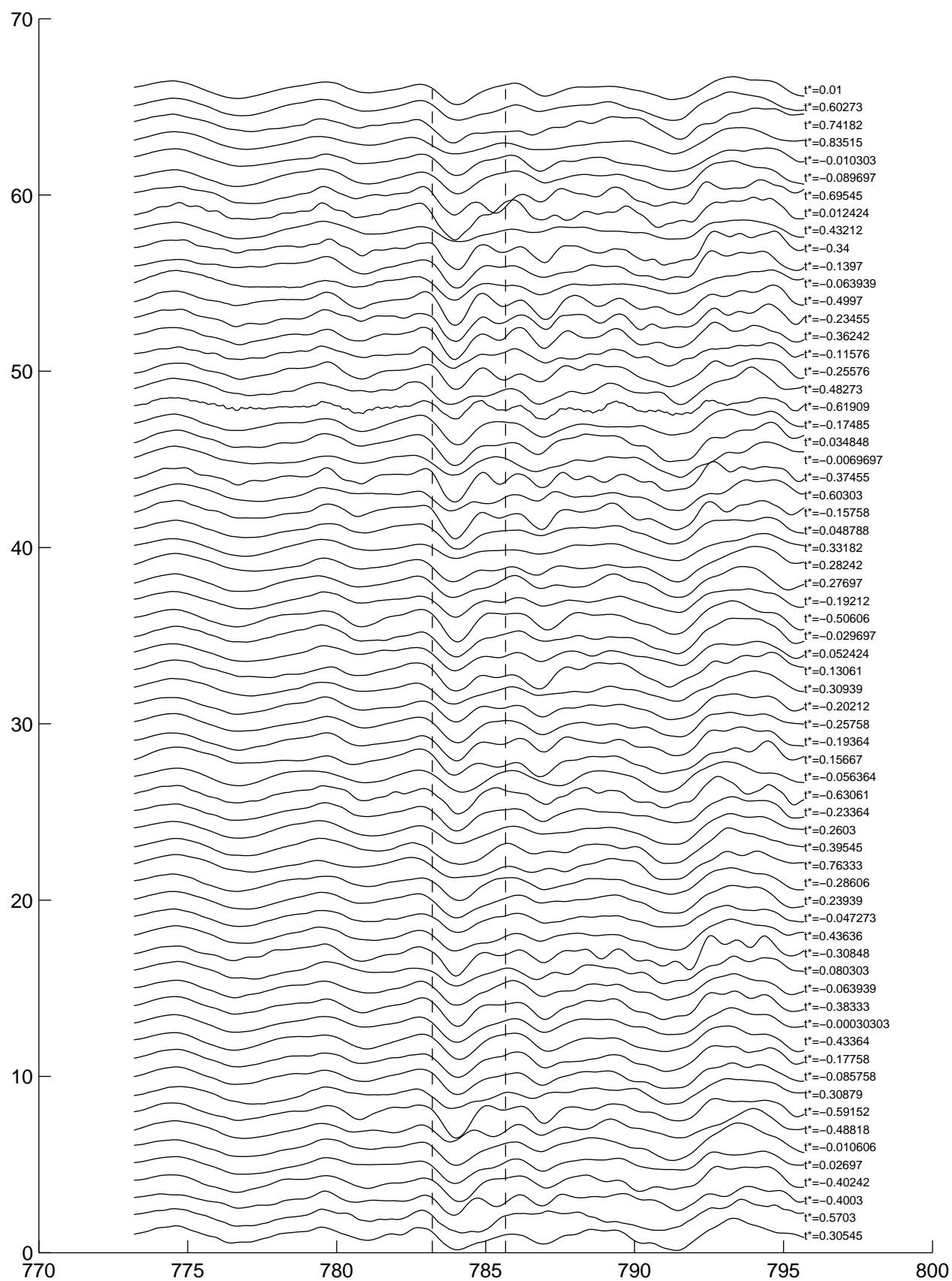
travel time residuals



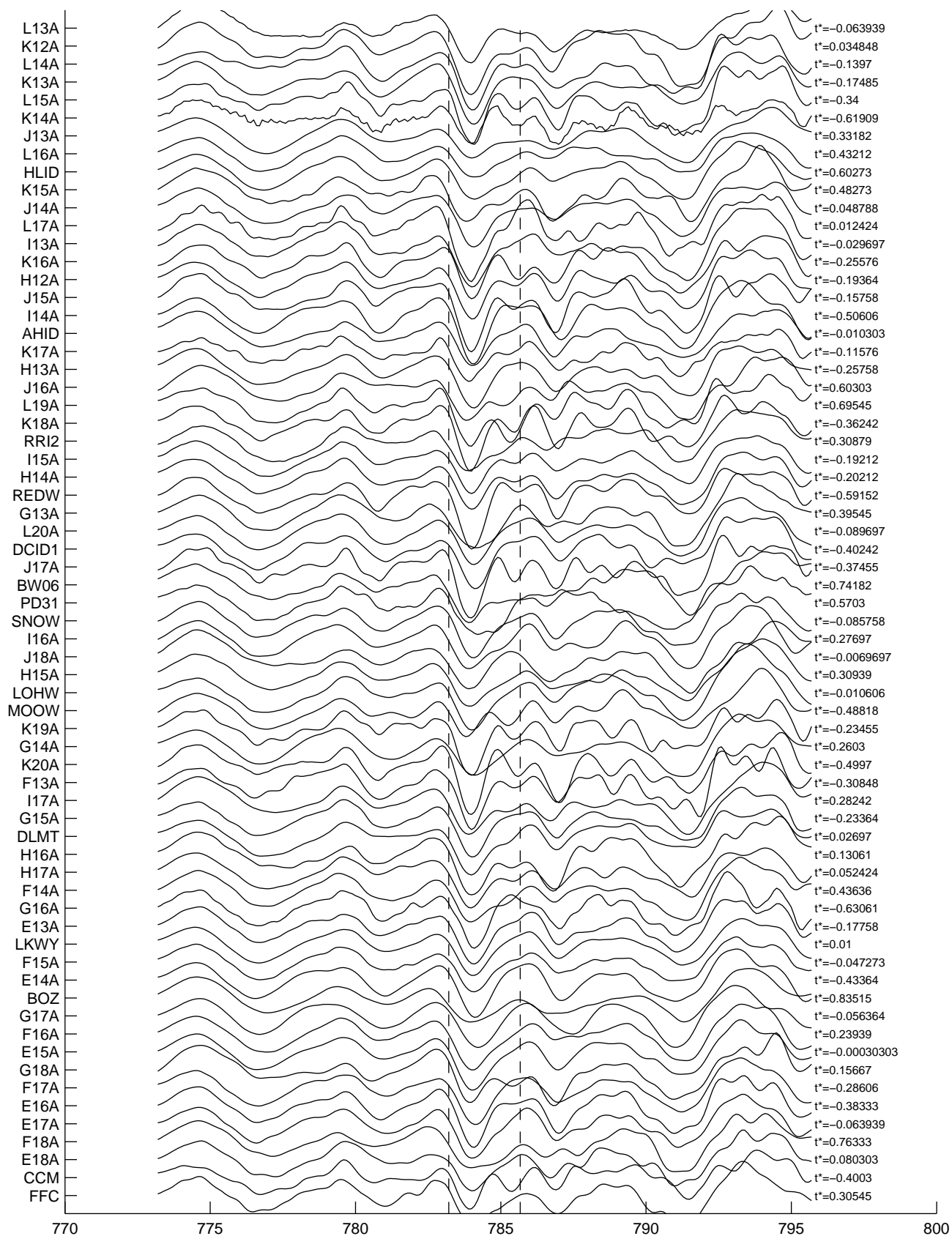
$t^*$  values



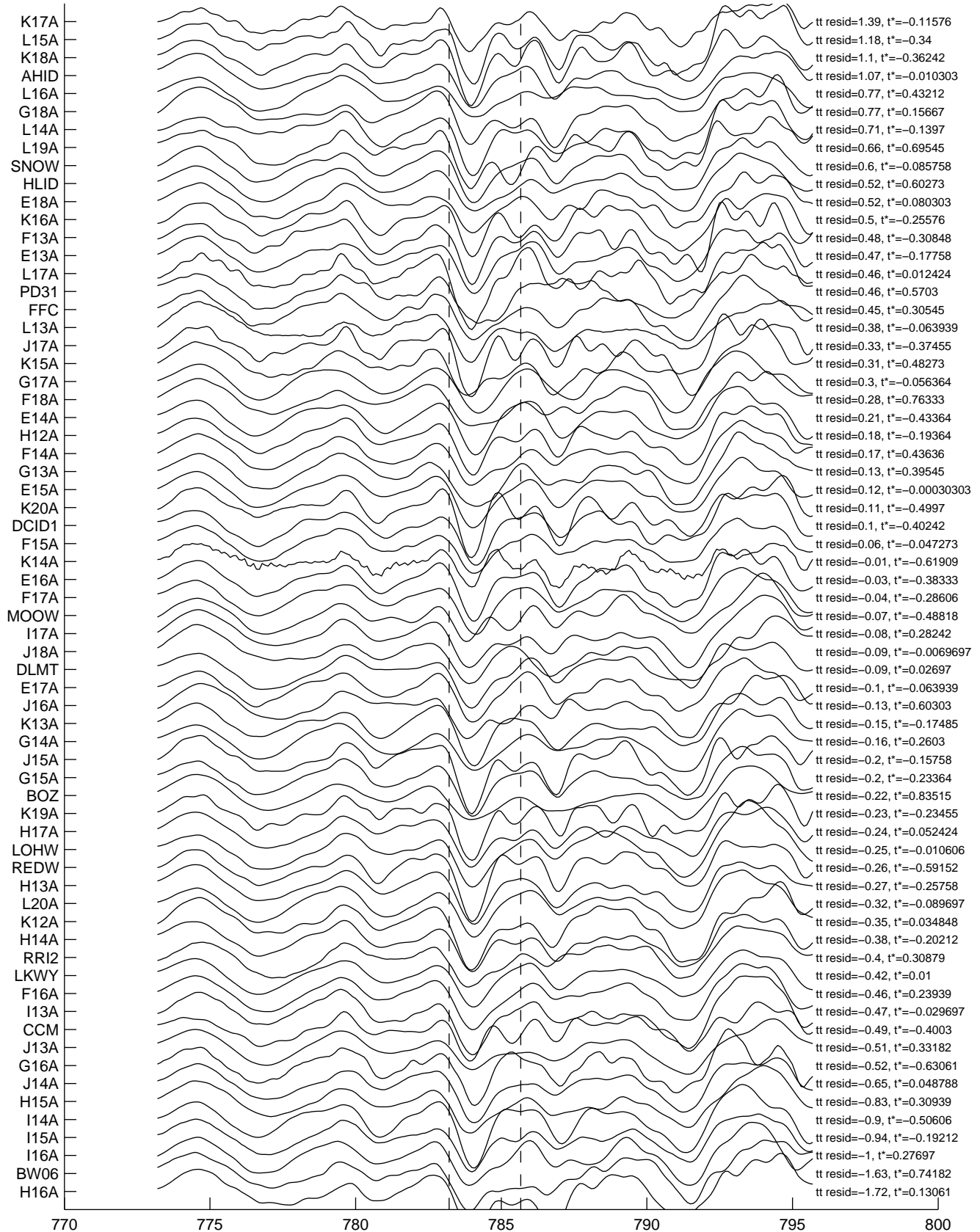
# Event\_2008\_045\_10\_09\_22



# Sorted by Delta:Event\_2008\_045\_10\_09\_22

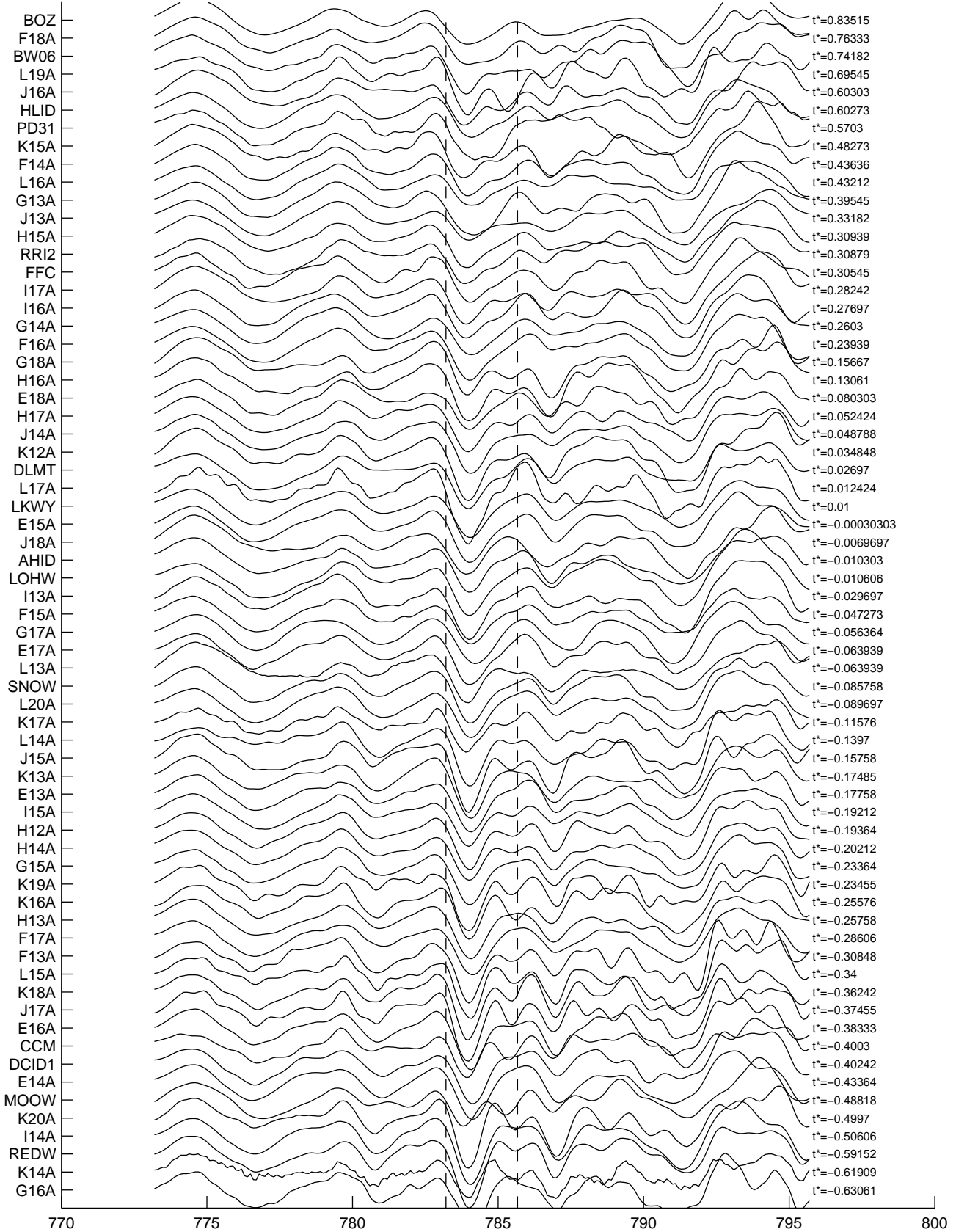


# Sorted by travel time:Event\_2008\_045\_10\_09\_22



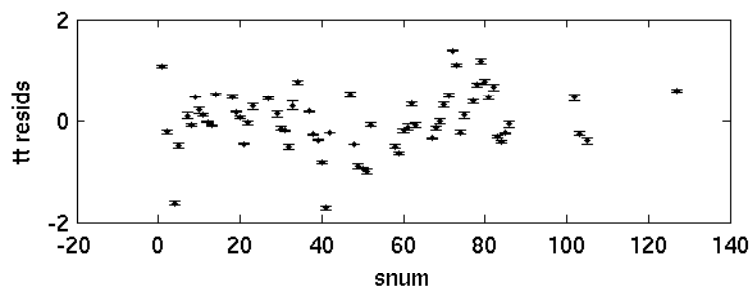
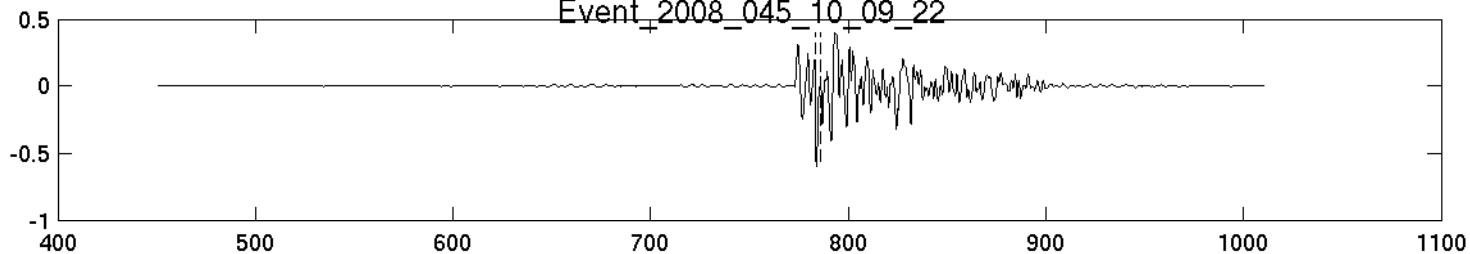


# Sorted by t\*:Event\_2008\_045\_10\_09\_22

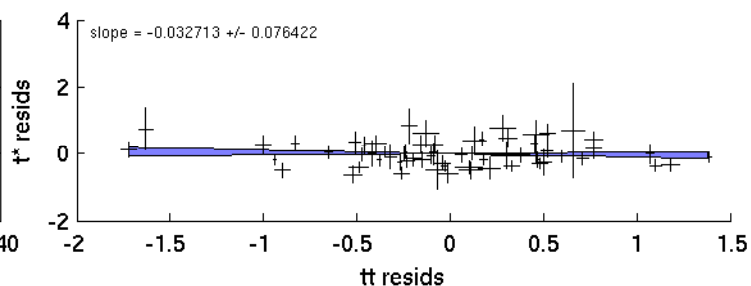
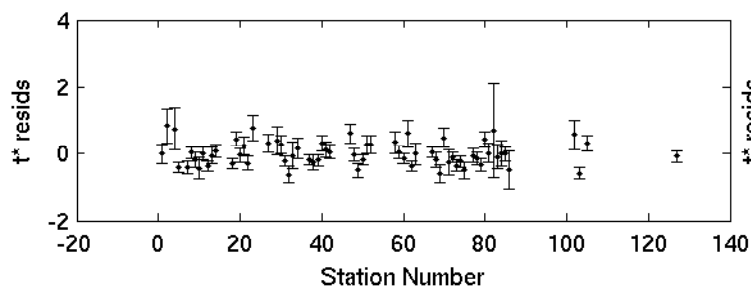


# Event\_2008\_045\_10\_09\_22

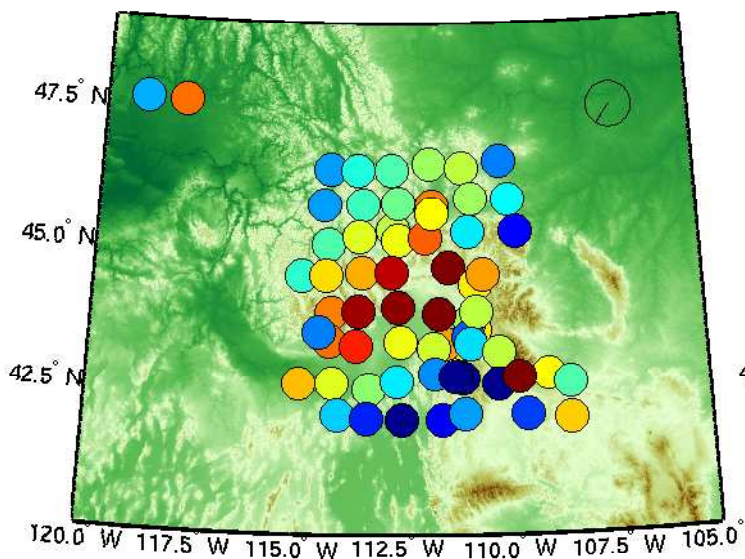
Stack



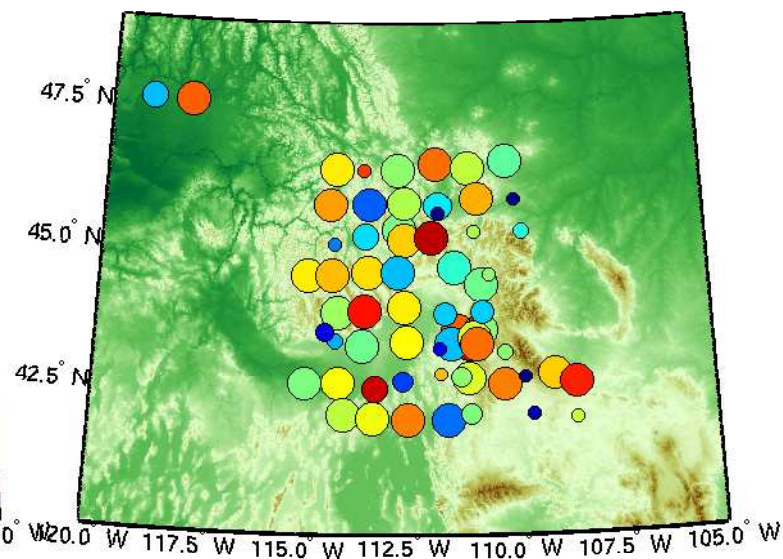
Baz = 35.9734  
Mean xcor value = 0.80333  
Range of  $t^*$  values is 1.4658  
Median  $t^*$  err is 0.22867  
Slope =  $-0.032713 \pm 0.076422$



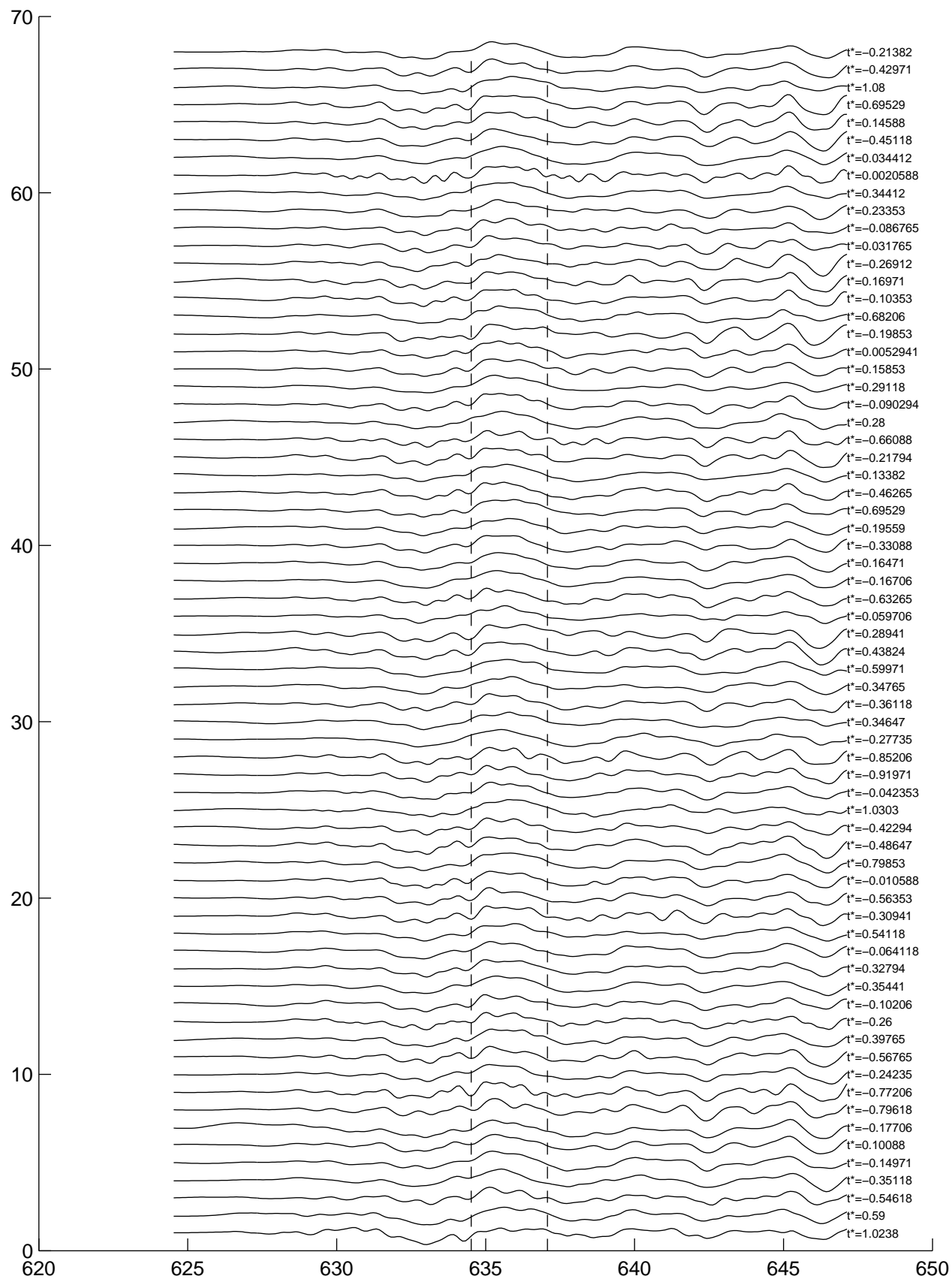
travel time residuals



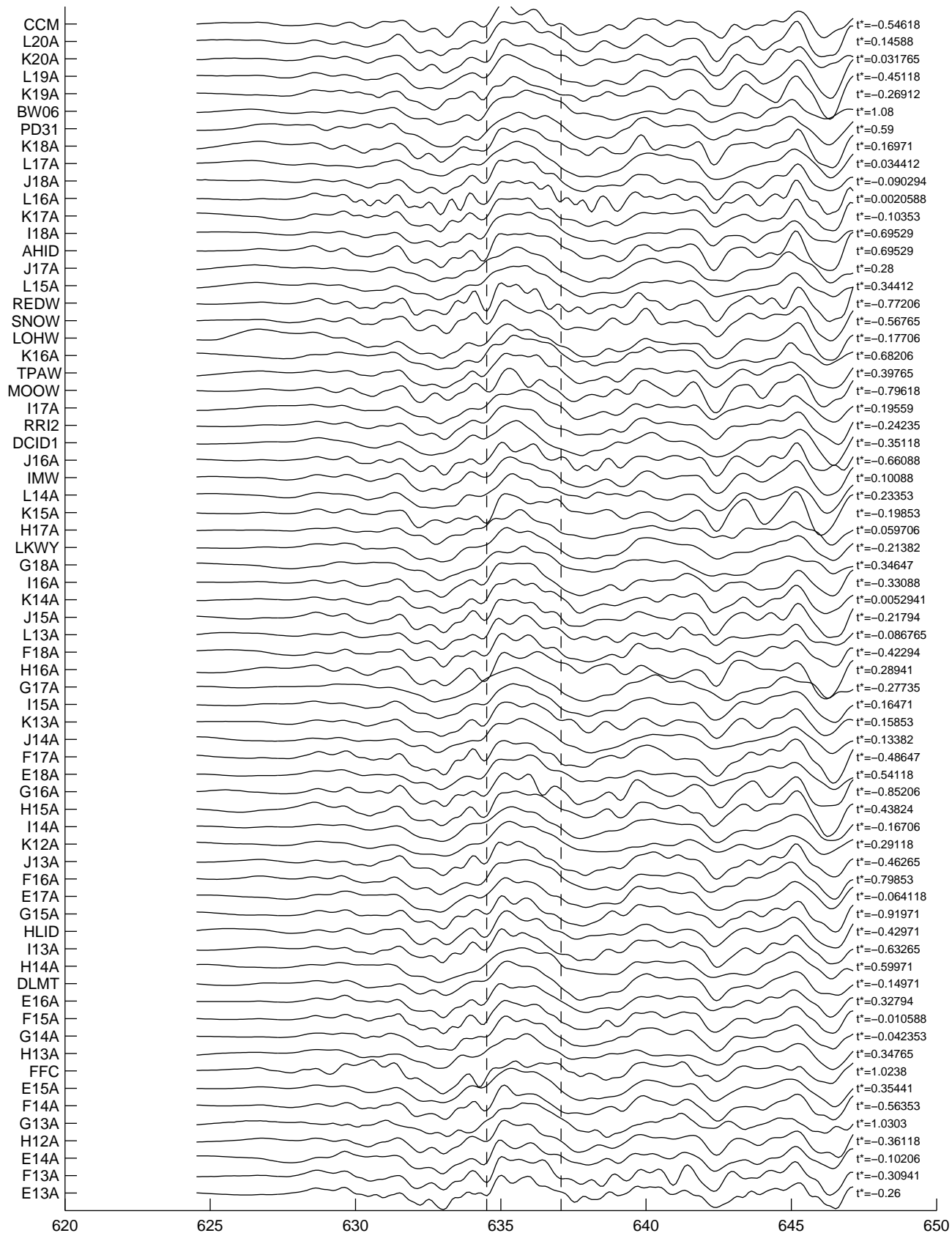
$t^*$  values



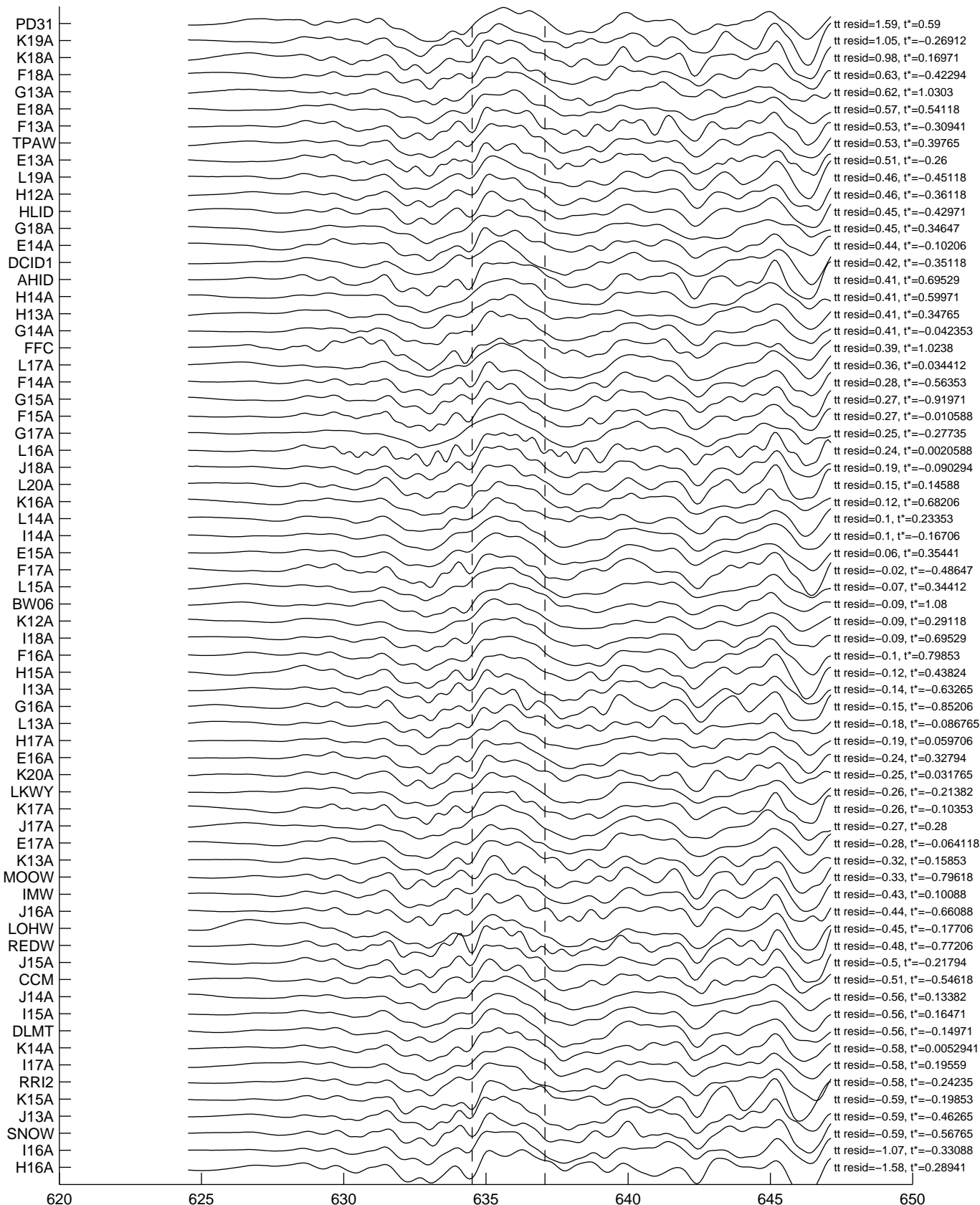
# Event\_2008\_063\_09\_31\_02



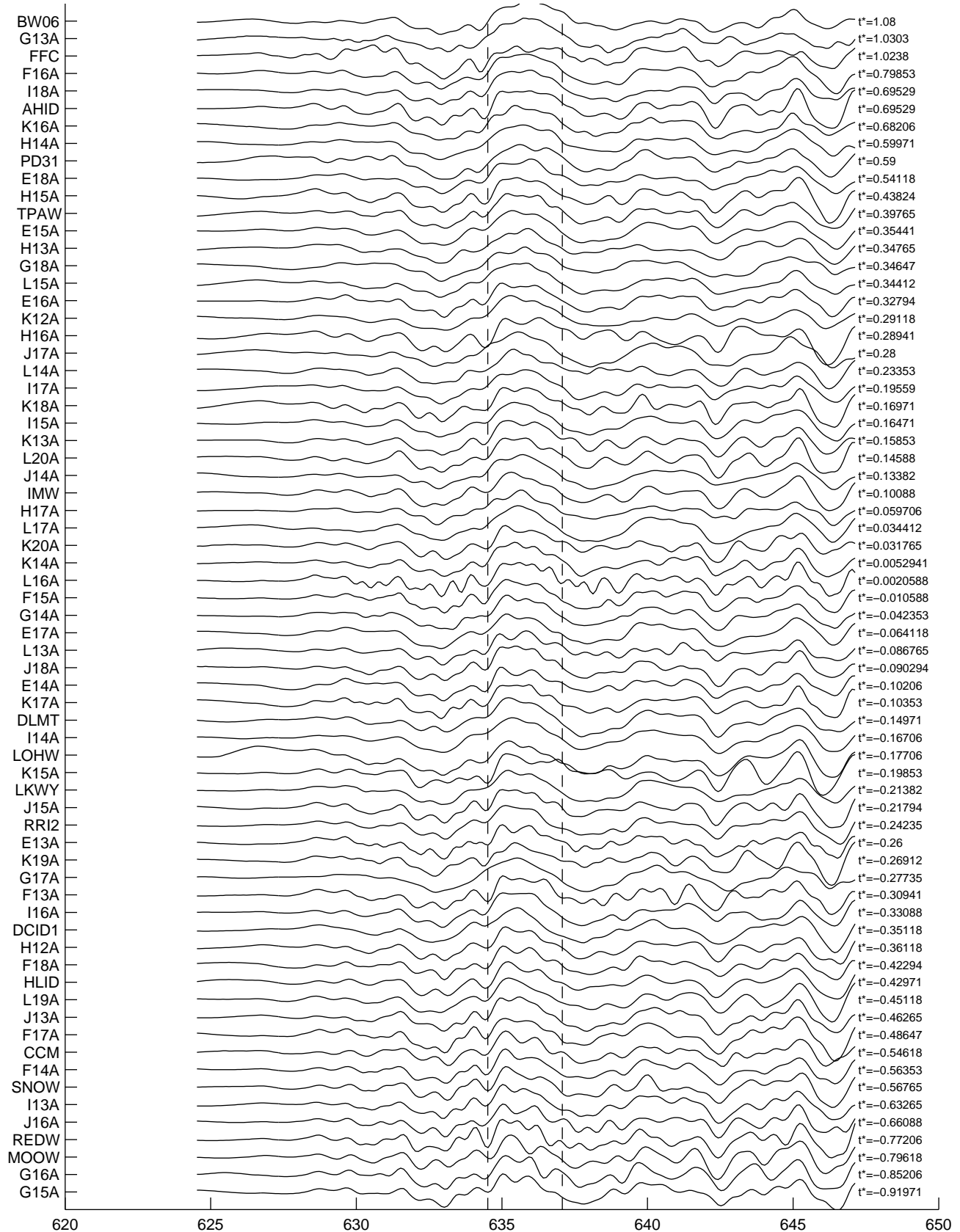
# Sorted by Delta:Event\_2008\_063\_09\_31\_02



# Sorted by travel time:Event\_2008\_063\_09\_31\_02



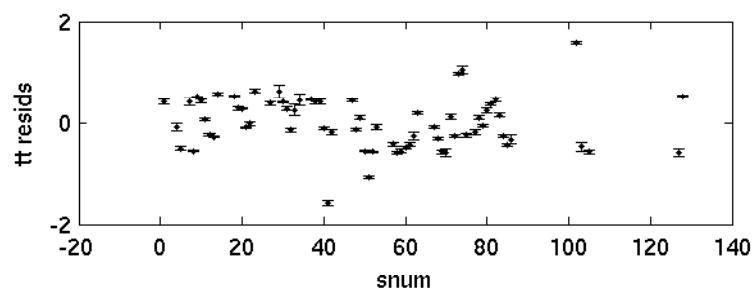
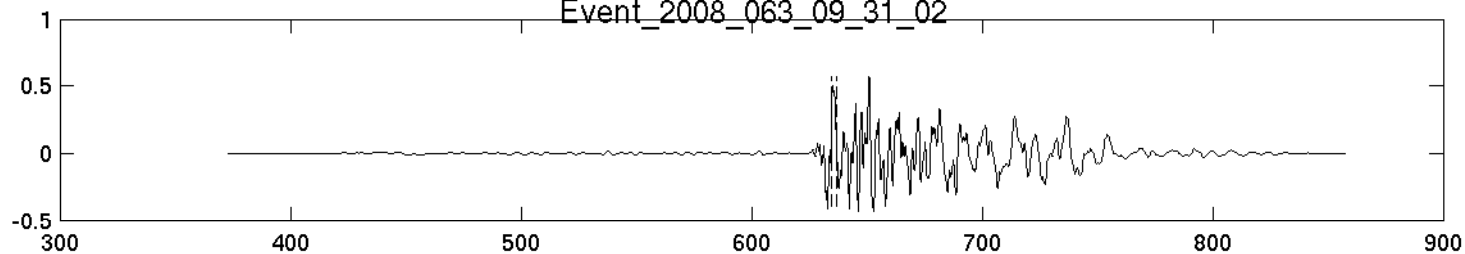
# Sorted by t\*:Event\_2008\_063\_09\_31\_02



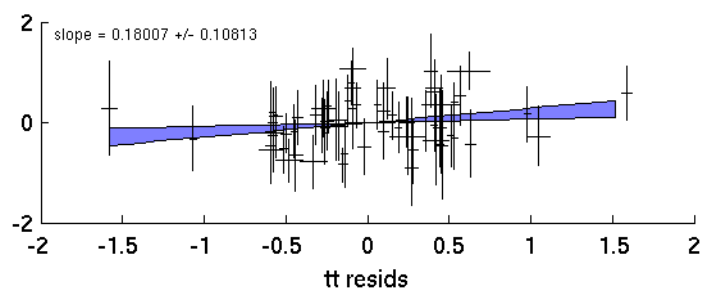
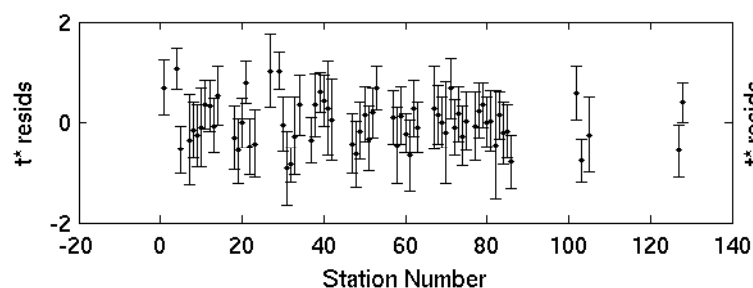


# Event\_2008\_063\_09\_31\_02

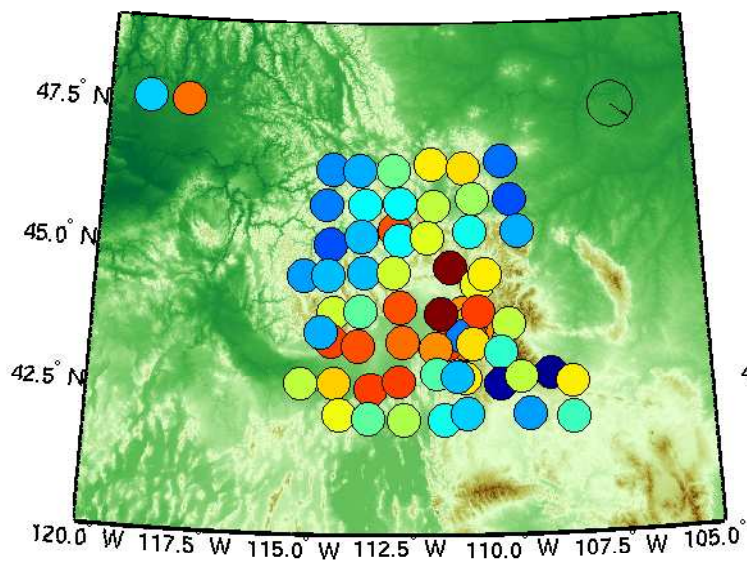
Stack



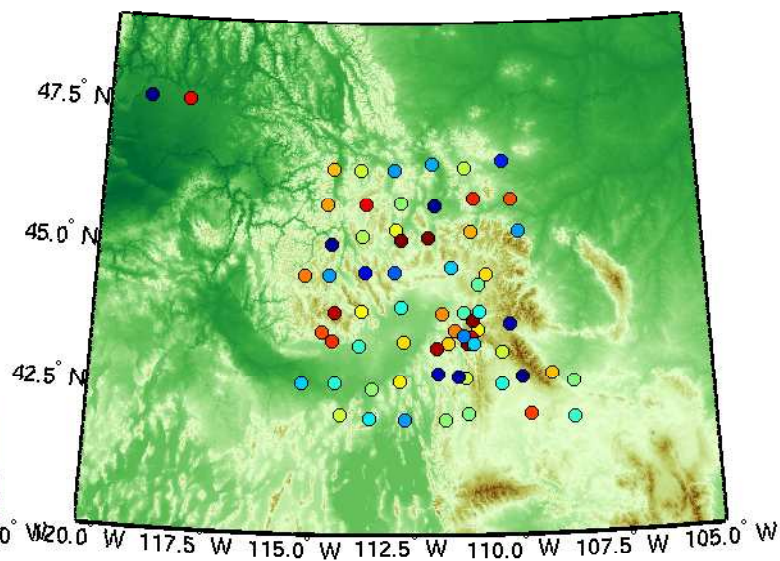
Baz = 309.4767  
Mean xcor value = 0.8125  
Range of t\* values is 1.9997  
Median t\* err is 0.56643  
Slope = 0.18007 +/- 0.10813



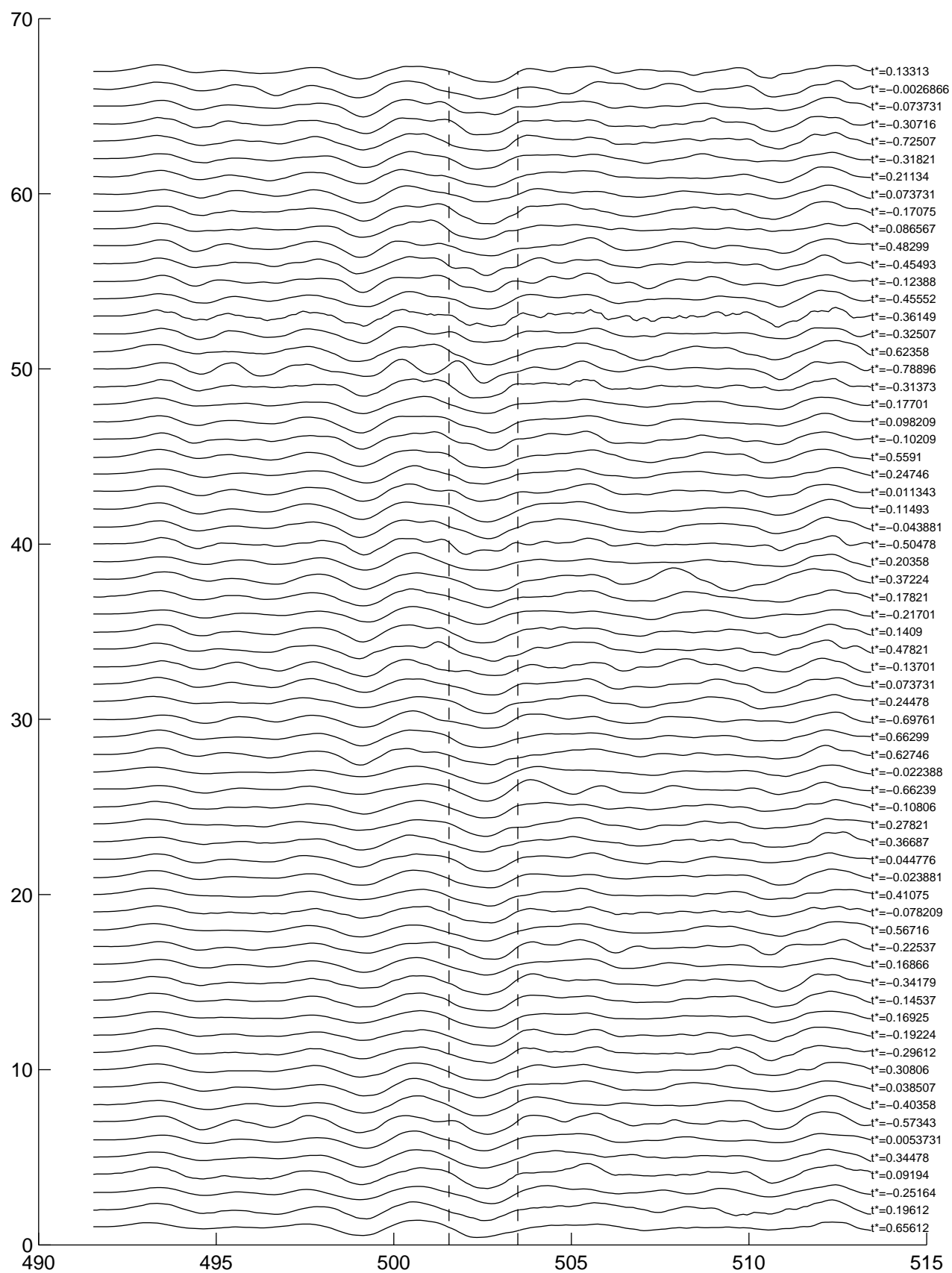
travel time residuals



t\* values

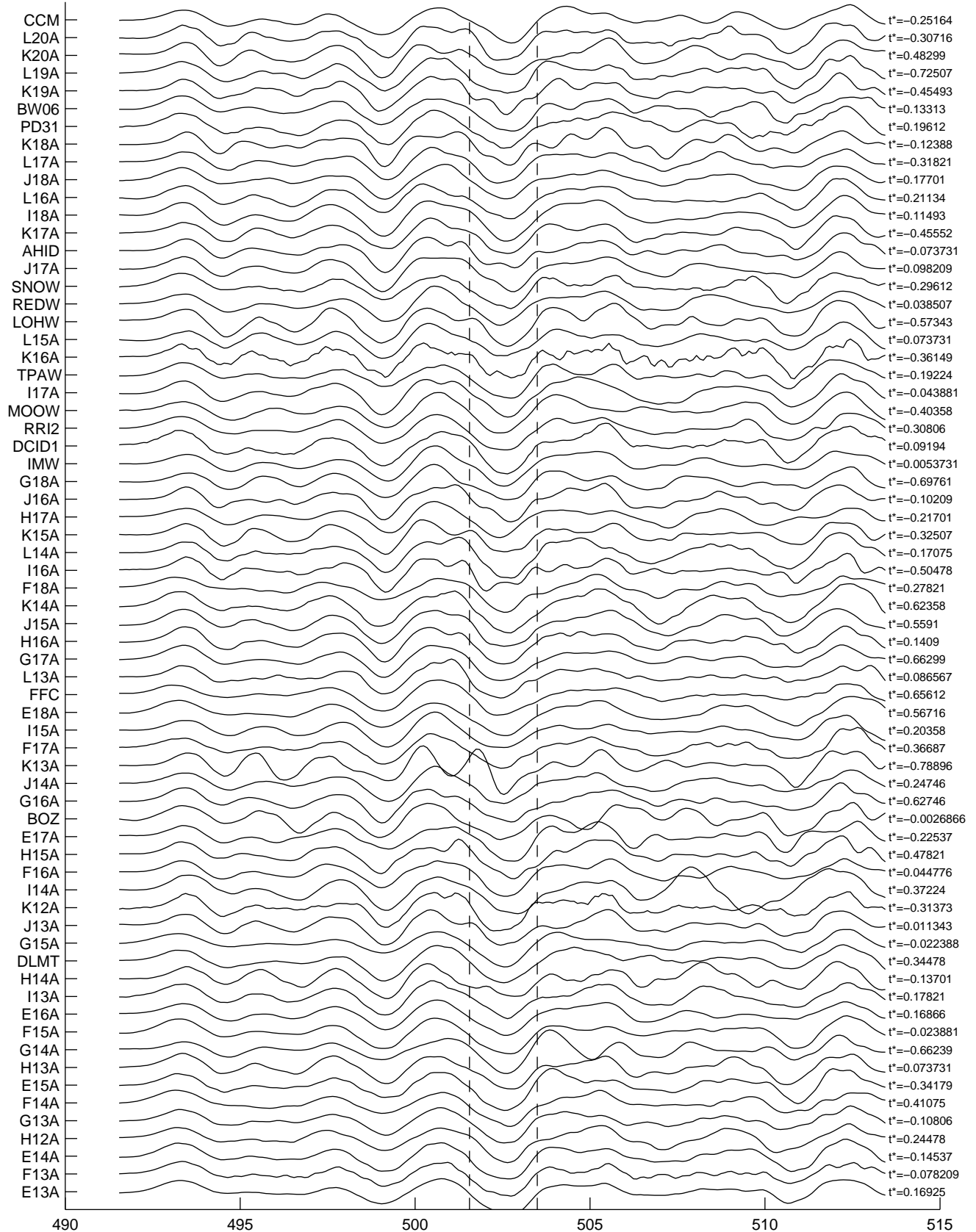


# Event\_2008\_106\_22\_59\_51

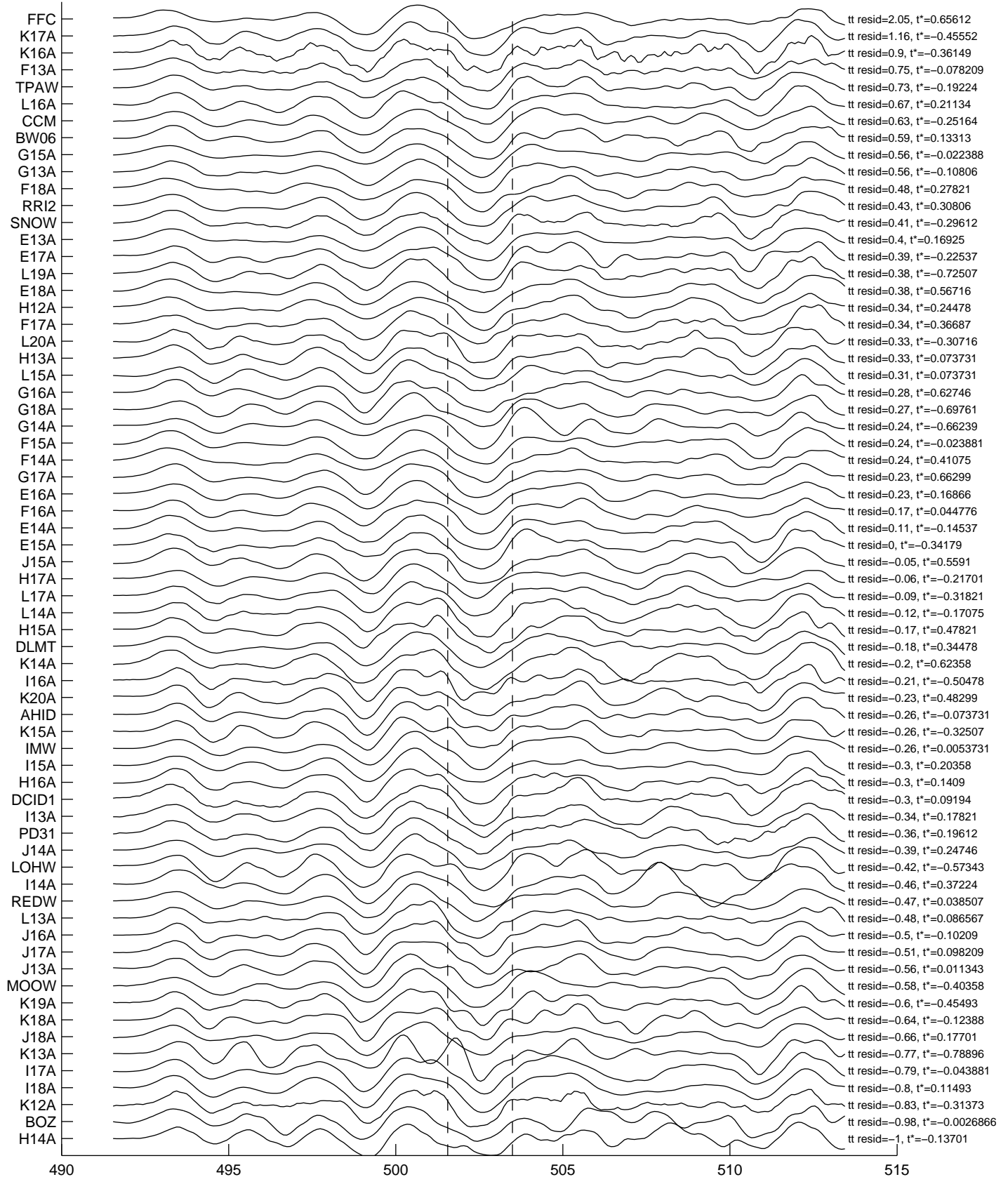




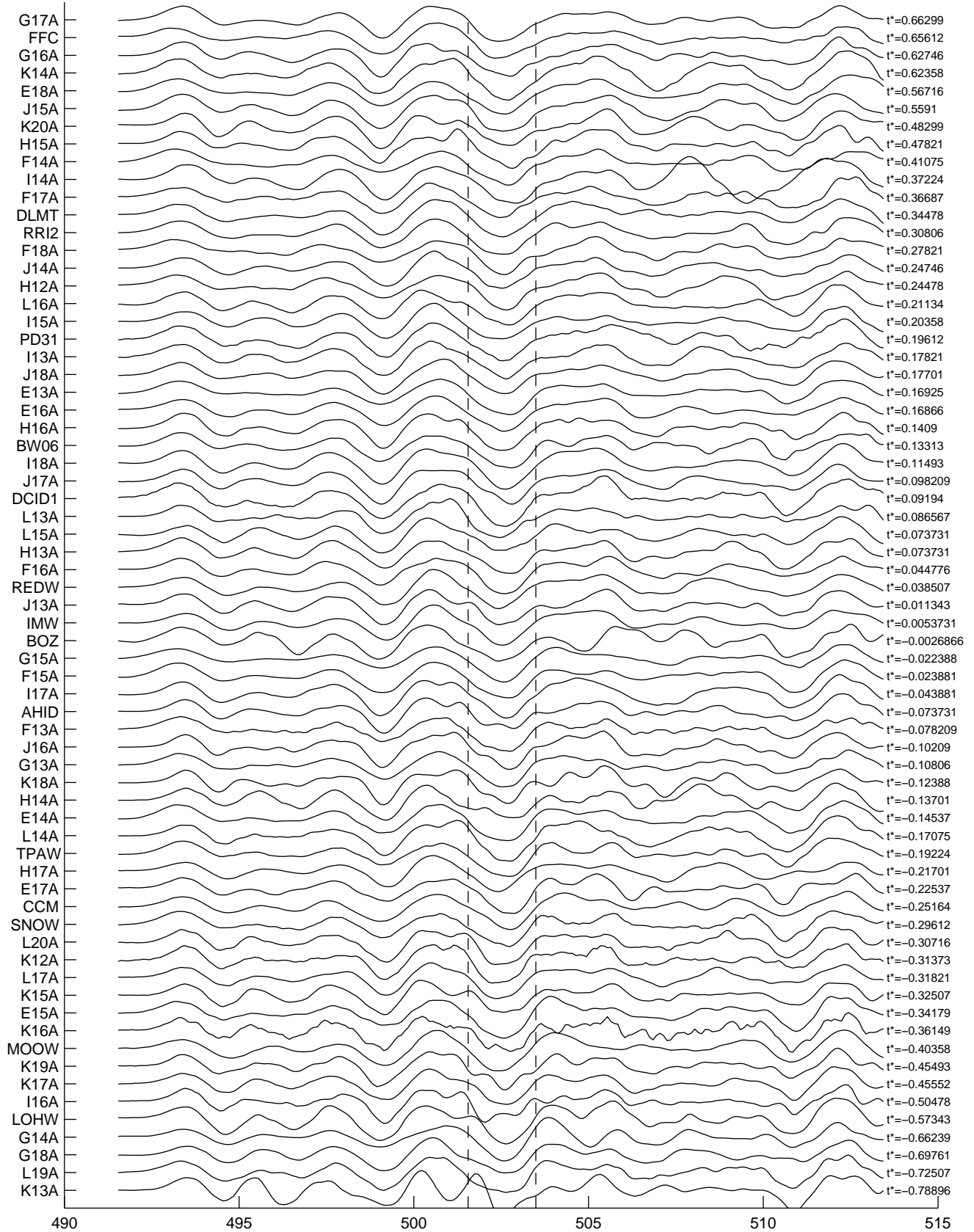
# Sorted by Delta:Event\_2008\_106\_22\_59\_51



# Sorted by travel time:Event\_2008\_106\_22\_59\_51

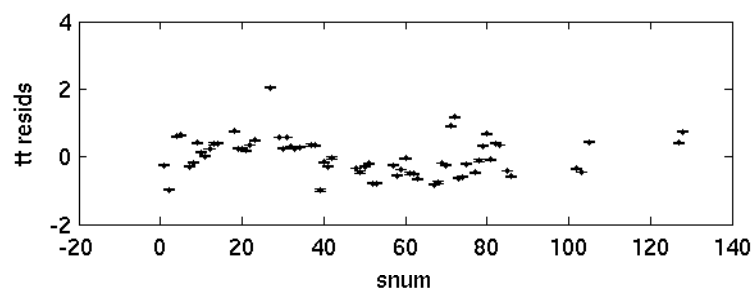
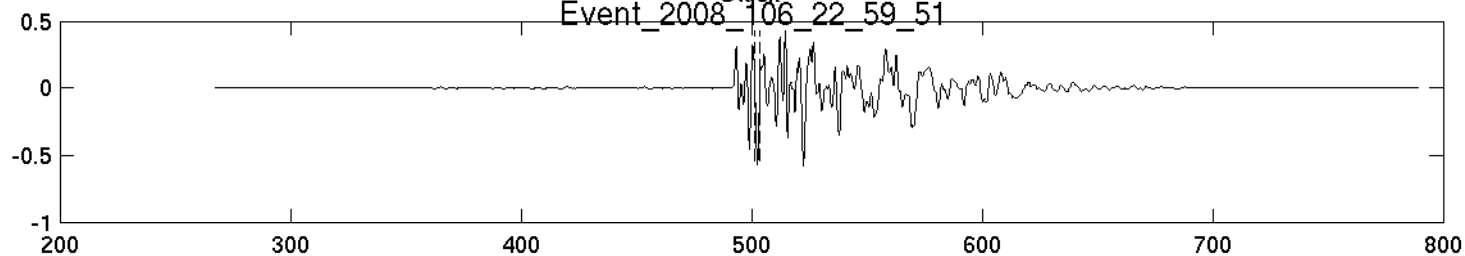


# Sorted by $t^*$ :Event\_2008\_106\_22\_59\_51

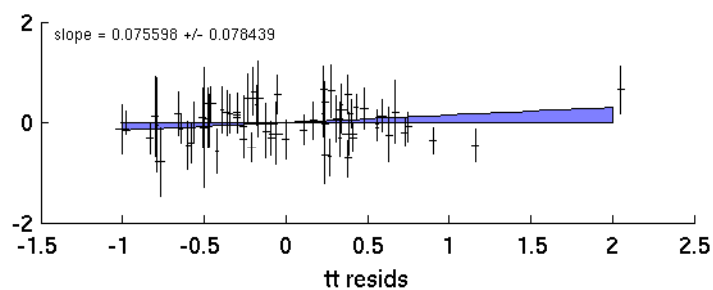
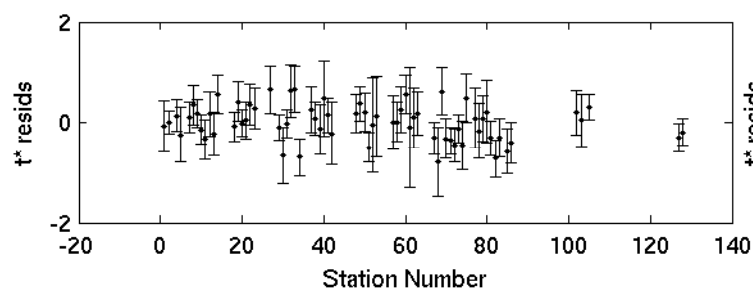


Event\_2008\_106\_22\_59\_51

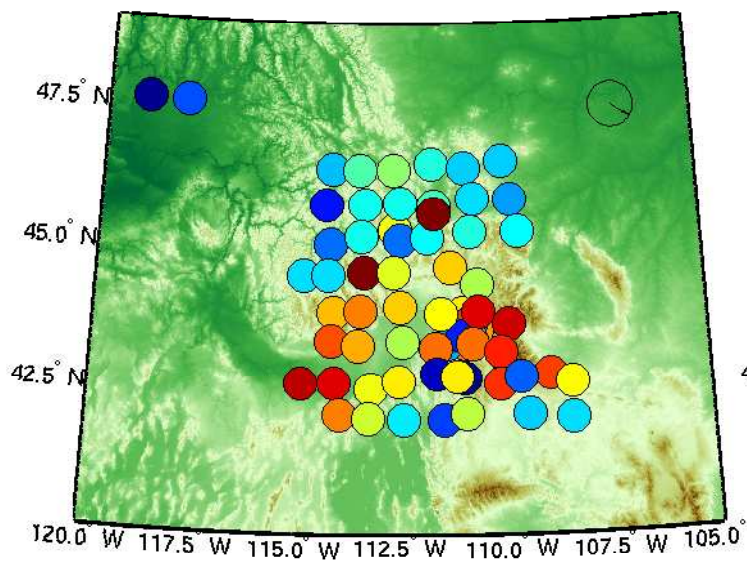
Stack



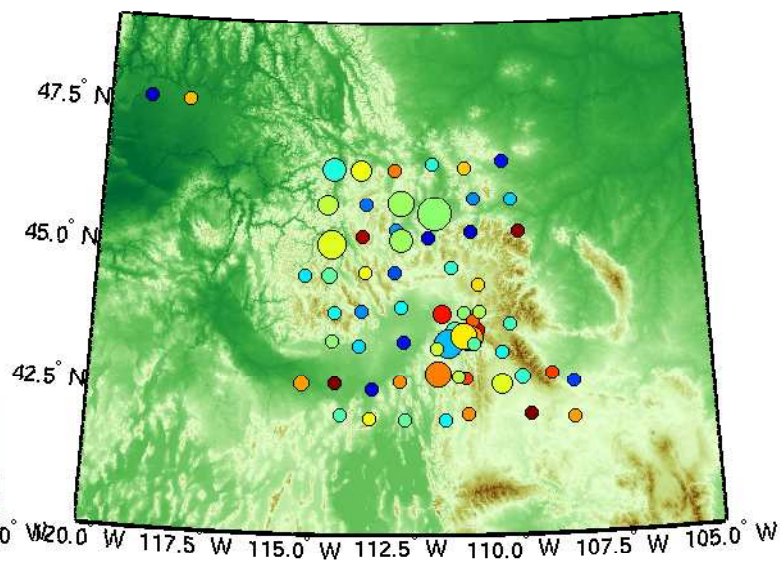
Baz = 305.1077  
Mean xcor value = 0.80418  
Range of  $t^*$  values is 1.4519  
Median  $t^*$  err is 0.39874  
Slope = 0.075598 +/- 0.078439



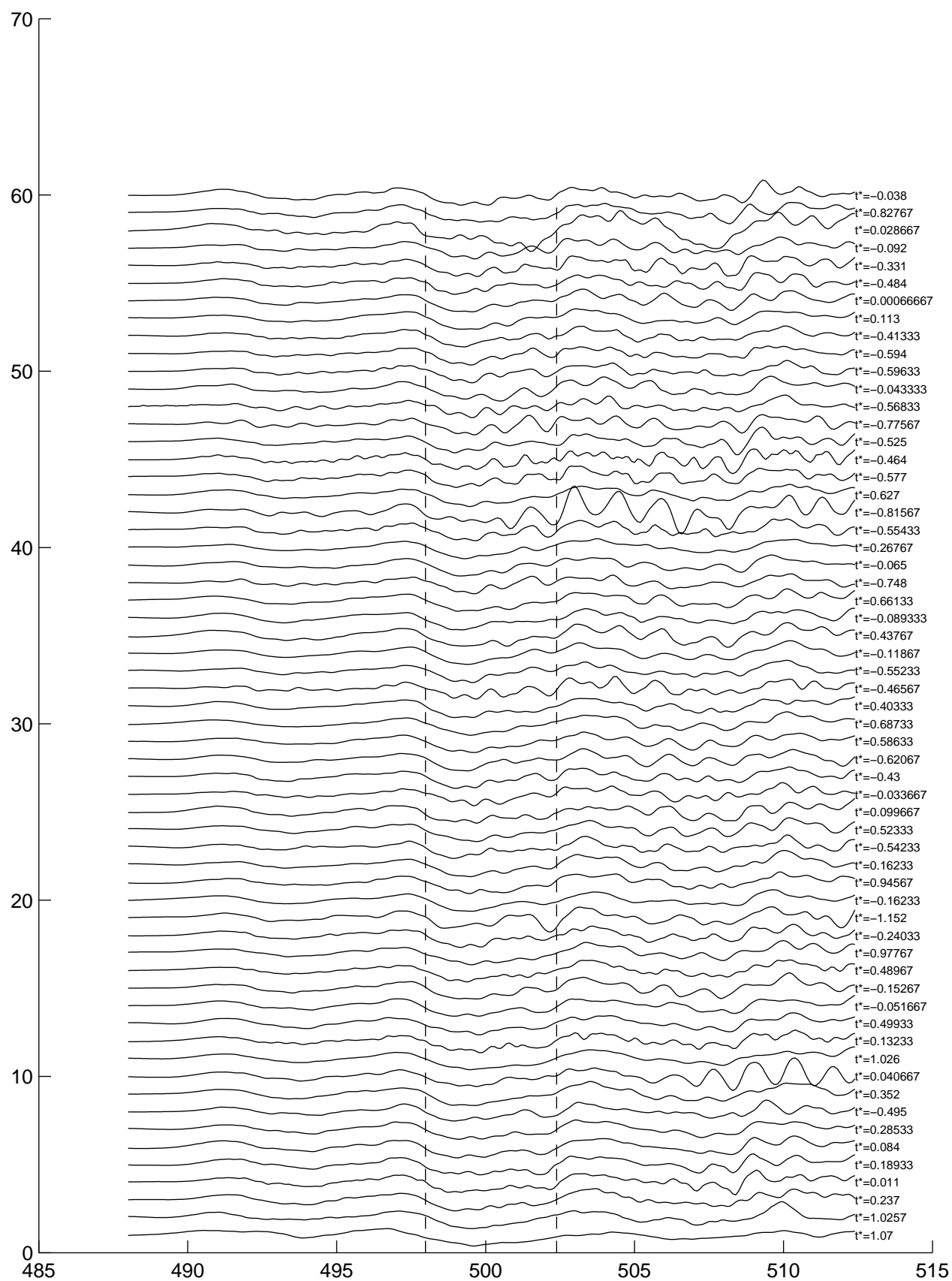
travel time residuals



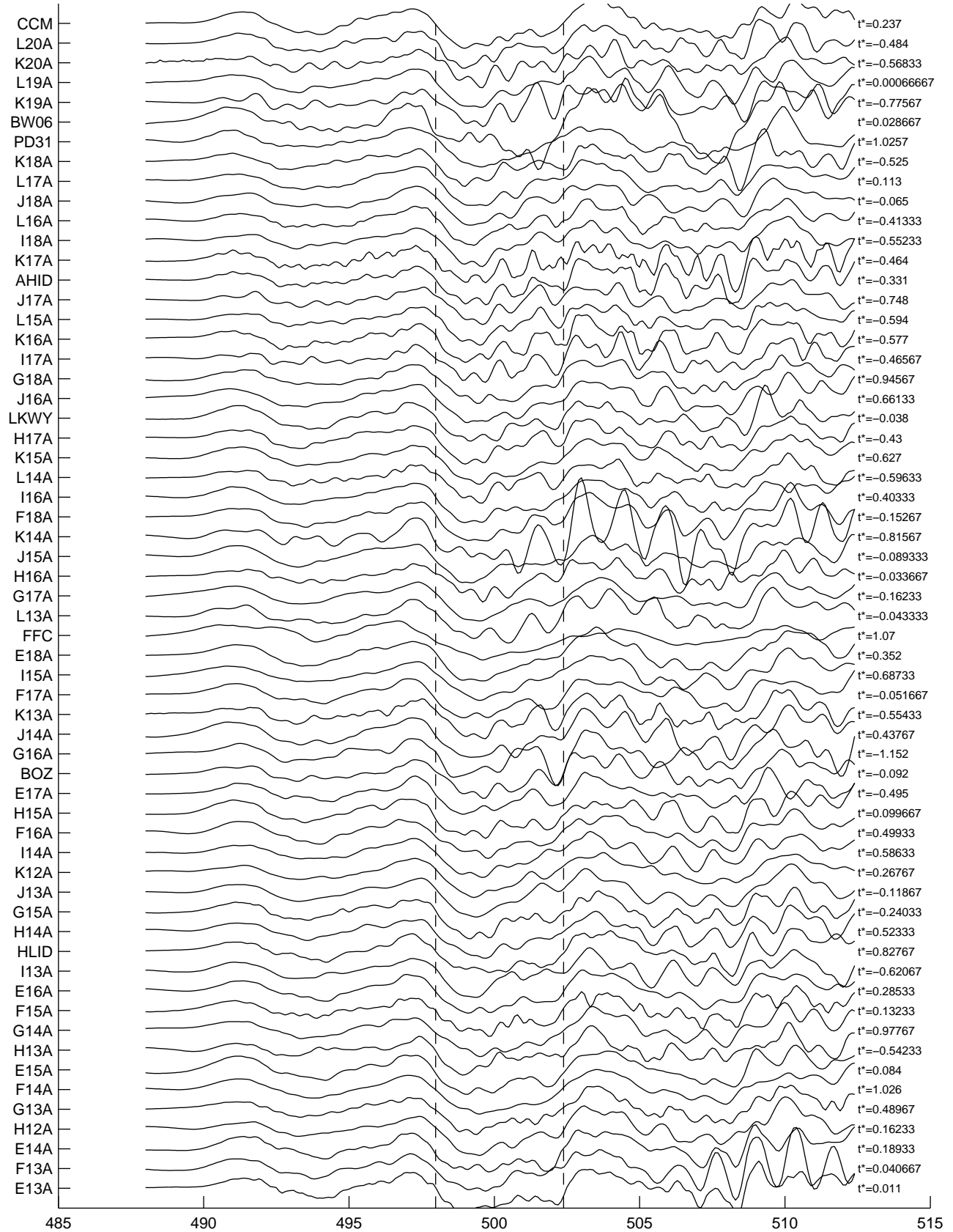
$t^*$  values



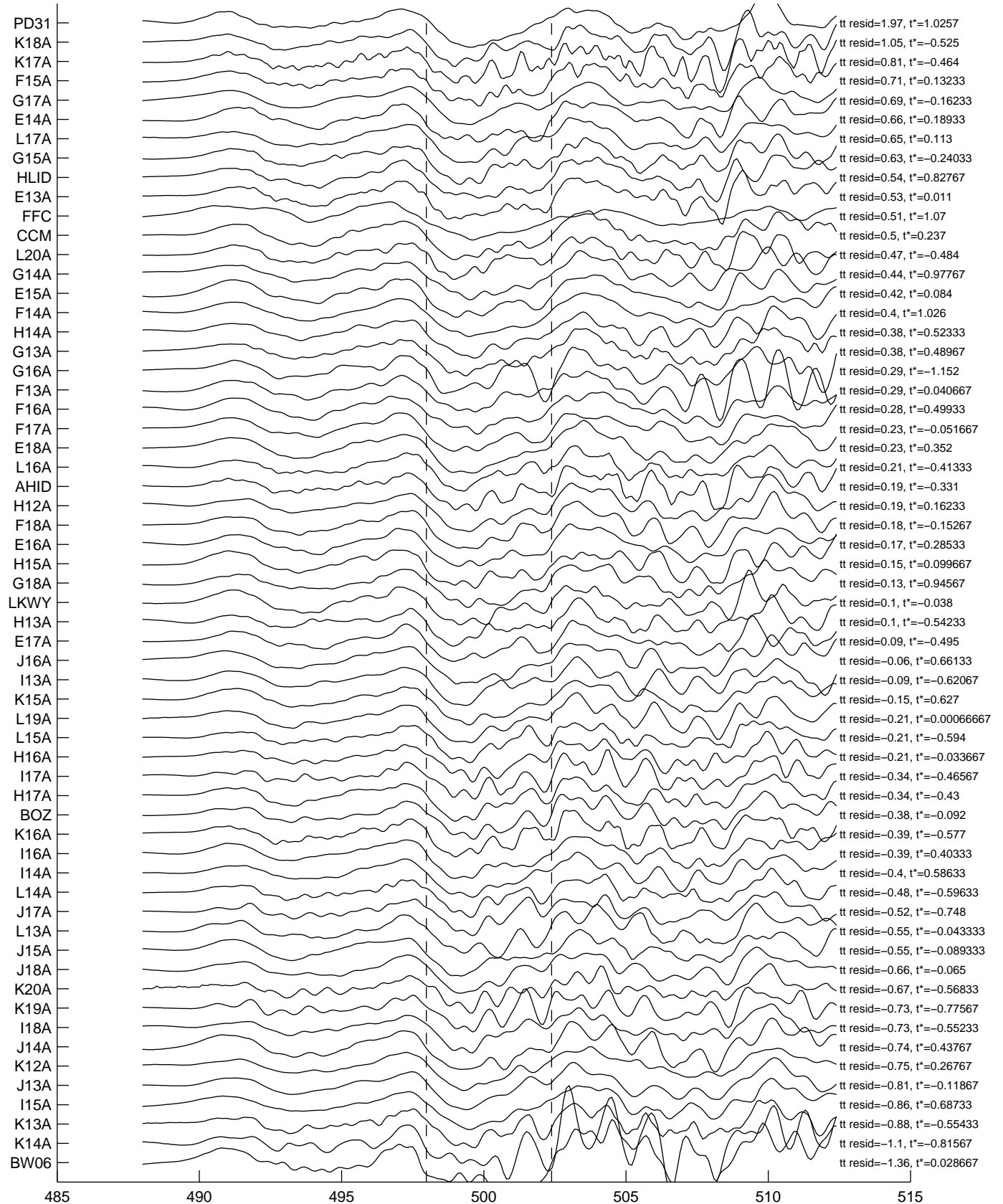
# Event\_2008\_107\_05\_54\_19



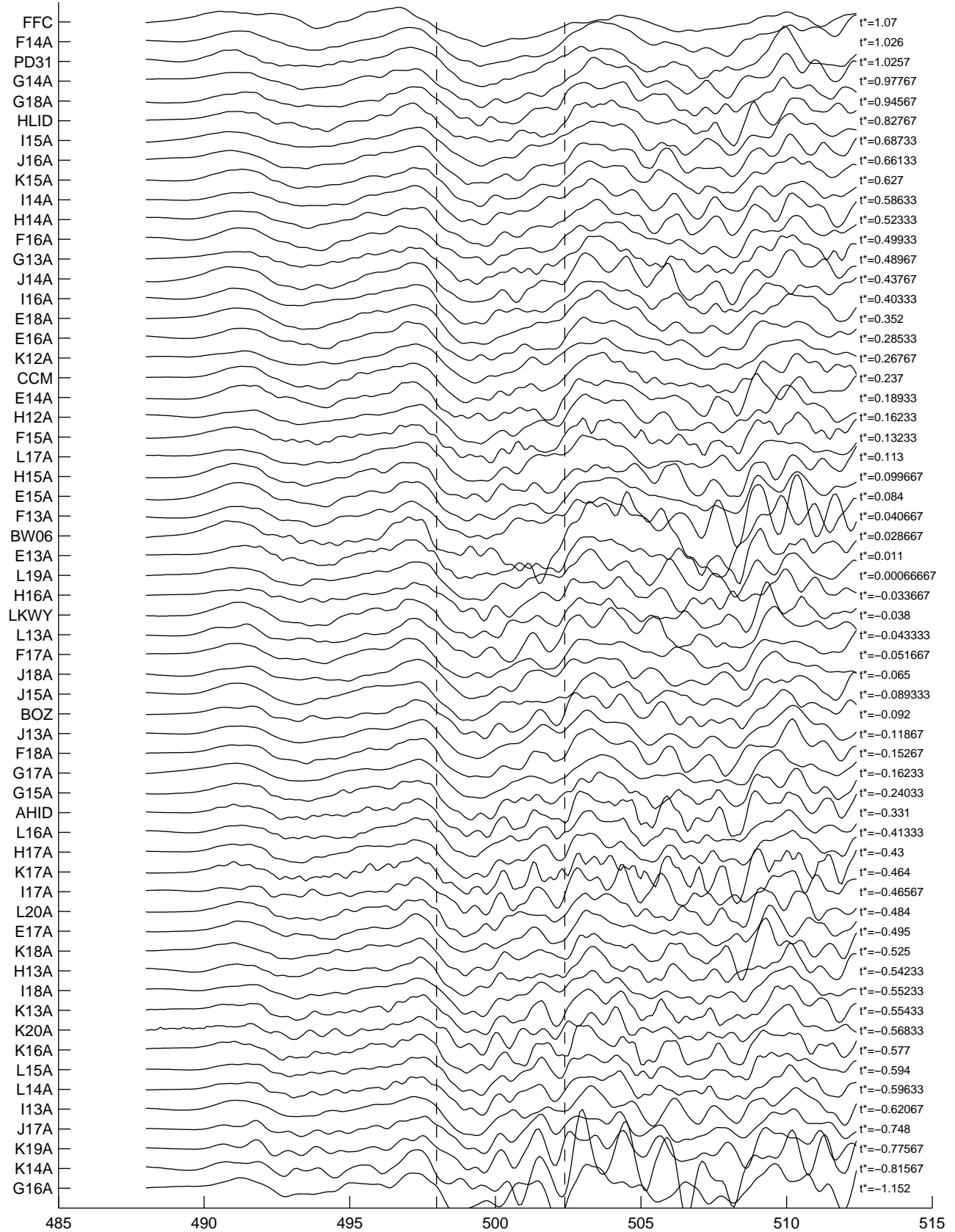
# Sorted by Delta:Event\_2008\_107\_05\_54\_19



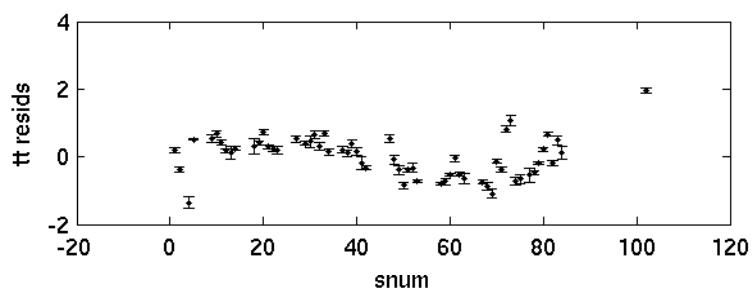
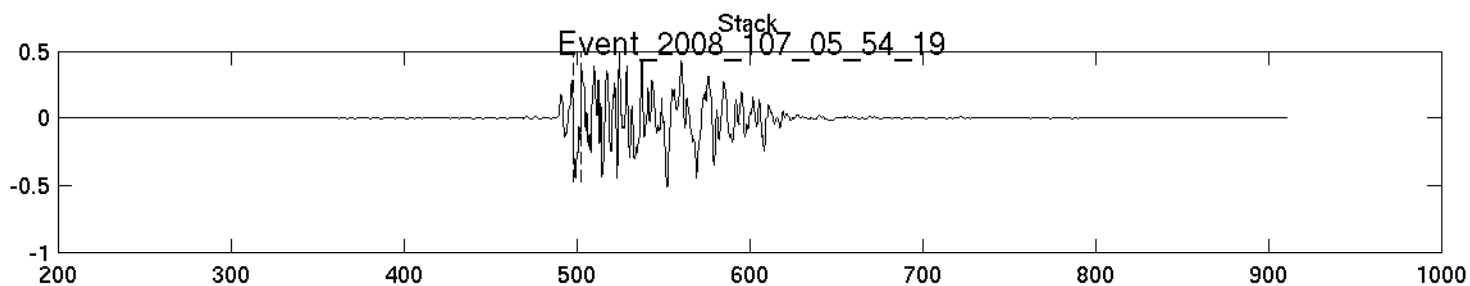
# Sorted by travel time:Event\_2008\_107\_05\_54\_19



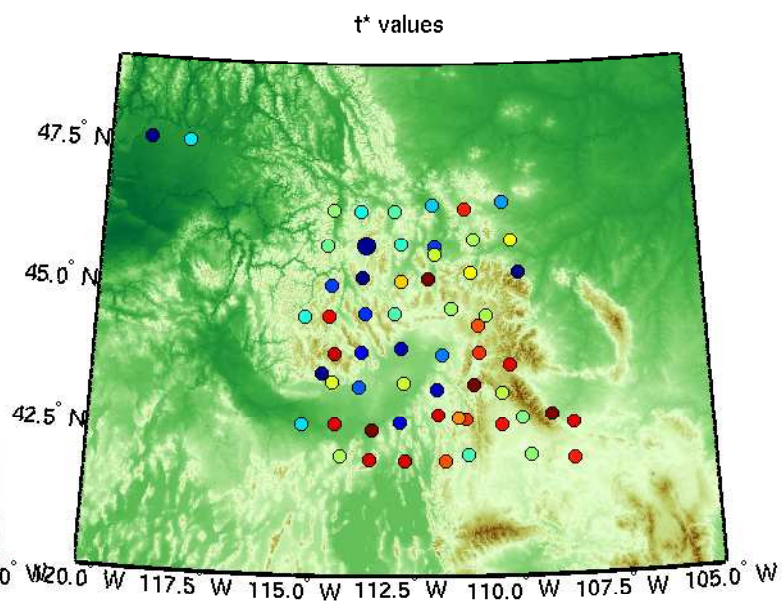
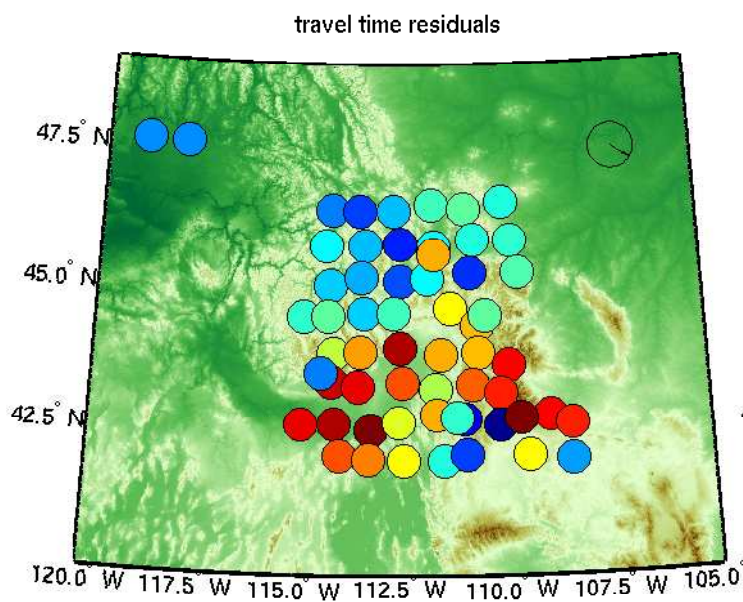
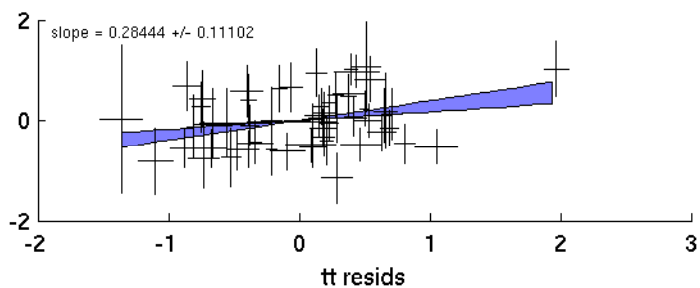
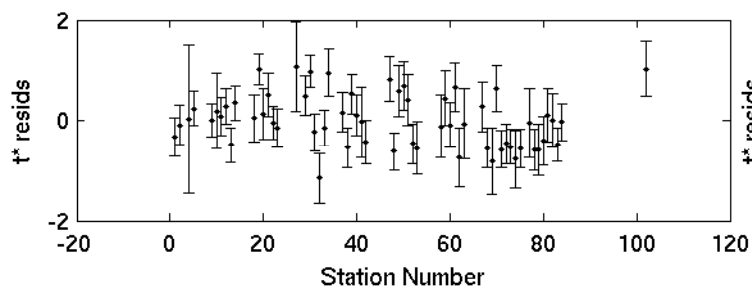
# Sorted by t\*:Event\_2008\_107\_05\_54\_19



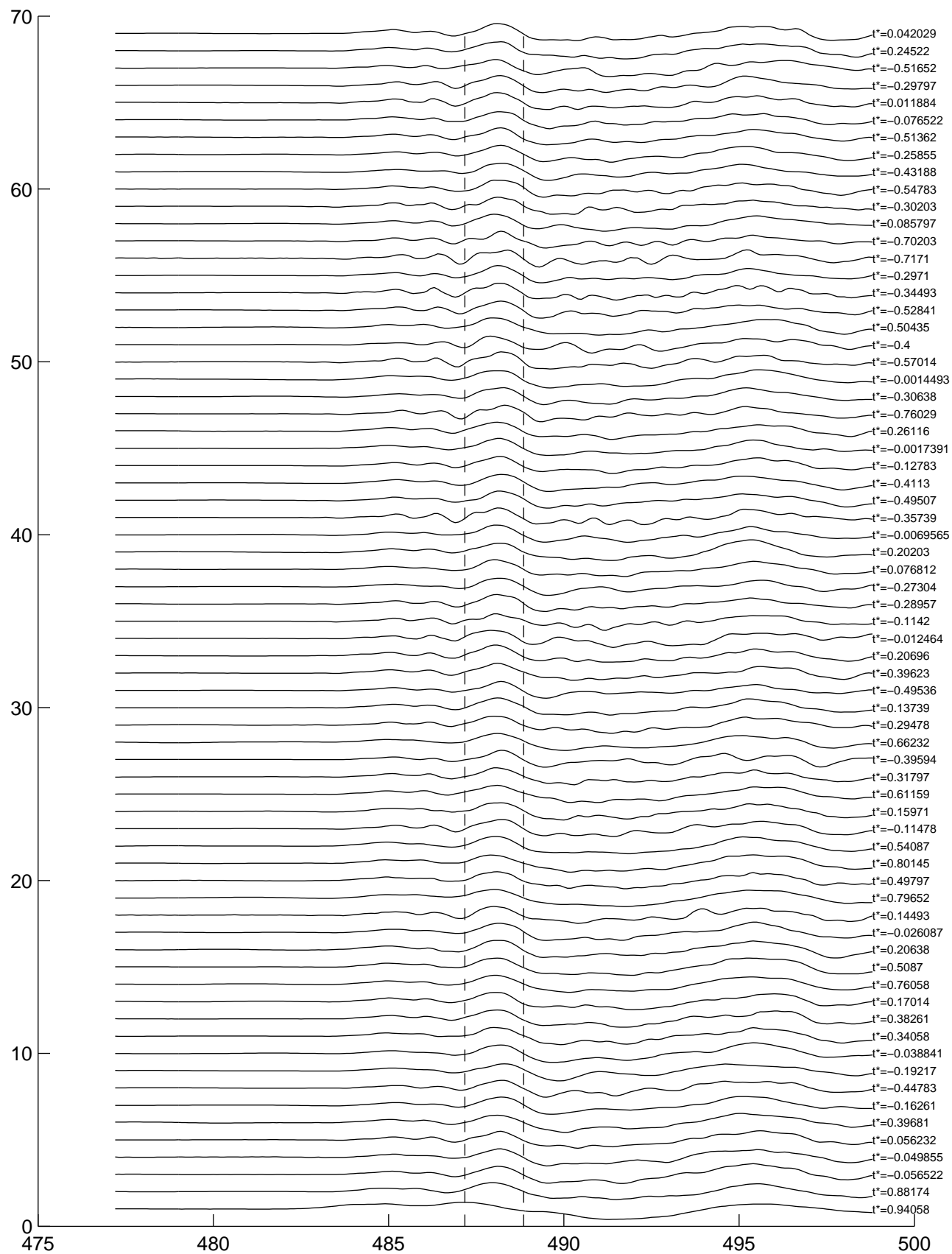




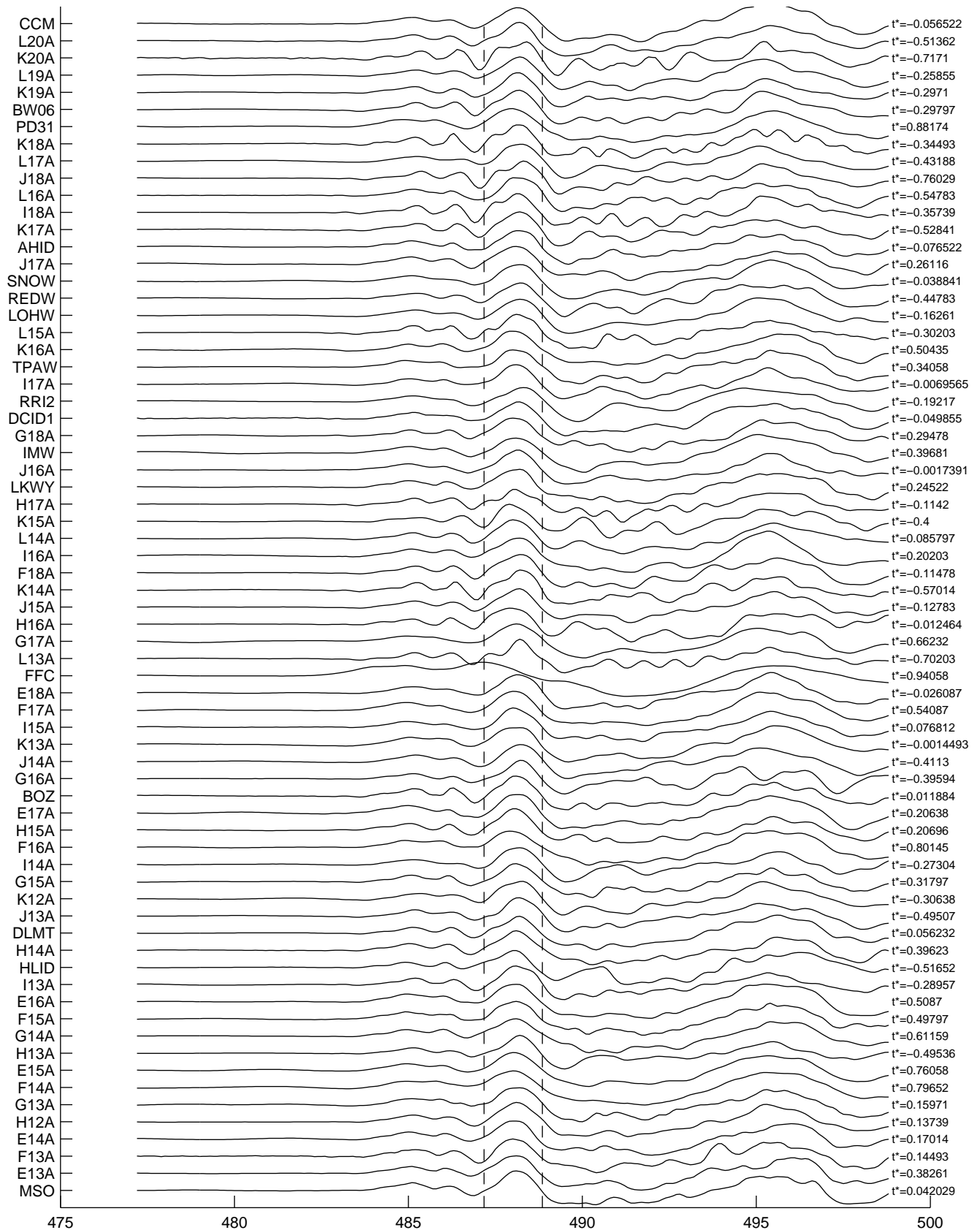
Baz = 305.027  
Mean xcor value = 0.781  
Range of  $t^*$  values is 2.222  
Median  $t^*$  err is 0.43765  
Slope = 0.28444 +/- 0.11102



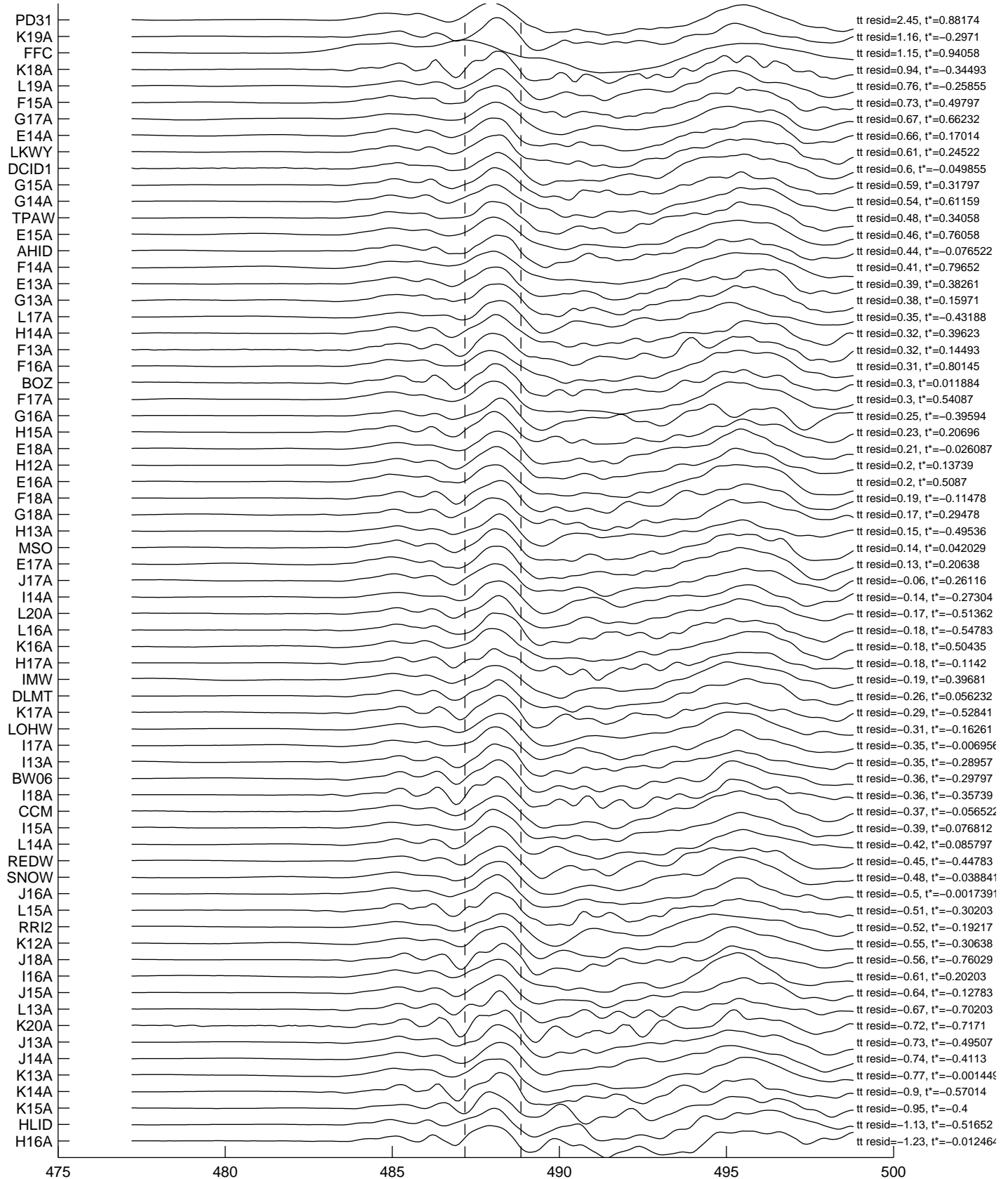
# Event\_2008\_123\_01\_33\_37



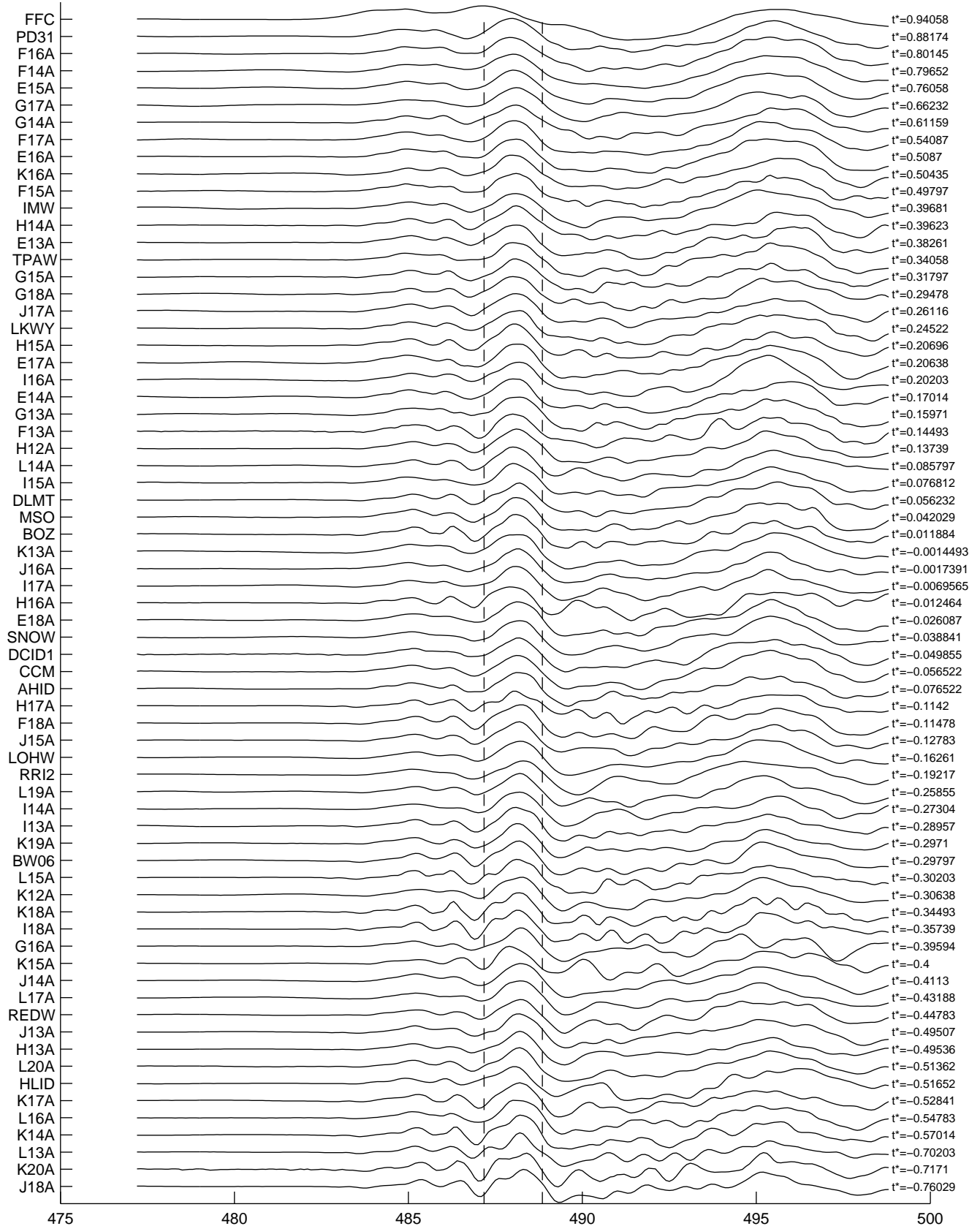
# Sorted by Delta:Event\_2008\_123\_01\_33\_37



# Sorted by travel time:Event\_2008\_123\_01\_33\_37

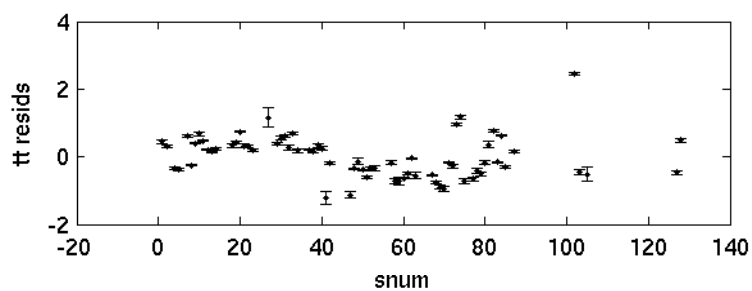
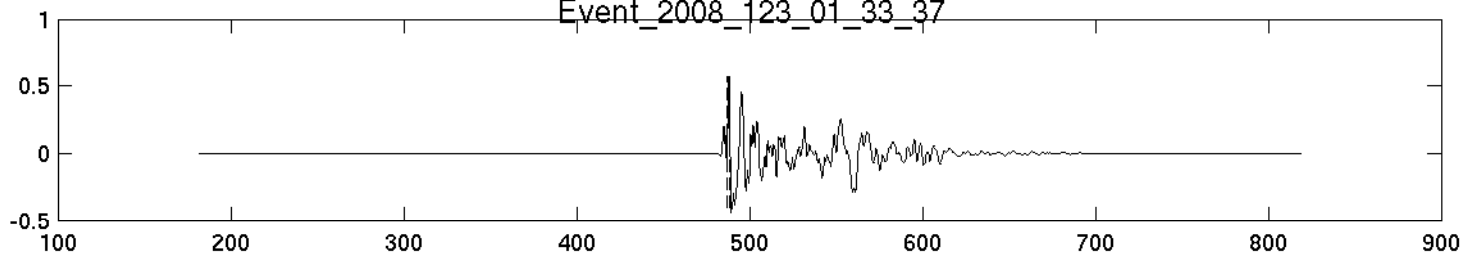


# Sorted by t\*:Event\_2008\_123\_01\_33\_37

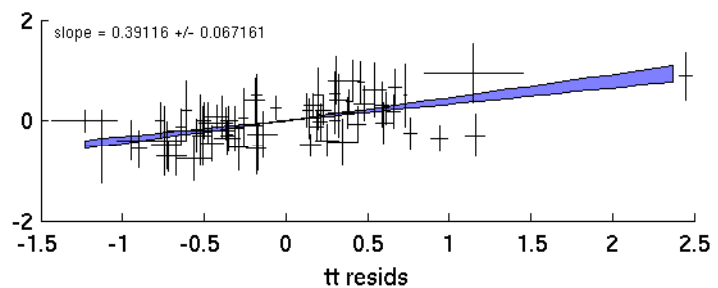
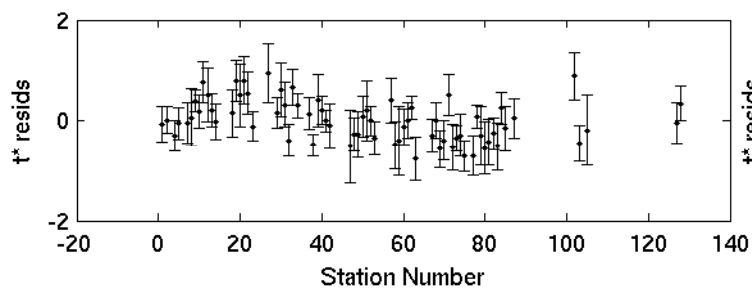


Event\_2008\_123\_01\_33\_37

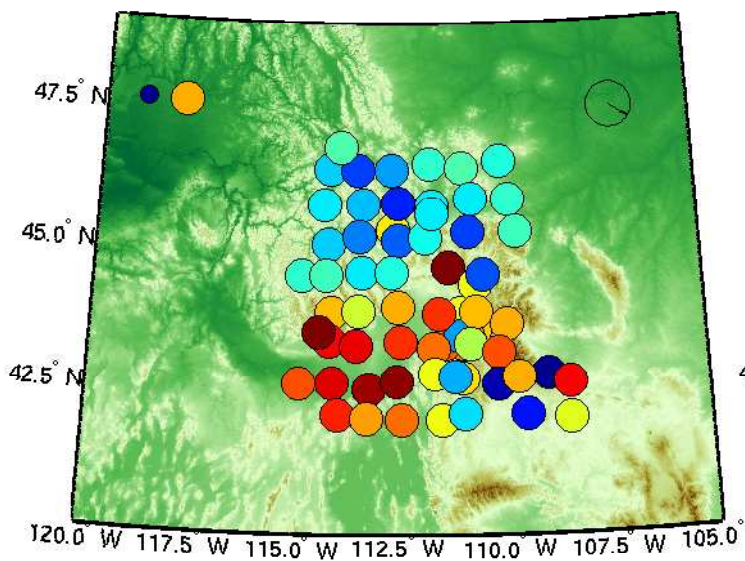
Stack



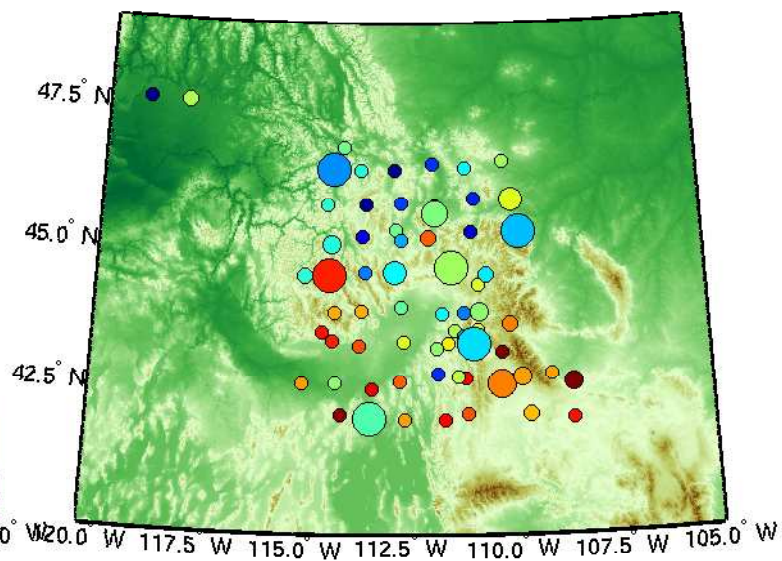
Baz = 304.6176  
Mean xcor value = 0.85116  
Range of  $t^*$  values is 1.7009  
Median  $t^*$  err is 0.39858  
Slope = 0.39116 +/- 0.067161



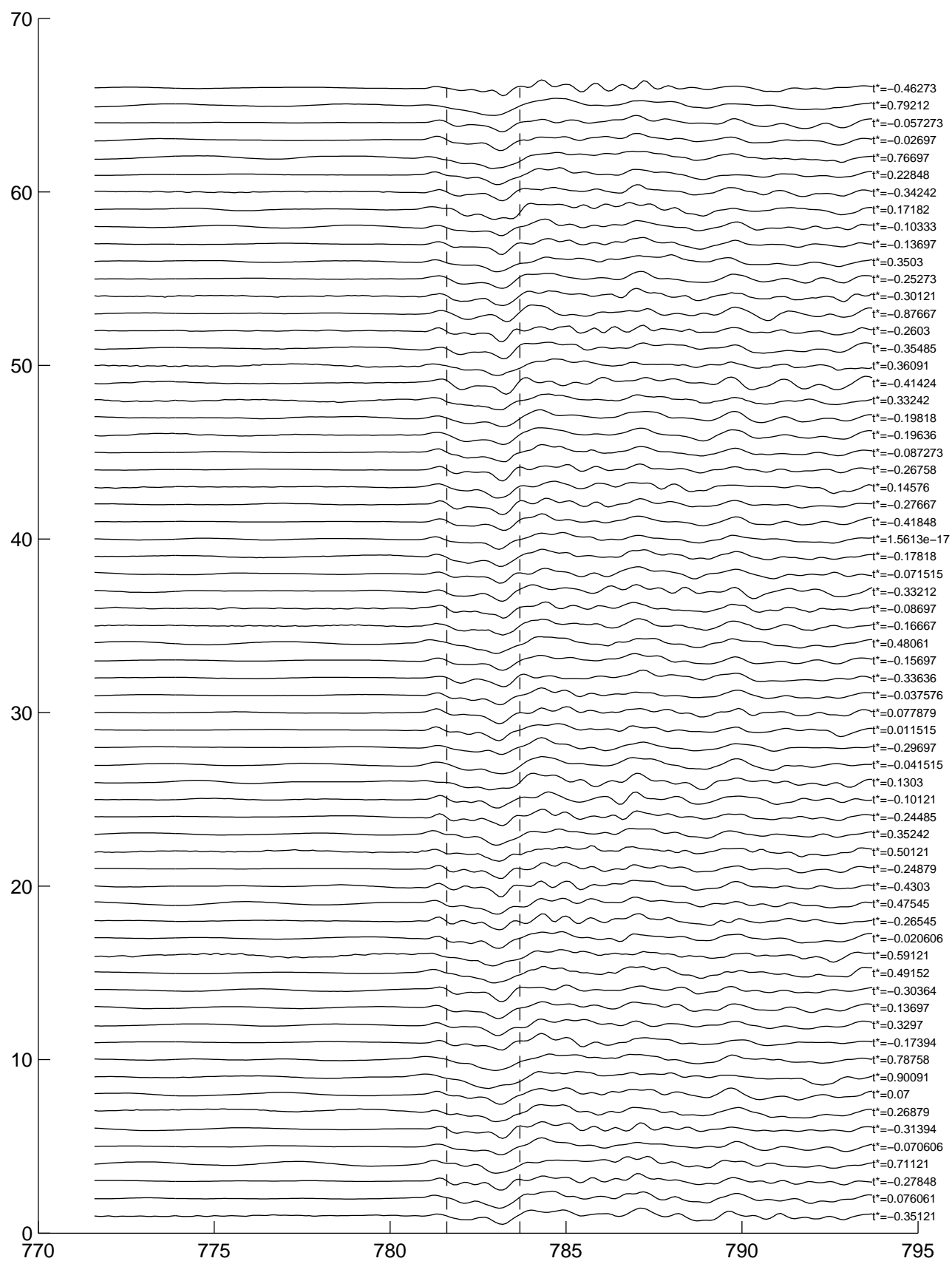
travel time residuals



$t^*$  values

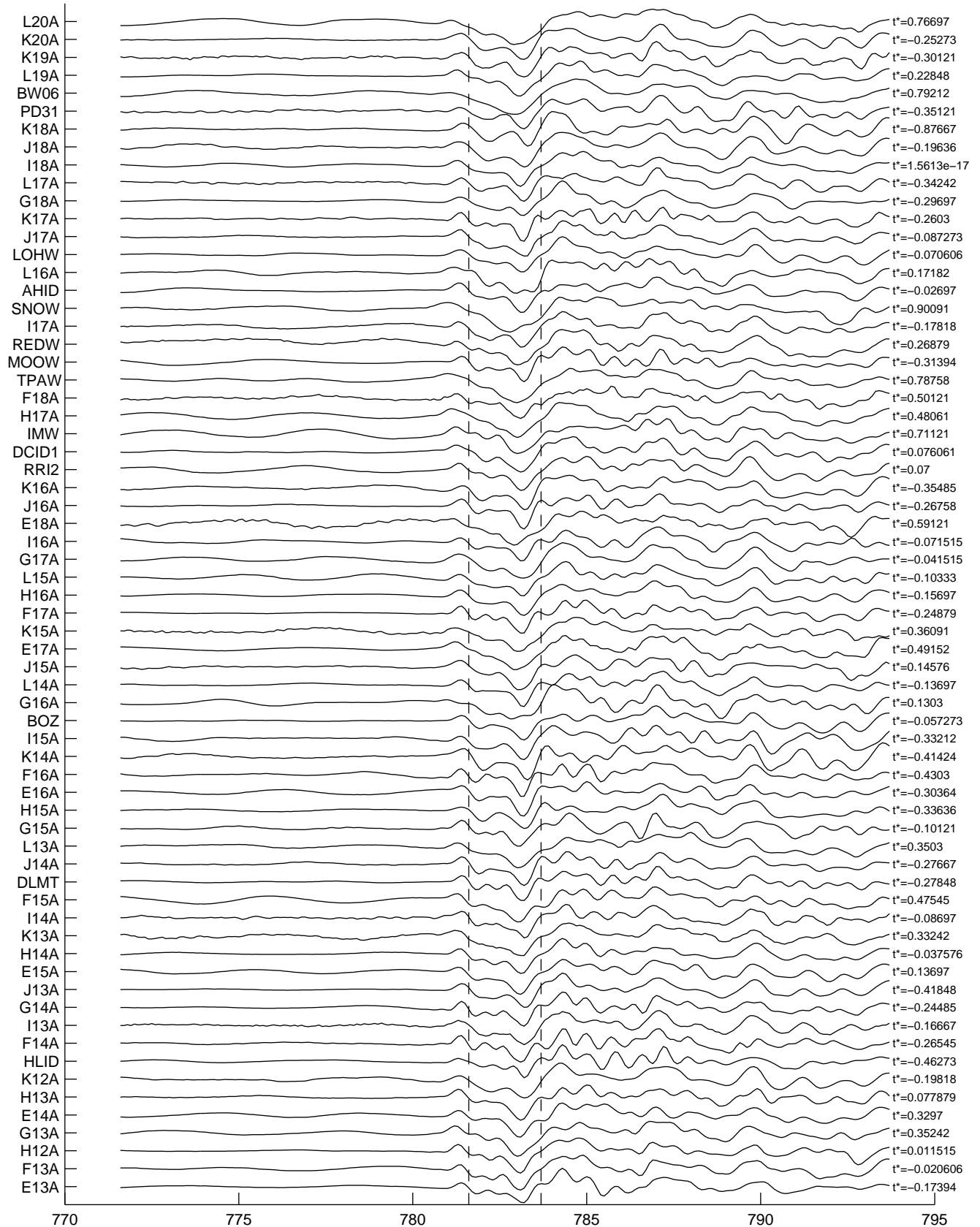


# Event\_2008\_130\_21\_51\_29



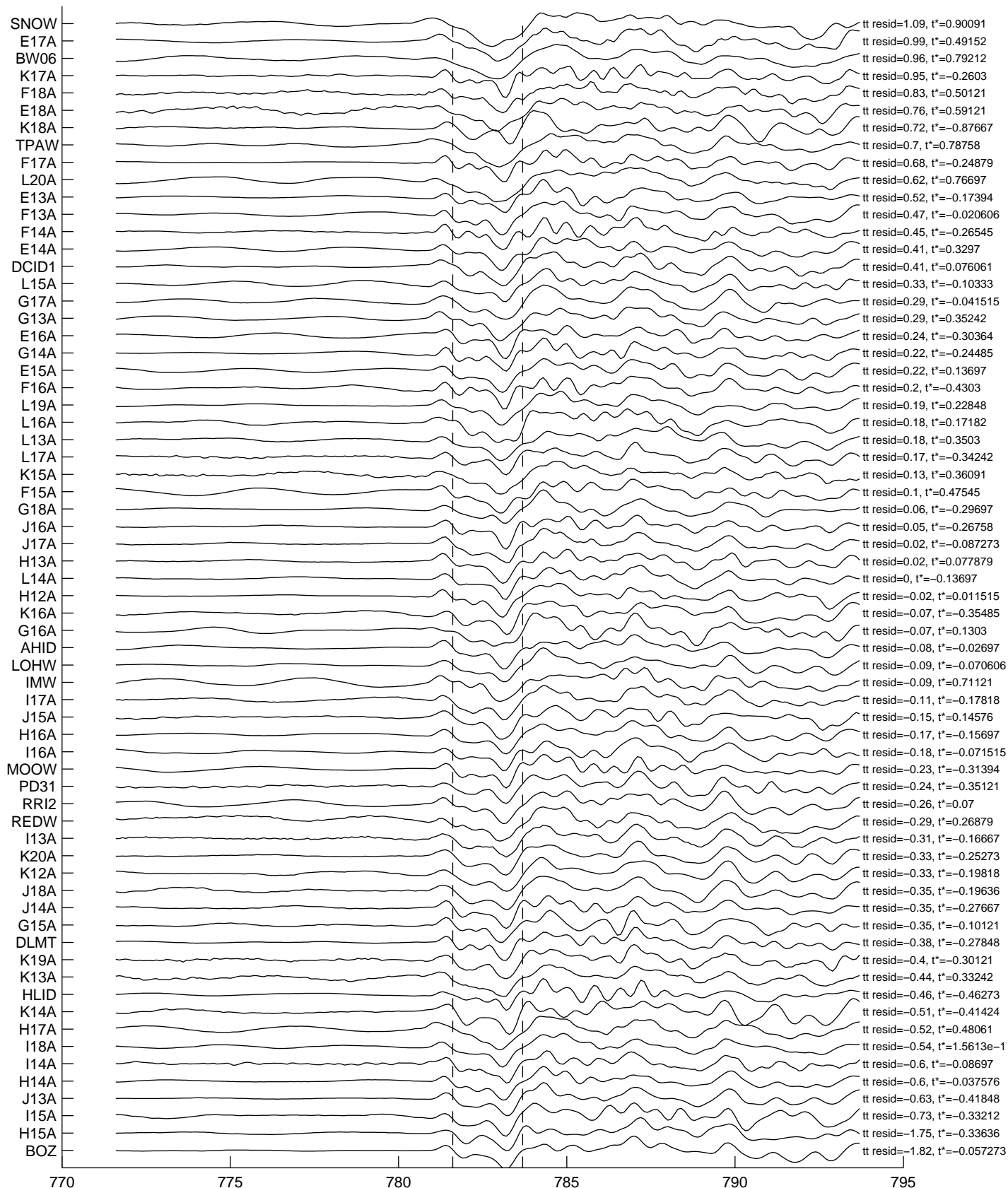


# Sorted by Delta:Event\_2008\_130\_21\_51\_29

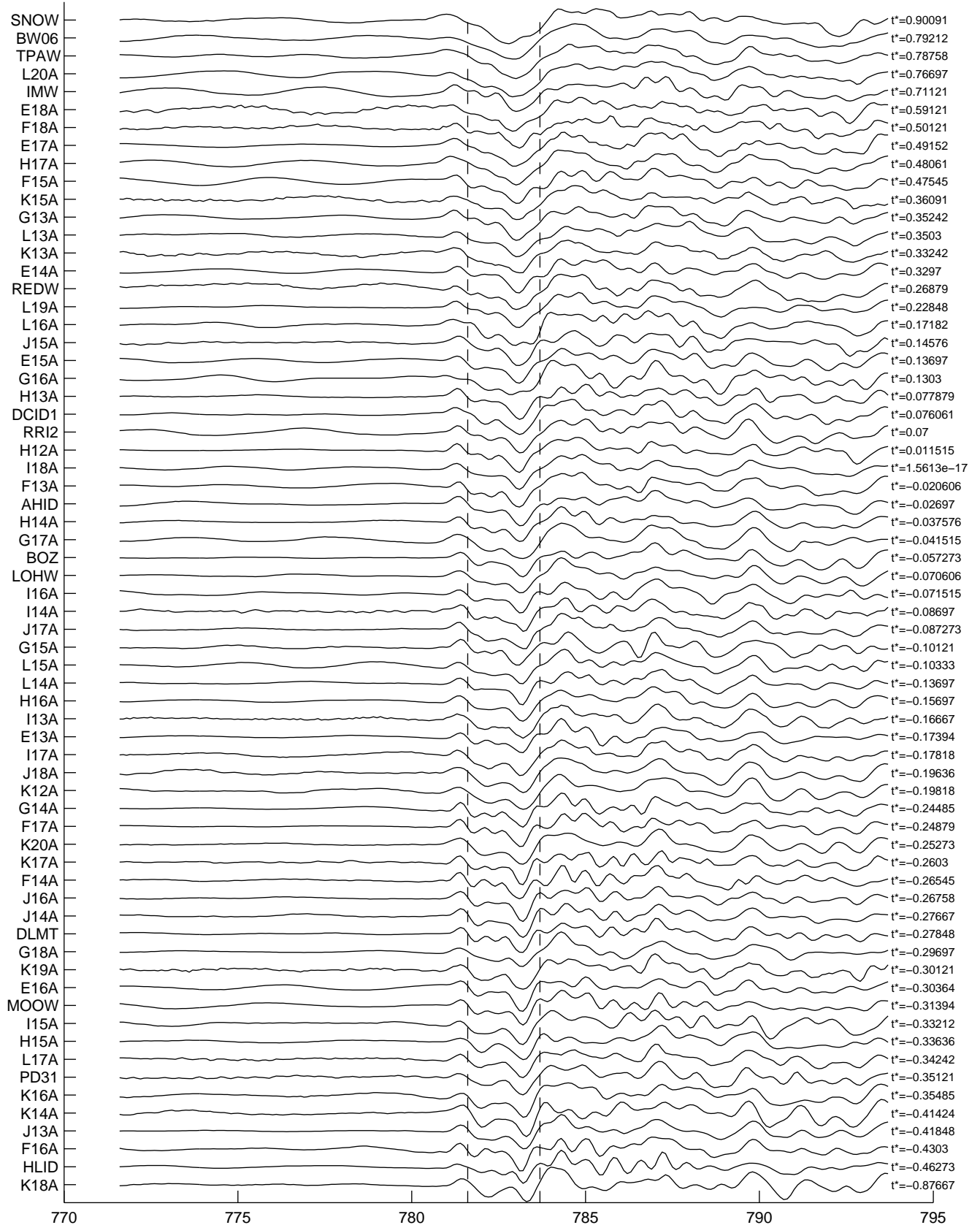




# Sorted by travel time:Event\_2008\_130\_21\_51\_29



# Sorted by t\*:Event\_2008\_130\_21\_51\_29



770

775

780

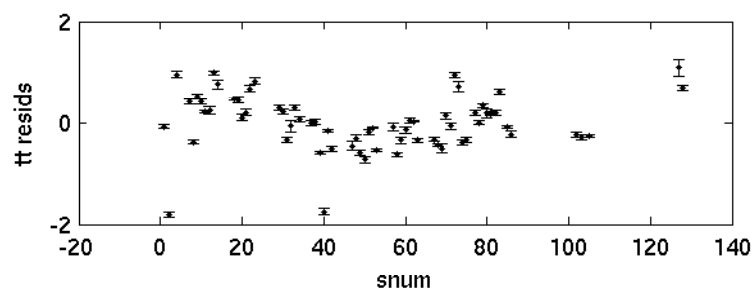
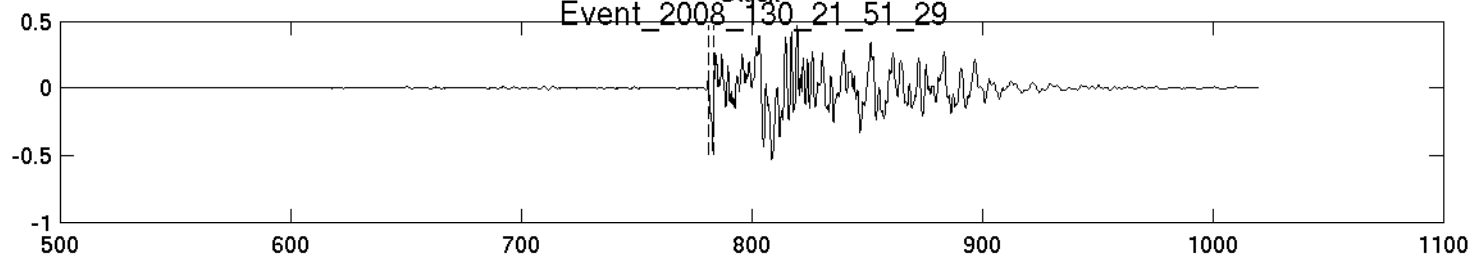
785

790

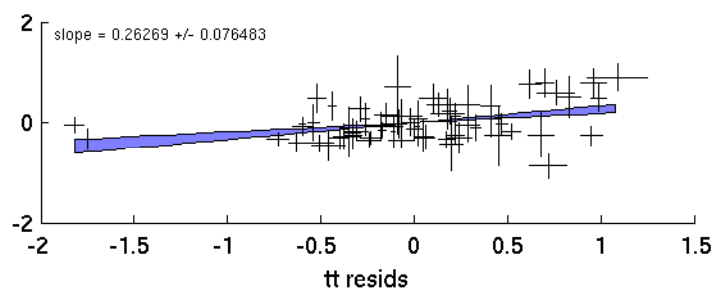
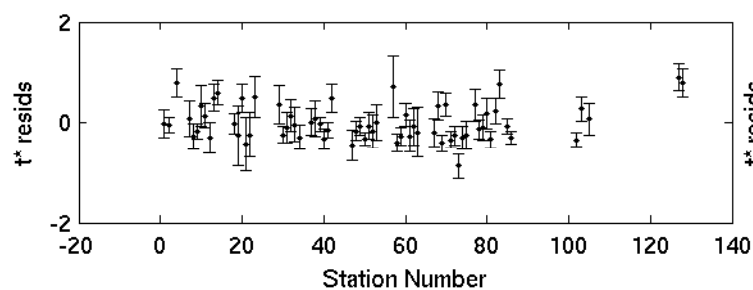
795

Event\_2008\_130\_21\_51\_29

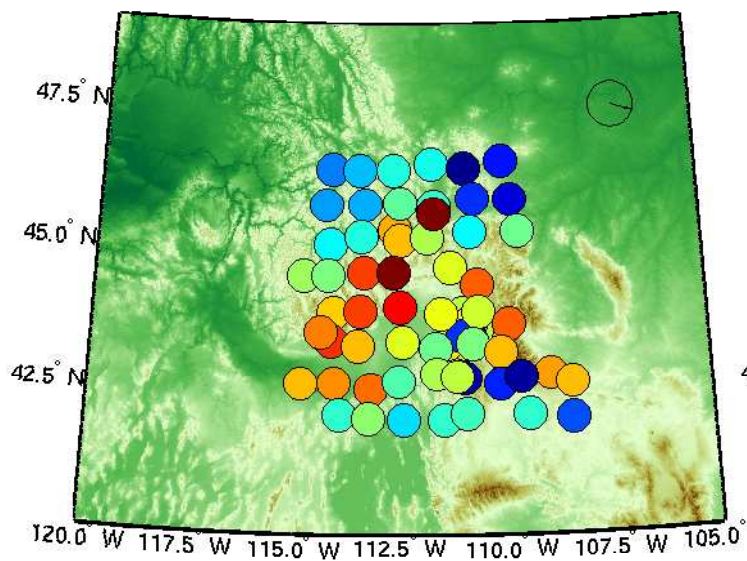
Stack



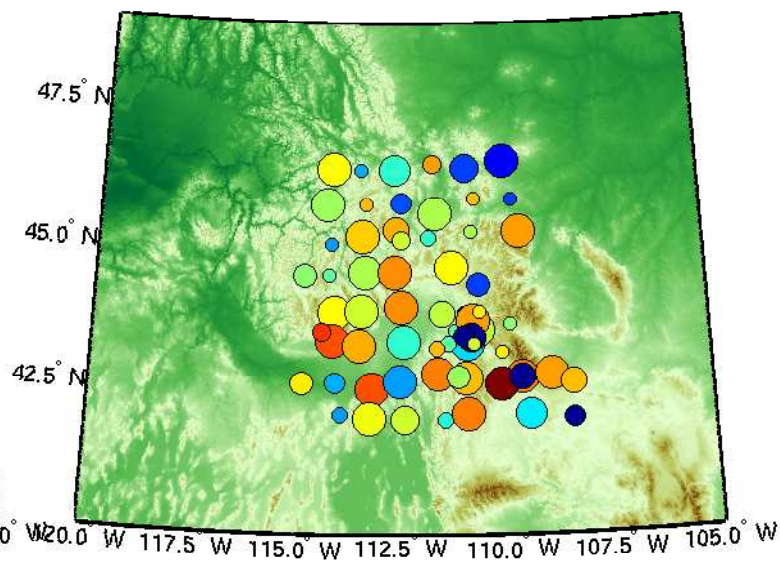
Baz = 269.3926  
Mean xcor value = 0.73727  
Range of  $t^*$  values is 1.7776  
Median  $t^*$  err is 0.26822  
Slope = 0.26269 +/- 0.076483



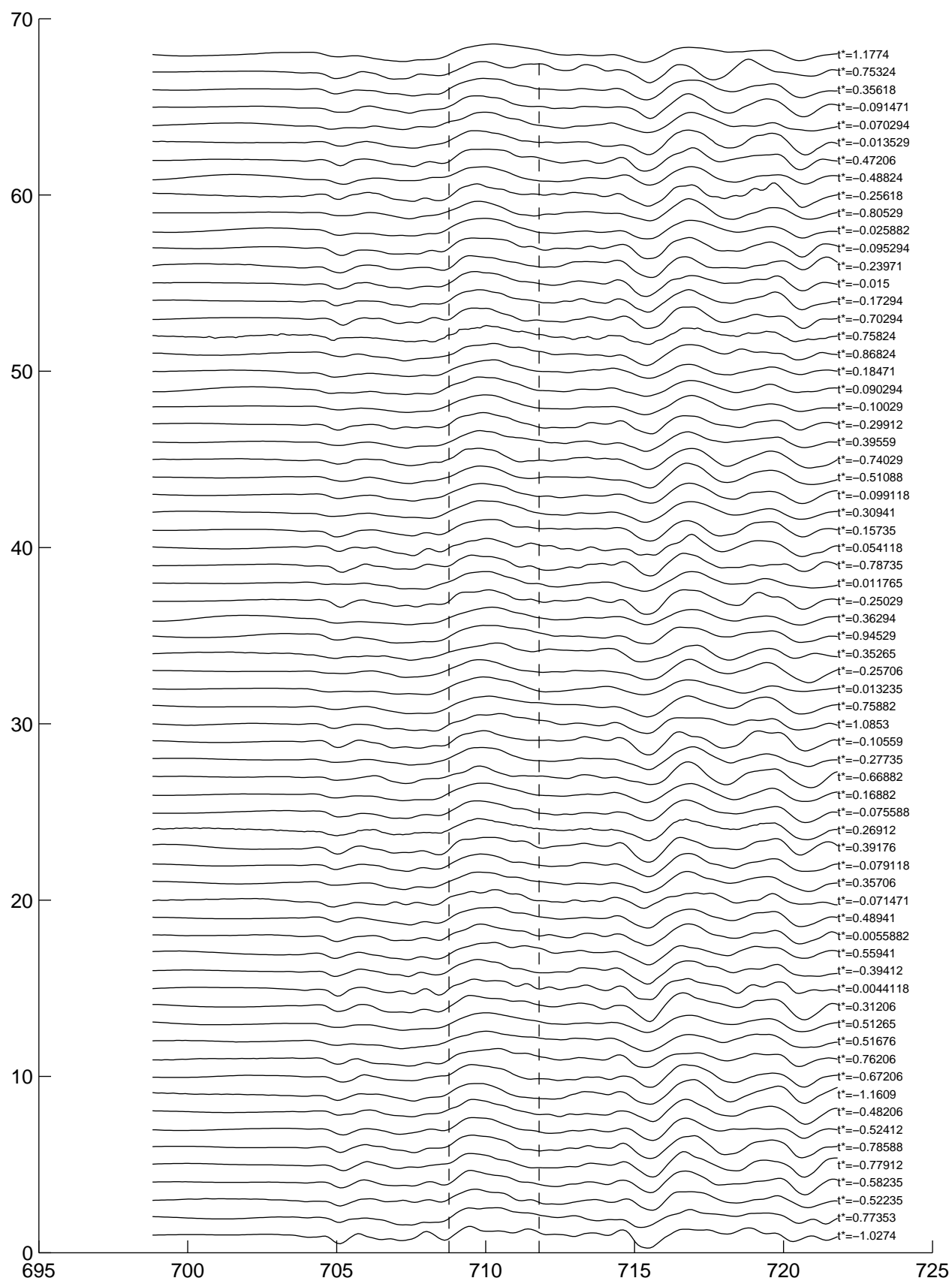
travel time residuals



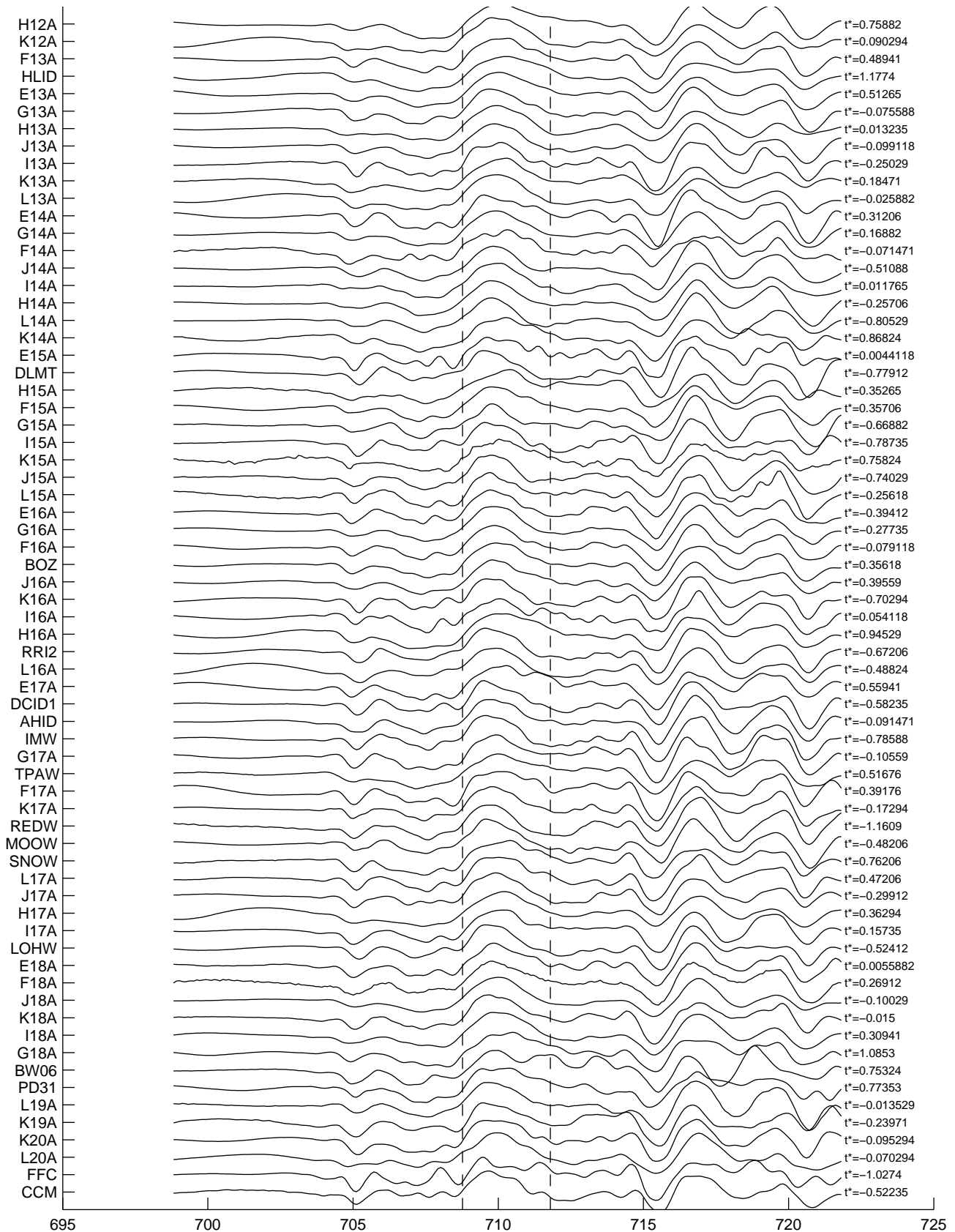
$t^*$  values



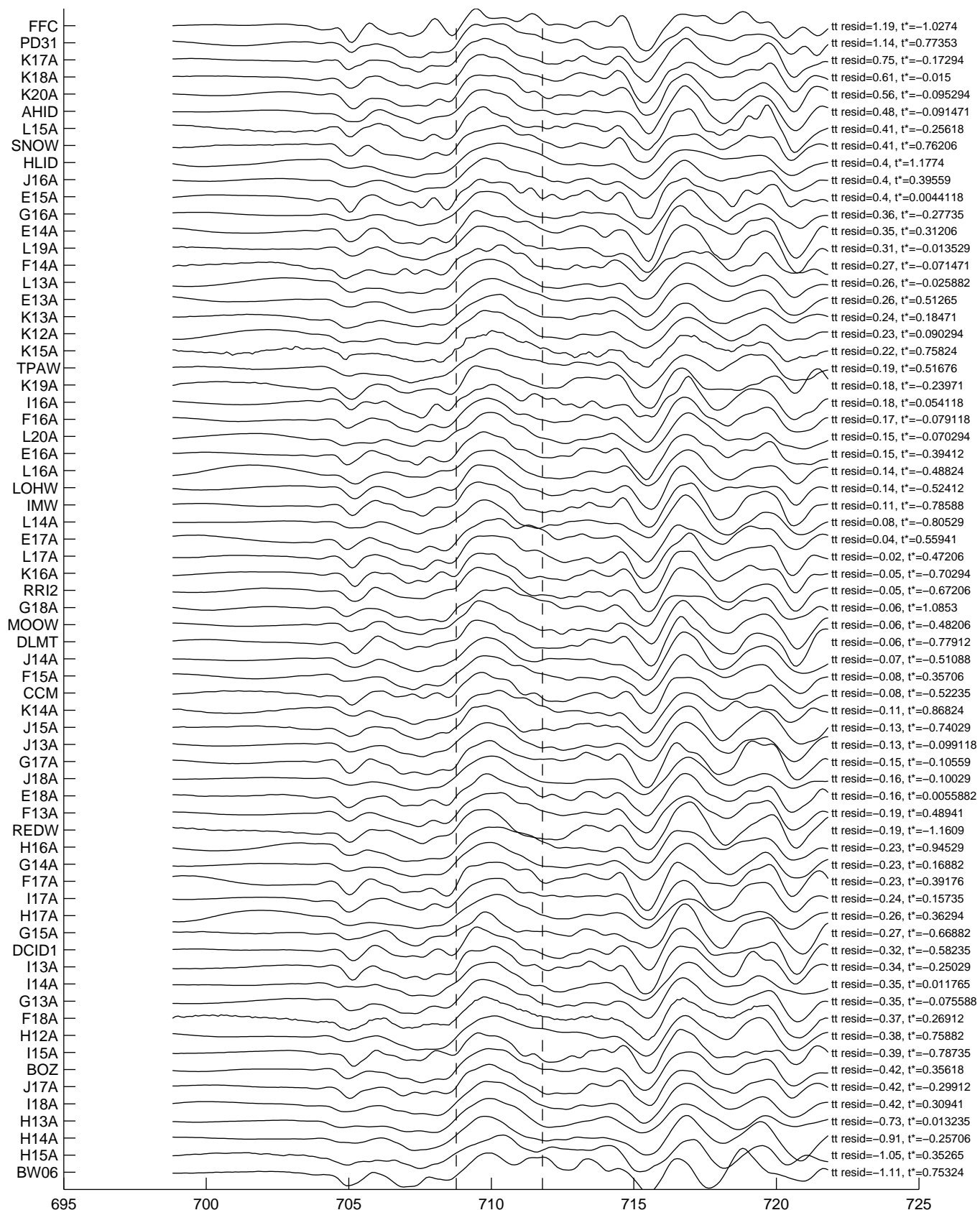
# Event\_2008\_144\_19\_35\_34



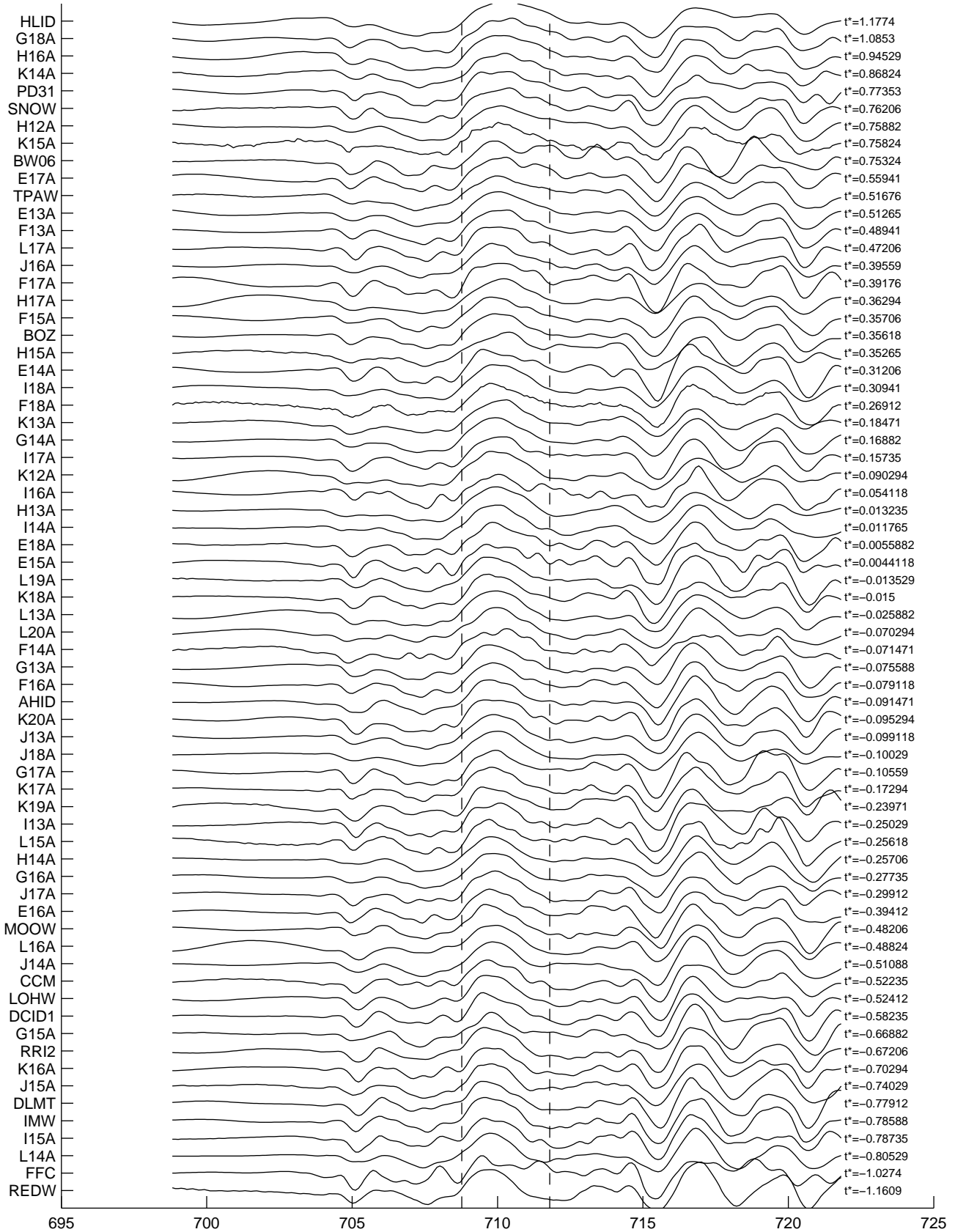
# Sorted by Delta:Event\_2008\_144\_19\_35\_34



# Sorted by travel time:Event\_2008\_144\_19\_35\_34



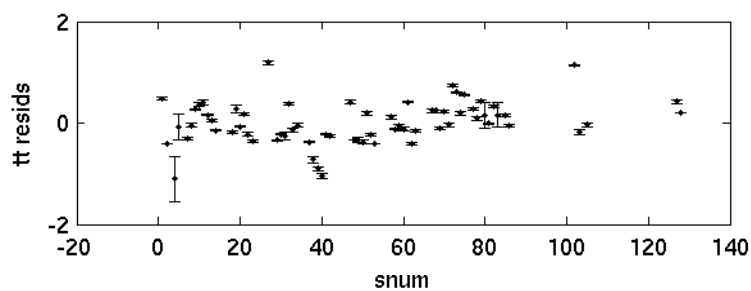
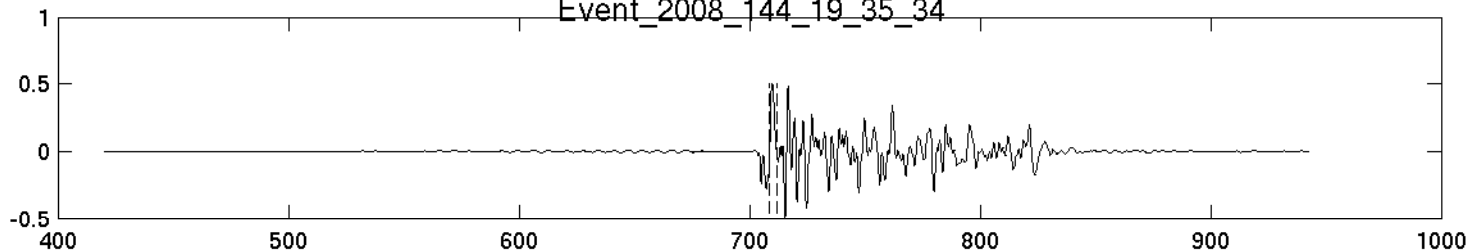
Sorted by  $t^*$ :Event\_2008\_144\_19\_35\_34



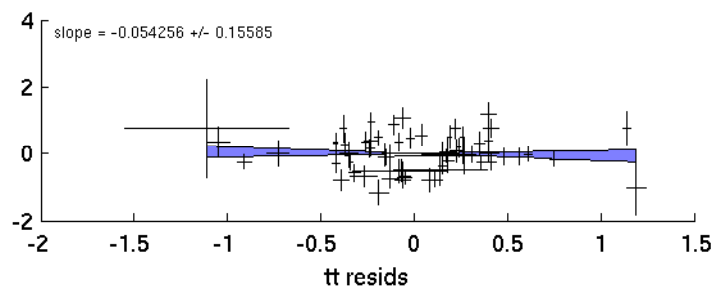
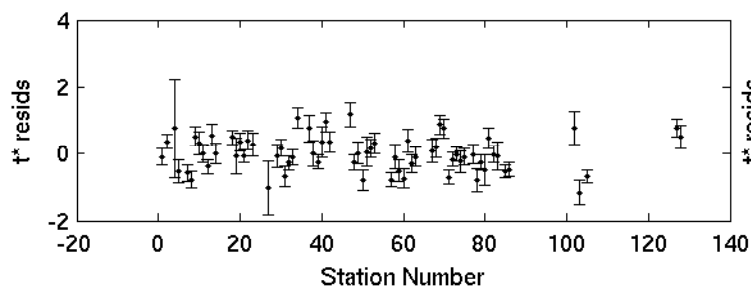


Event\_2008\_144\_19\_35\_34

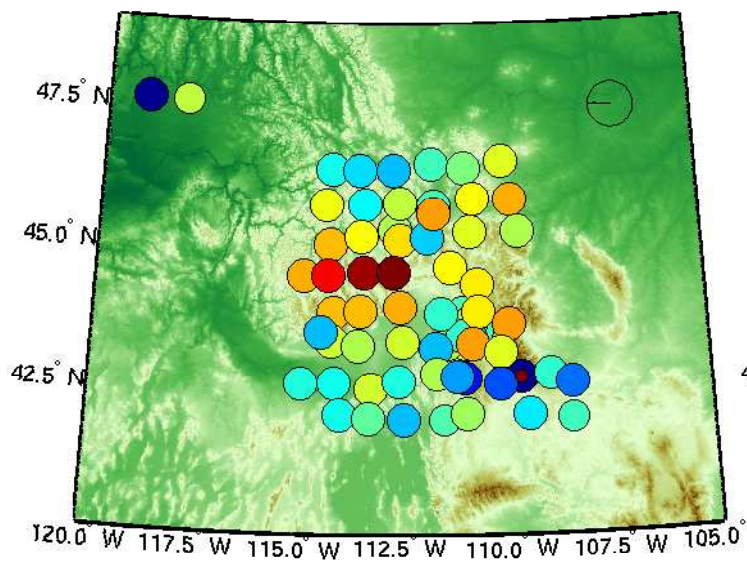
Stack



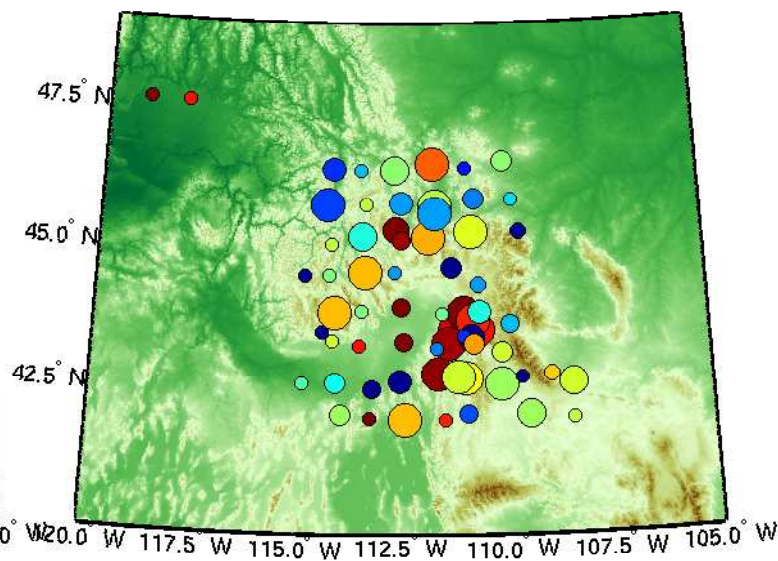
Baz = 94.1902  
Mean xcor value = 0.82162  
Range of  $t^*$  values is 2.3382  
Median  $t^*$  err is 0.28878  
Slope = -0.054256 +/- 0.15585



travel time residuals

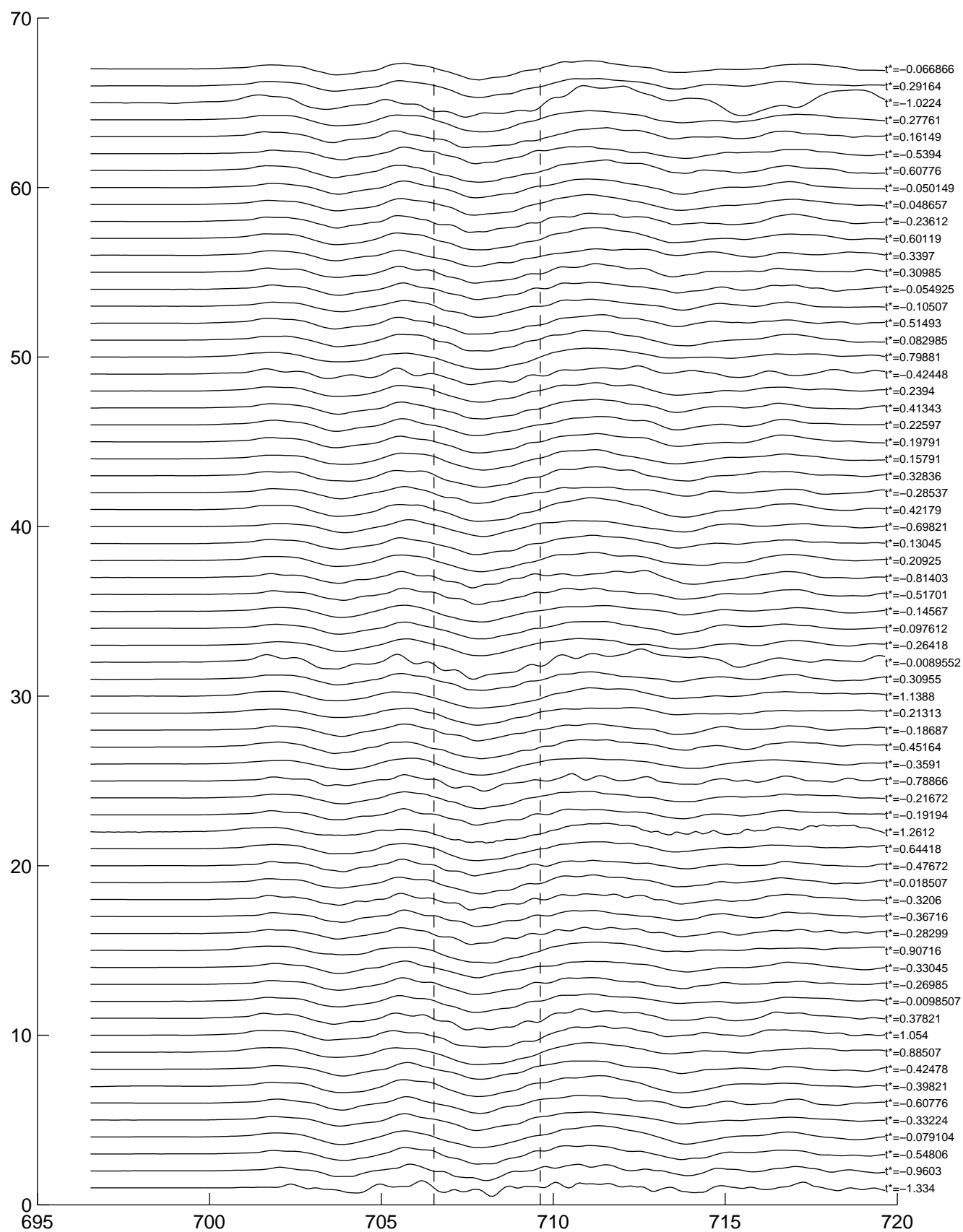


$t^*$  values

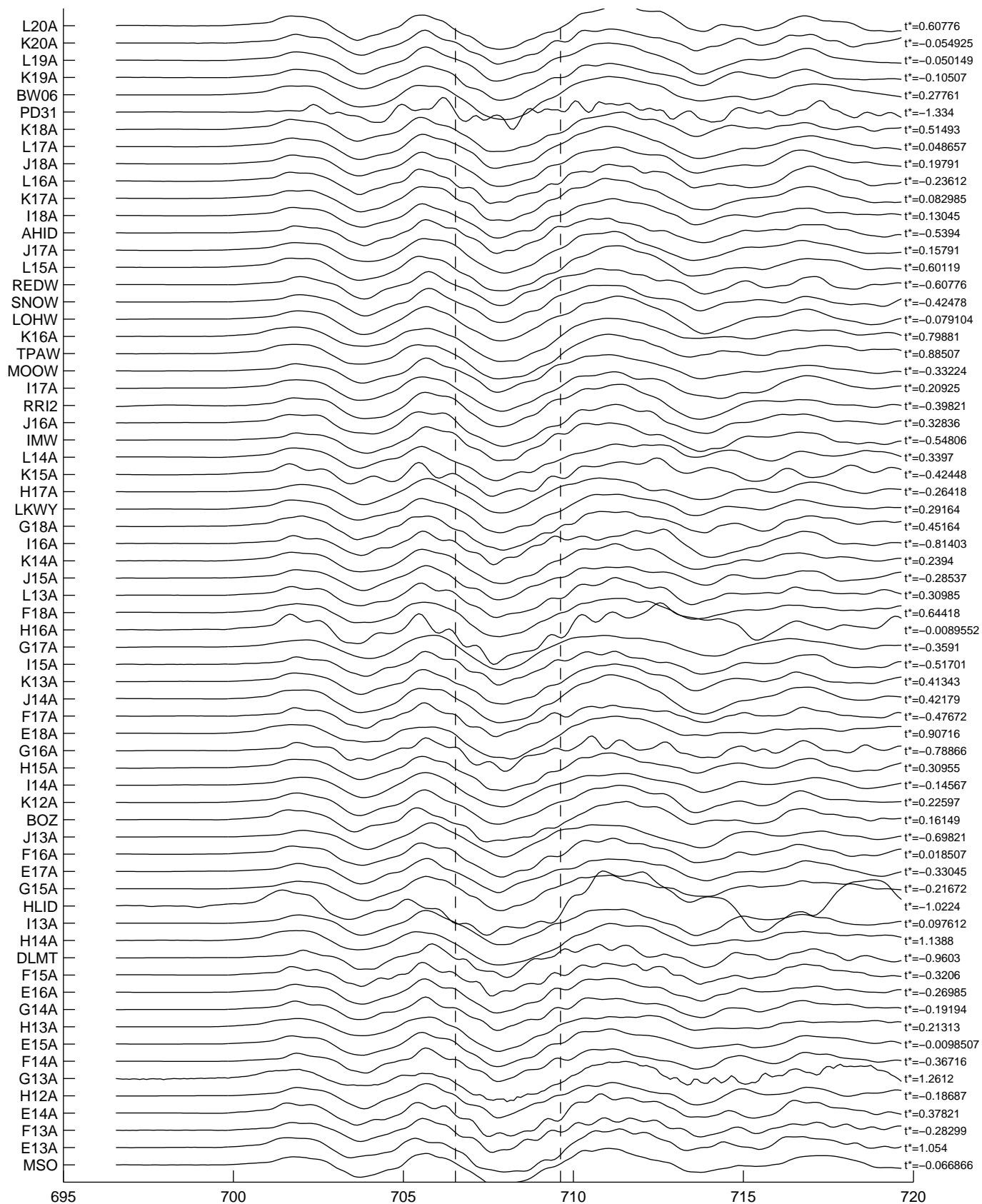




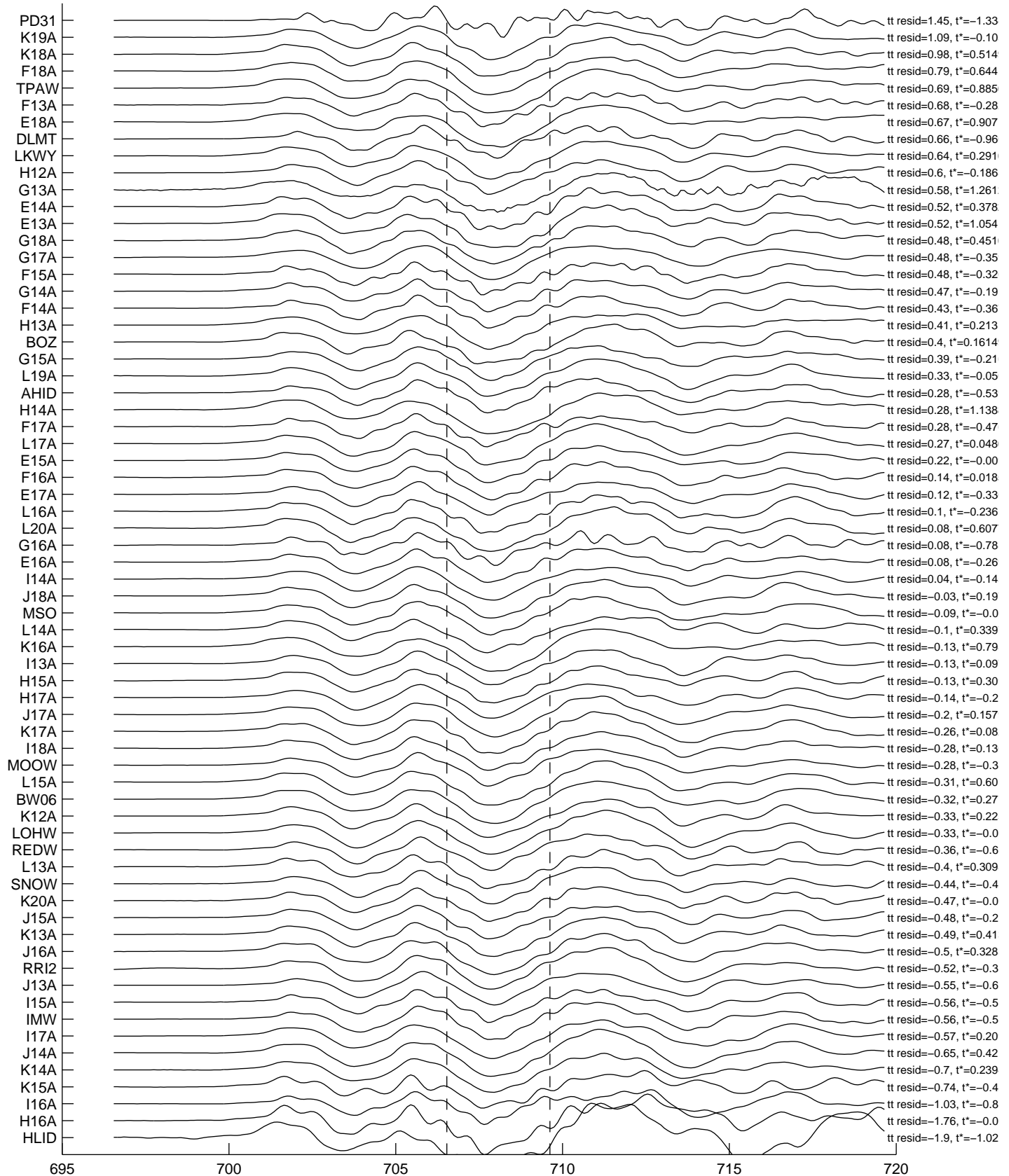
# Event\_2008\_165\_23\_43\_45



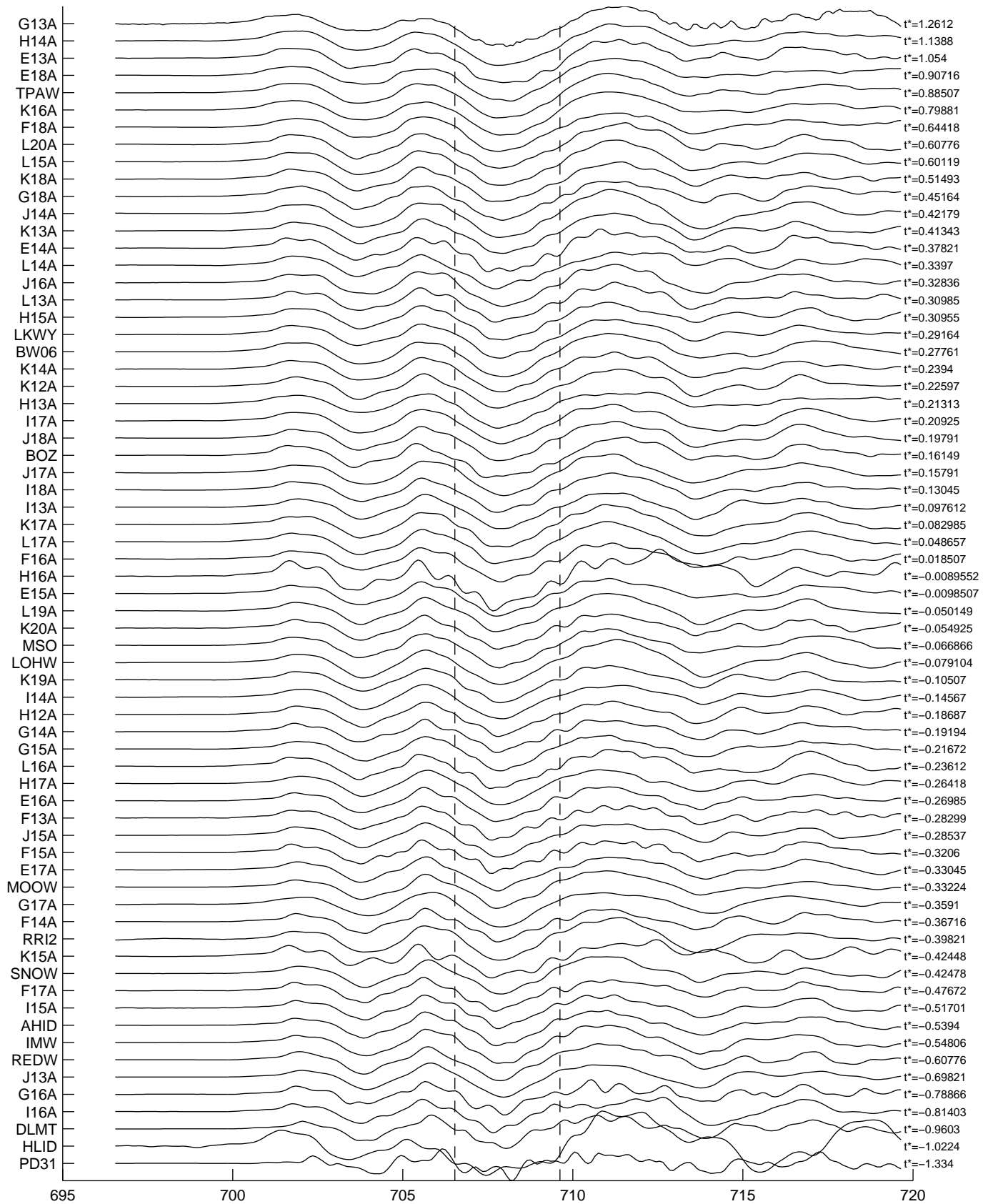
# Sorted by Delta:Event\_2008\_165\_23\_43\_45



# Sorted by travel time:Event\_2008\_165\_23\_43\_45

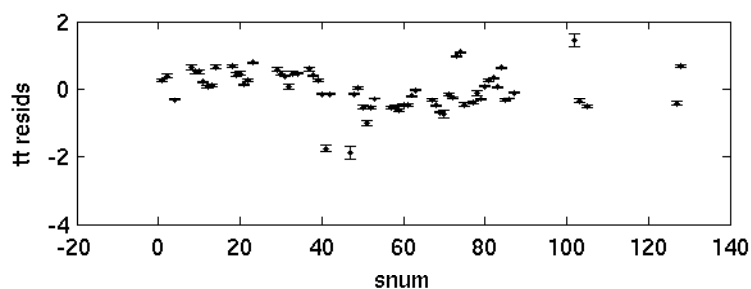
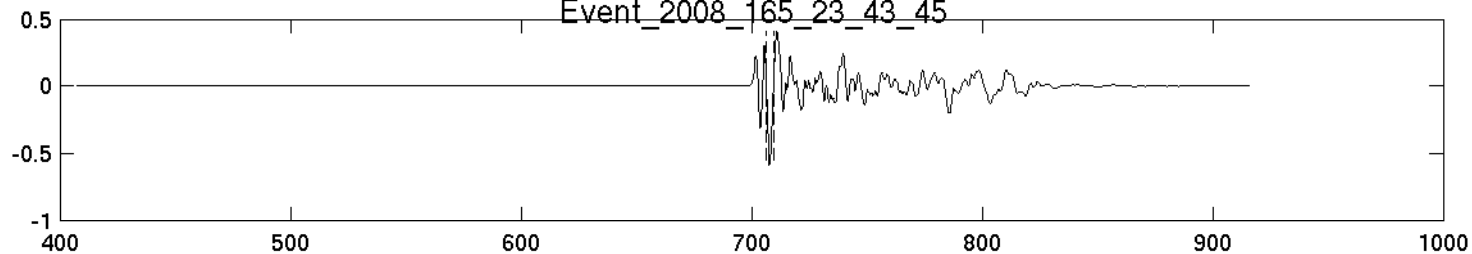


# Sorted by $t^*$ :Event\_2008\_165\_23\_43\_45

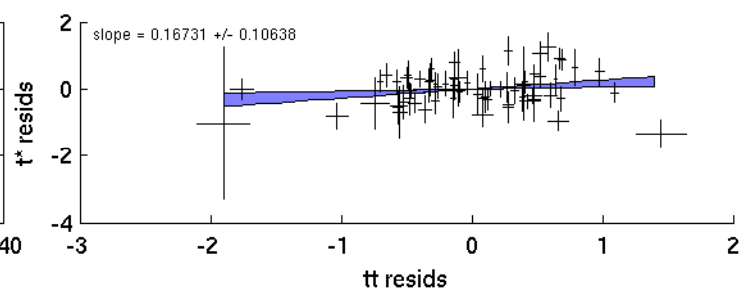
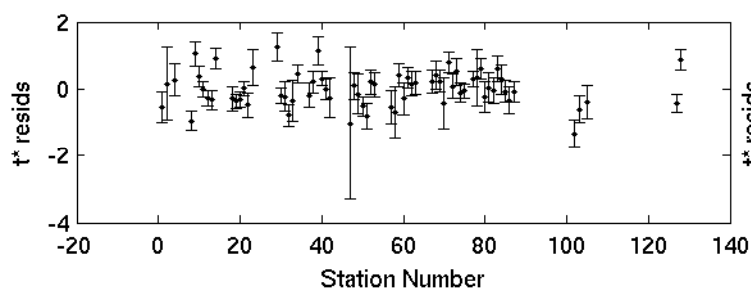


Event\_2008\_165\_23\_43\_45

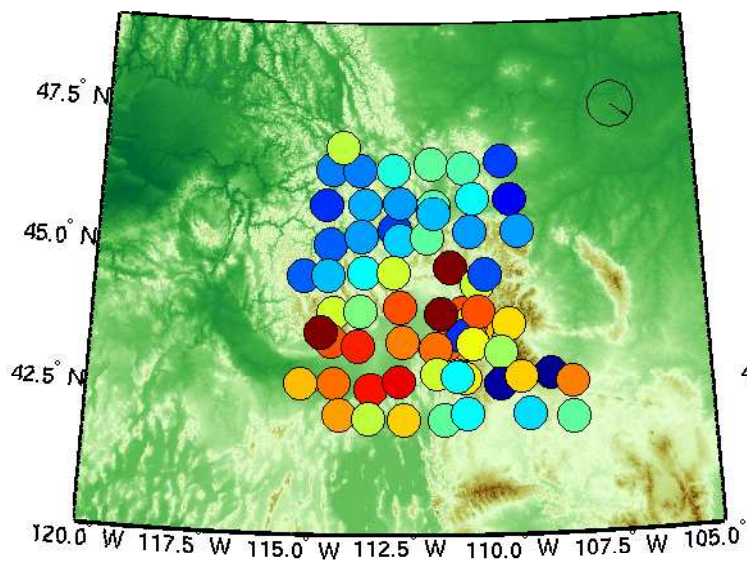
Stack



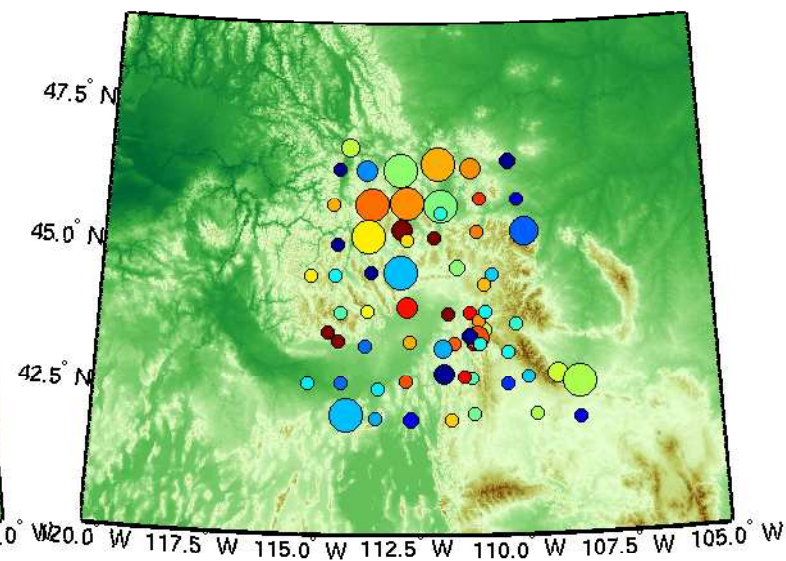
Baz = 309.5841  
Mean xcor value = 0.89478  
Range of  $t^*$  values is 2.5952  
Median  $t^*$  err is 0.35918  
Slope = 0.16731 +/- 0.10638



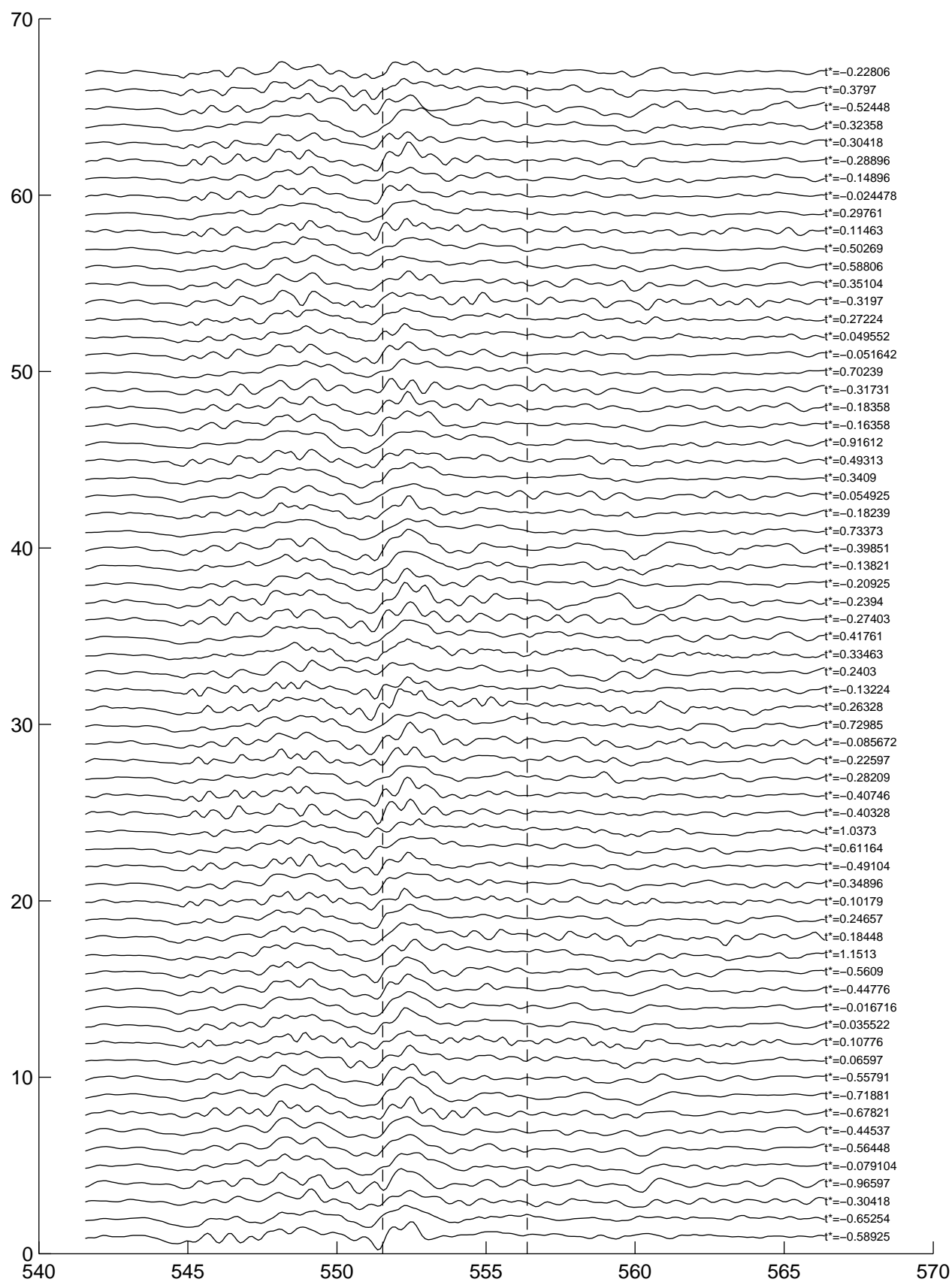
travel time residuals



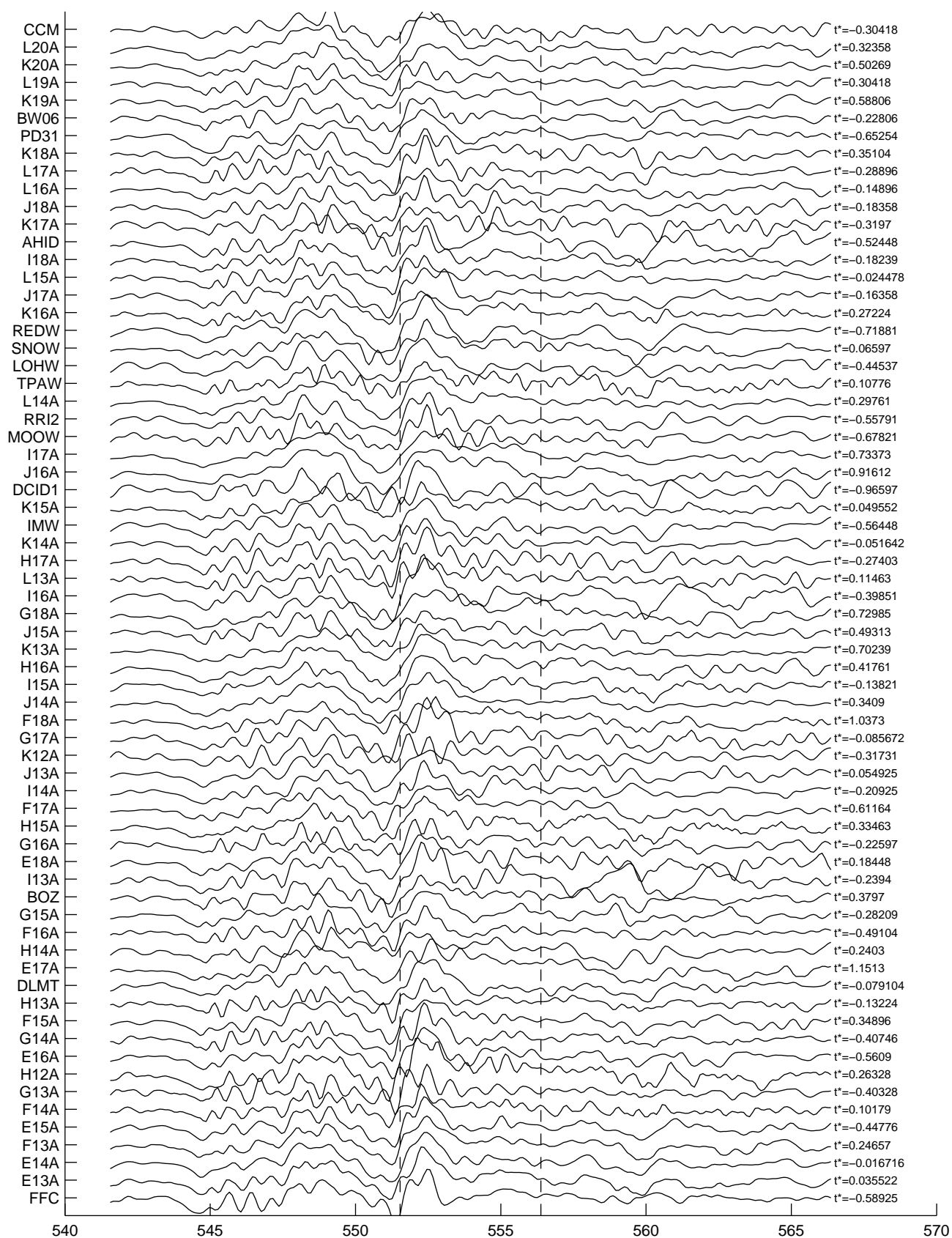
$t^*$  values



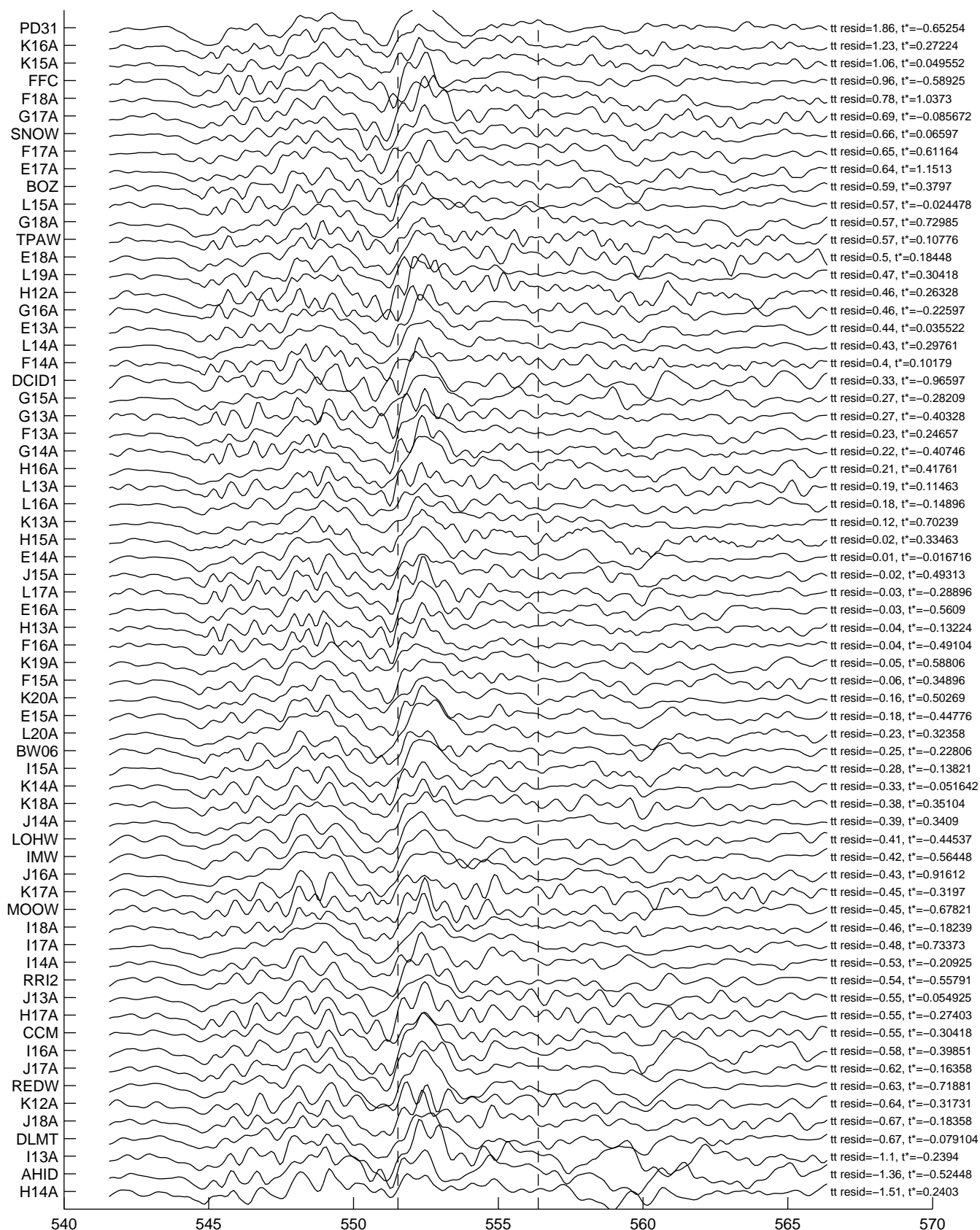
# Event\_2008\_187\_02\_12\_04



# Sorted by Delta:Event\_2008\_187\_02\_12\_04

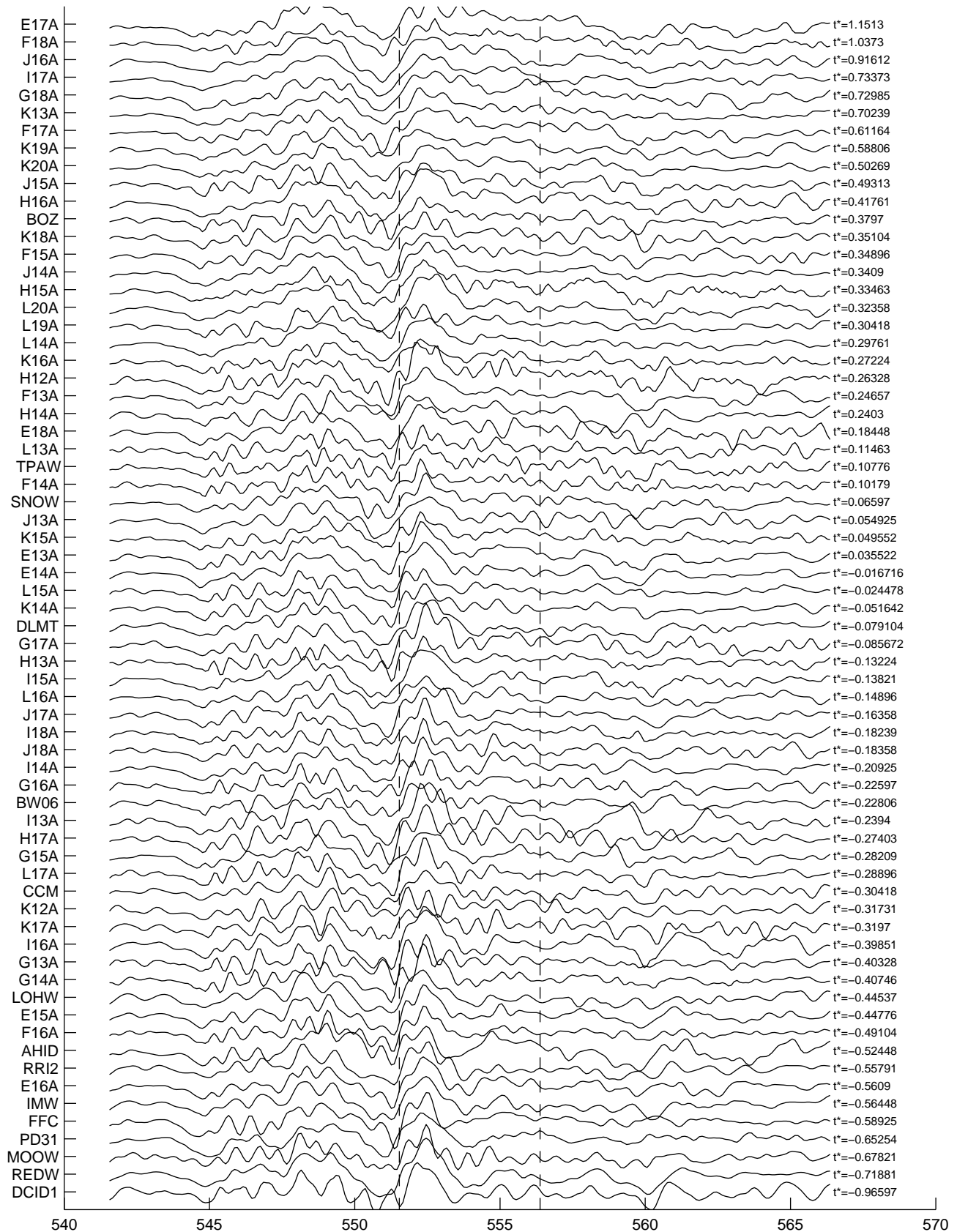


# Sorted by travel time:Event\_2008\_187\_02\_12\_04

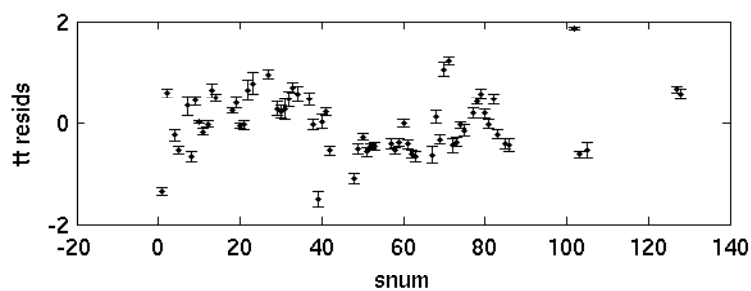
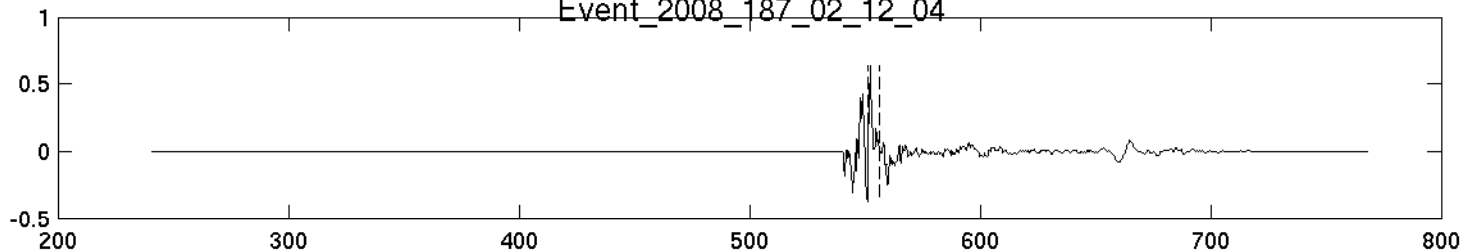




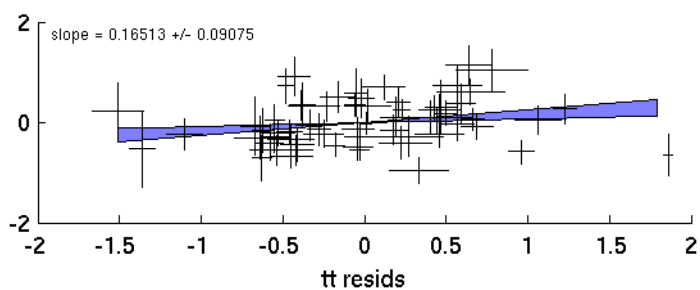
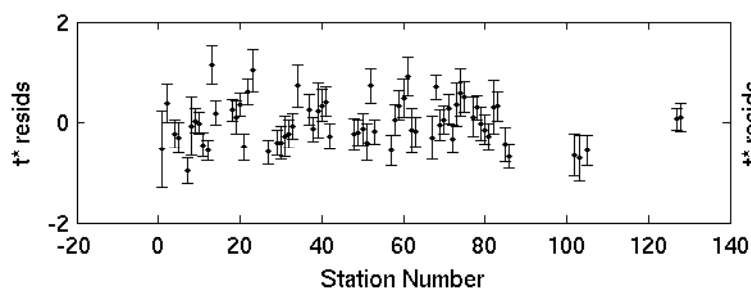
# Sorted by t\*:Event\_2008\_187\_02\_12\_04



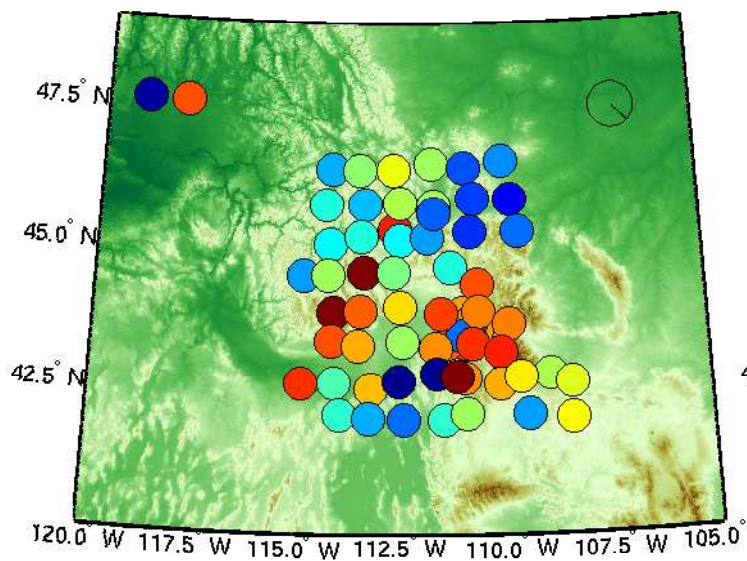
Stack  
Event\_2008\_187\_02\_12\_04



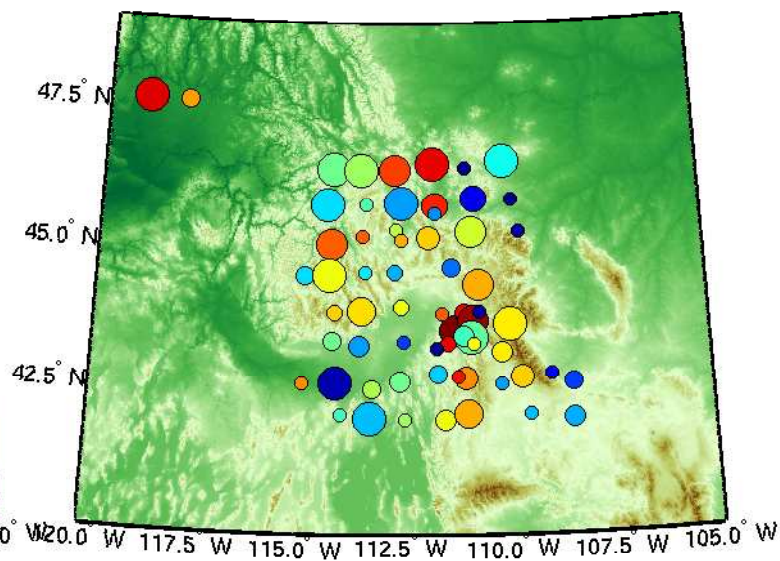
Baz = 316.6141  
Mean xcor value = 0.73836  
Range of  $t^*$  values is 2.1173  
Median  $t^*$  err is 0.29918  
Slope = 0.16513  $\pm$  0.09075



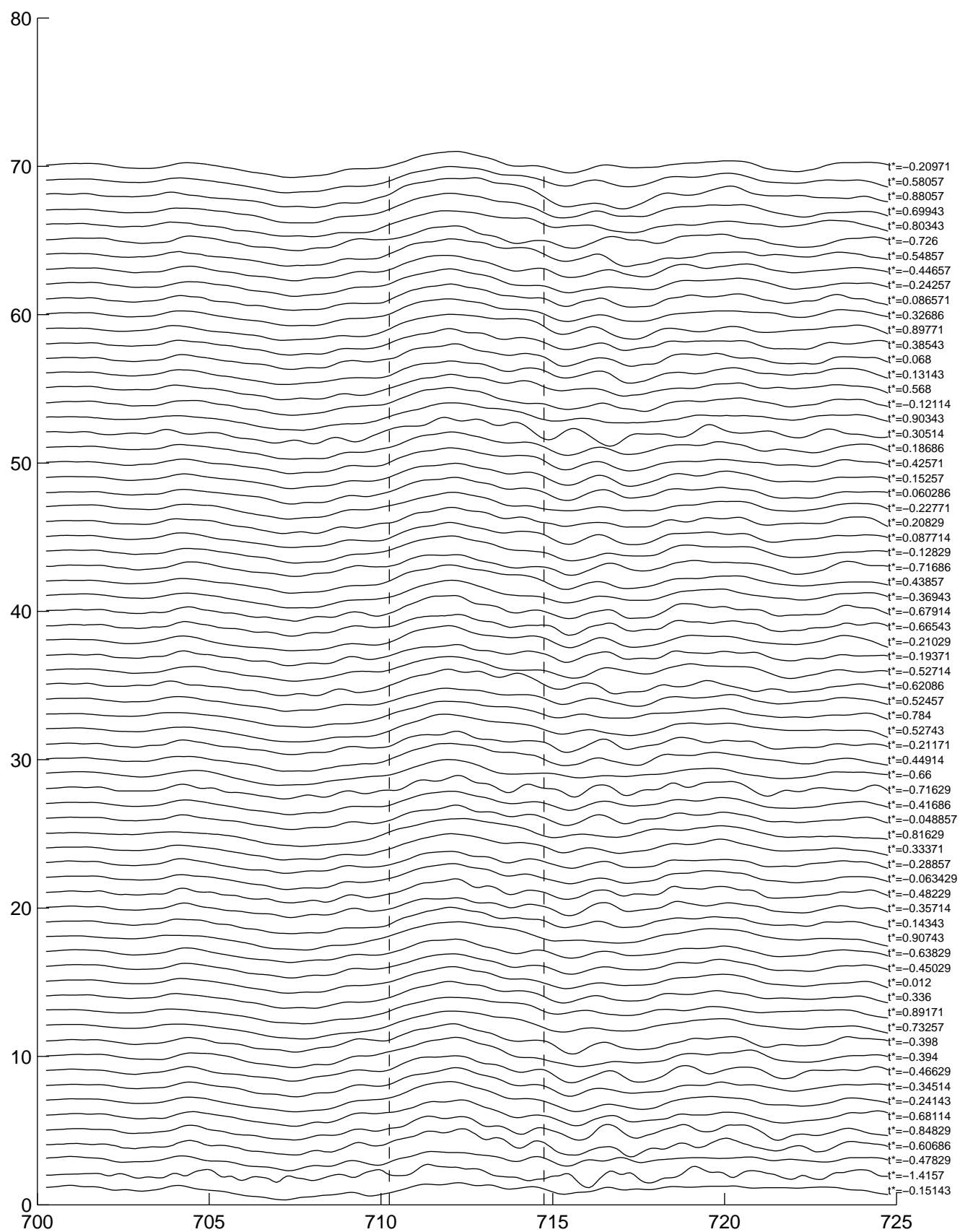
travel time residuals



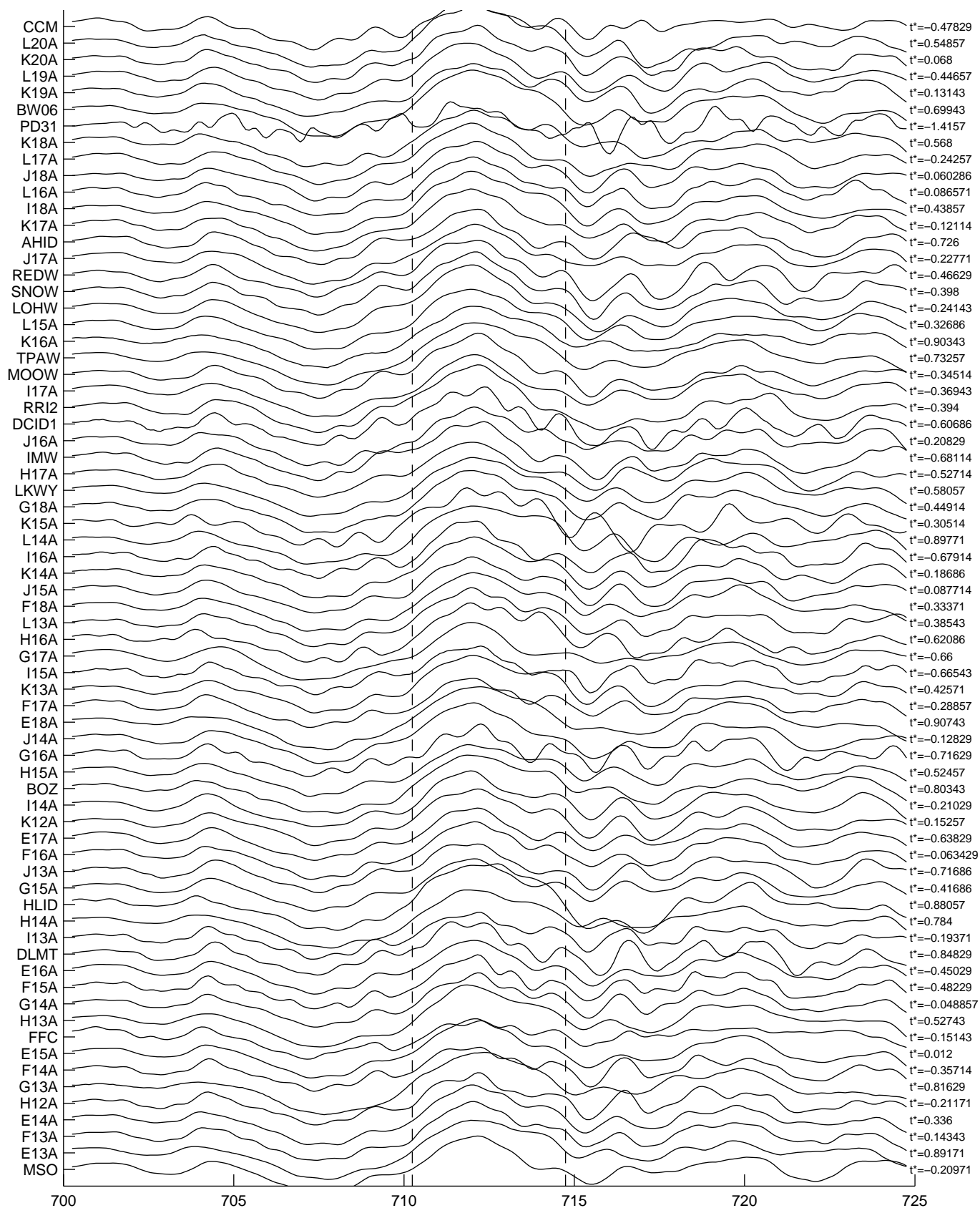
$t^*$  values



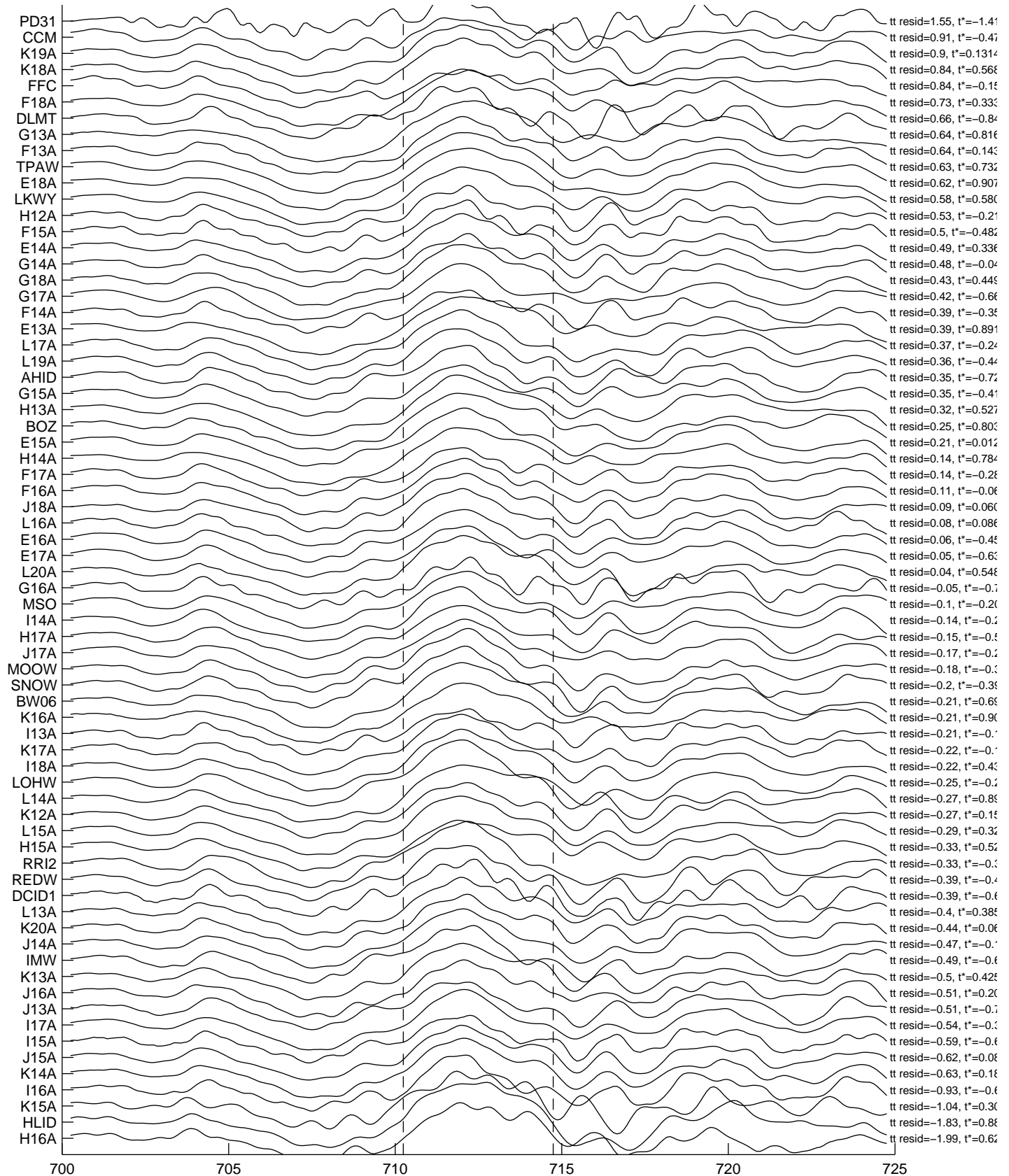
# Event\_2008\_201\_02\_39\_28



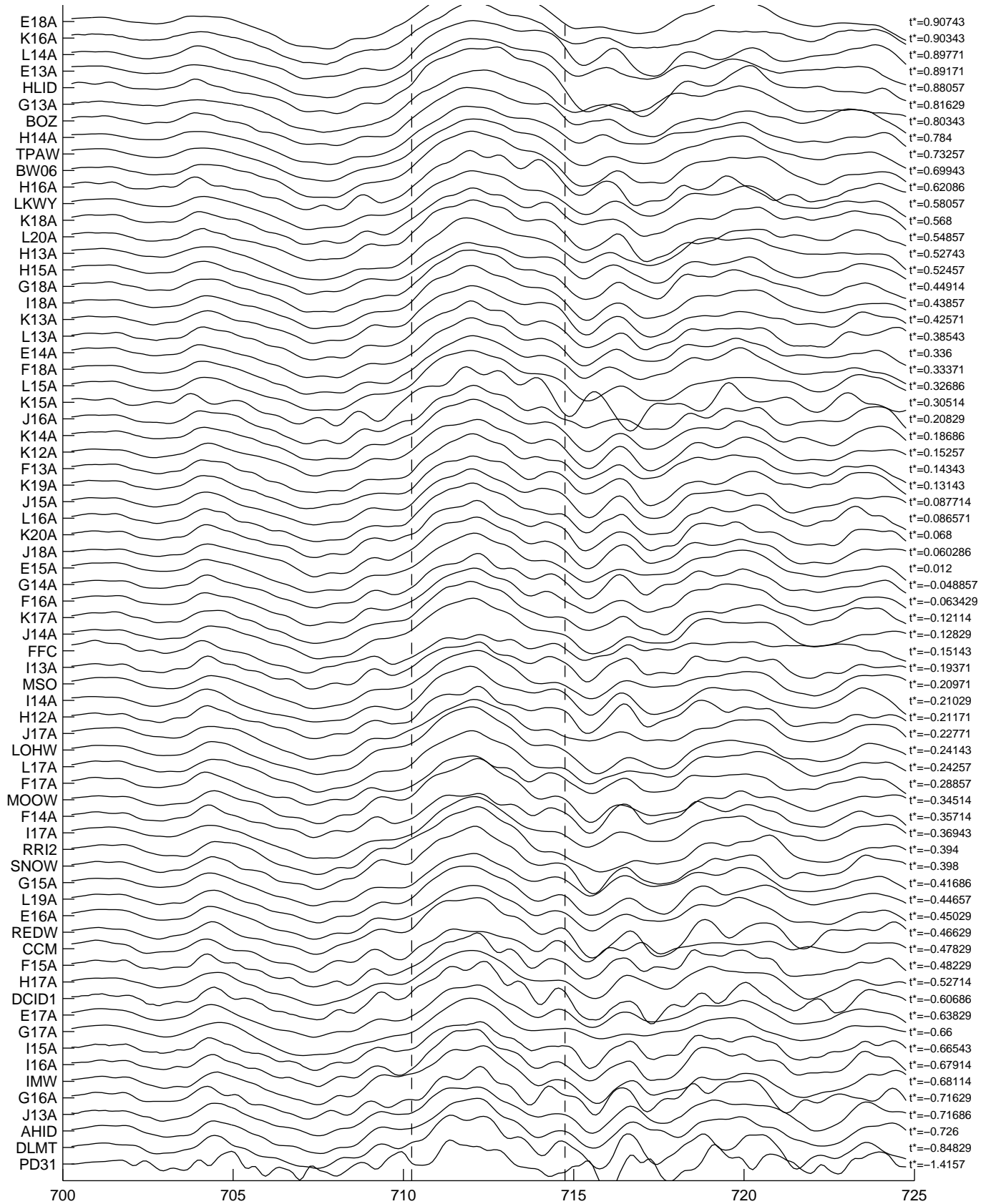
# Sorted by Delta:Event\_2008\_201\_02\_39\_28



# Sorted by travel time:Event\_2008\_201\_02\_39\_28



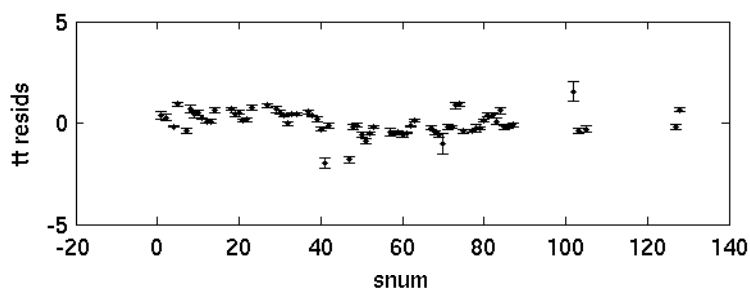
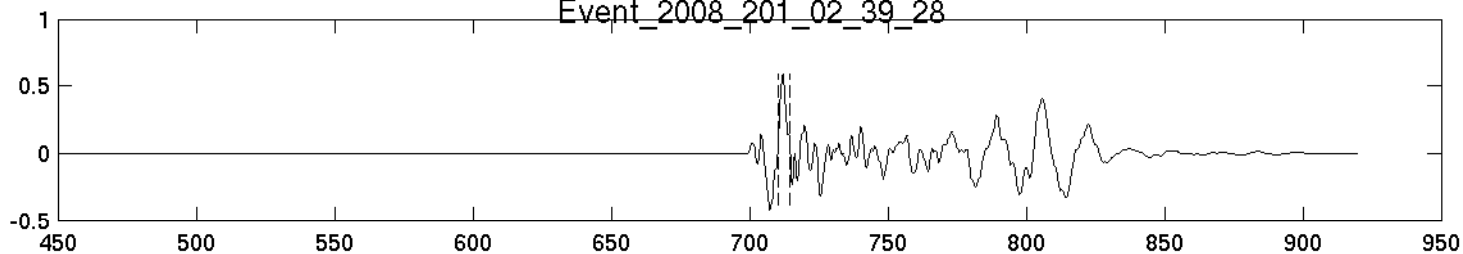
# Sorted by t\*:Event\_2008\_201\_02\_29\_28



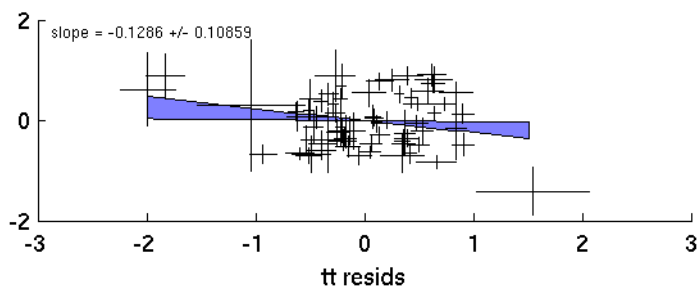
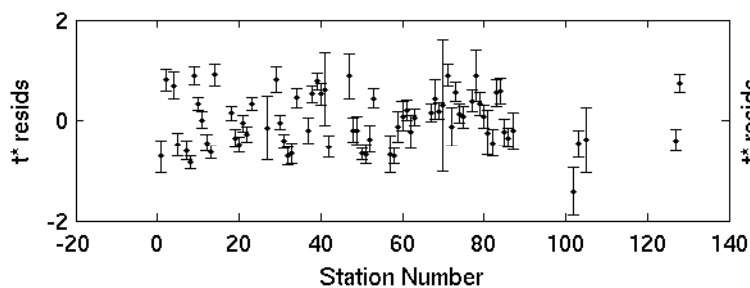


# Event\_2008\_201\_02\_39\_28

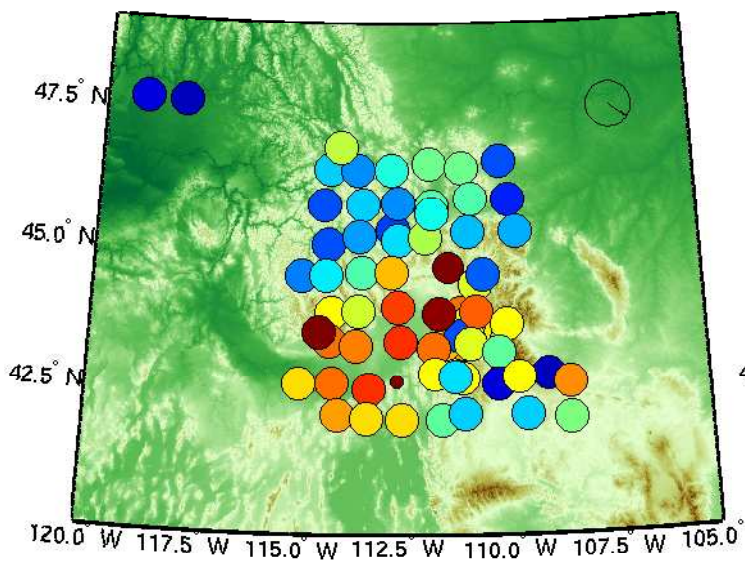
Stack



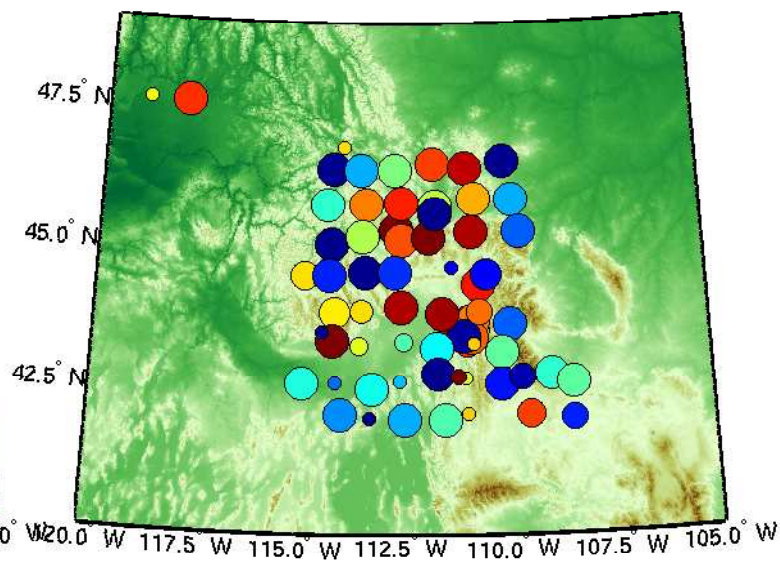
Baz = 307.9674  
Mean xcor value = 0.89971  
Range of  $t^*$  values is 2.3231  
Median  $t^*$  err is 0.21097  
Slope =  $-0.1286 \pm 0.10859$



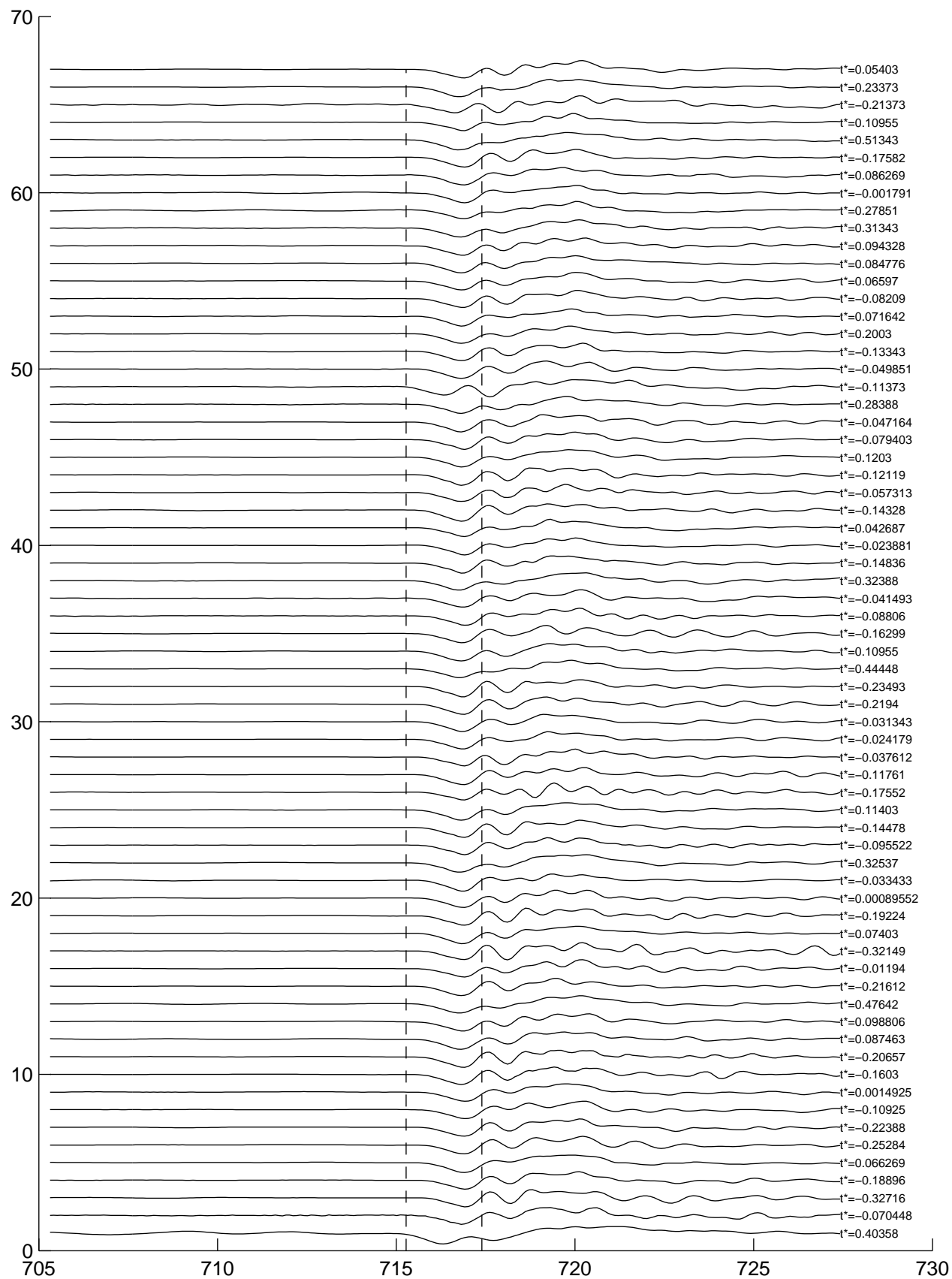
travel time residuals



$t^*$  values

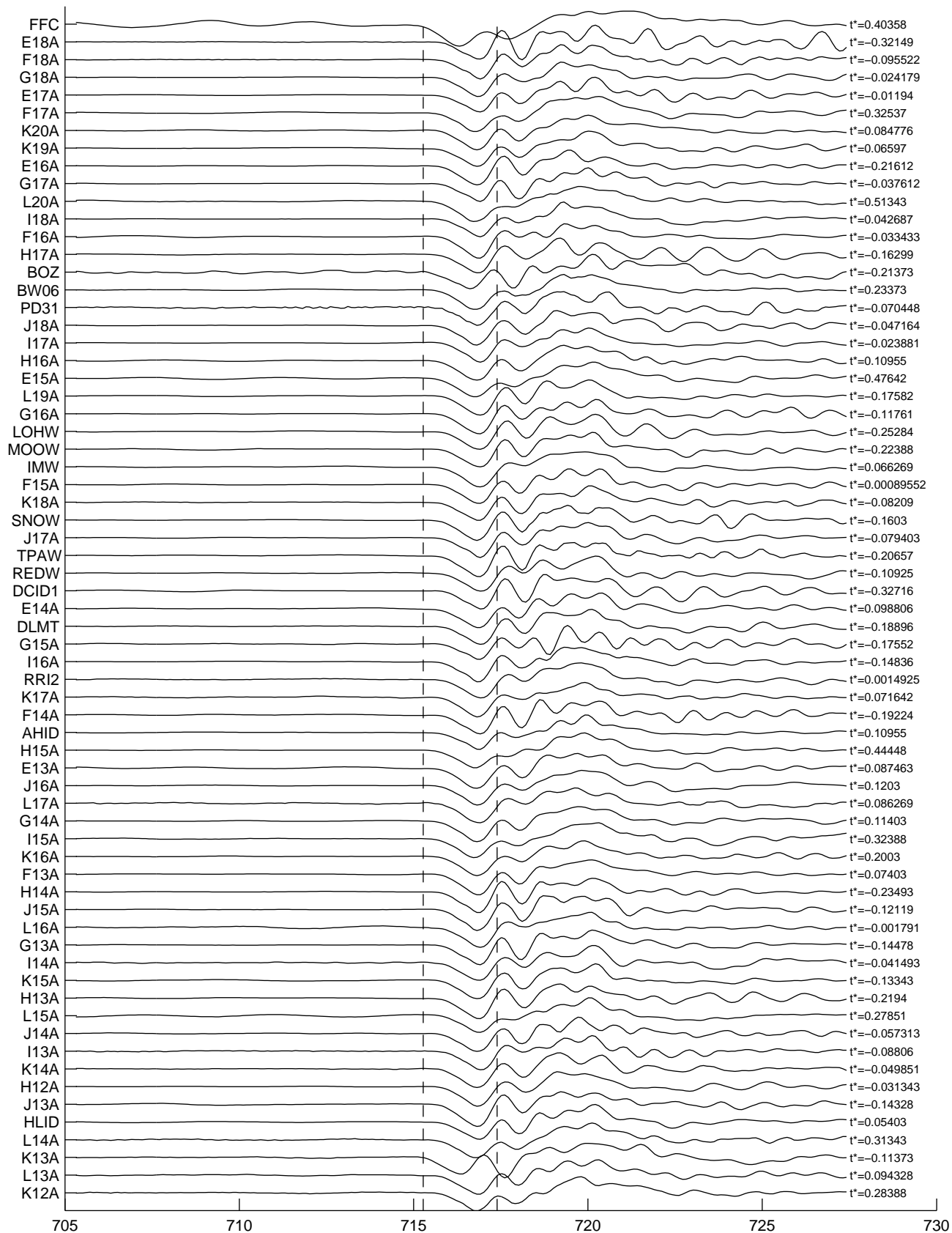


# Event\_2008\_201\_22\_39\_52

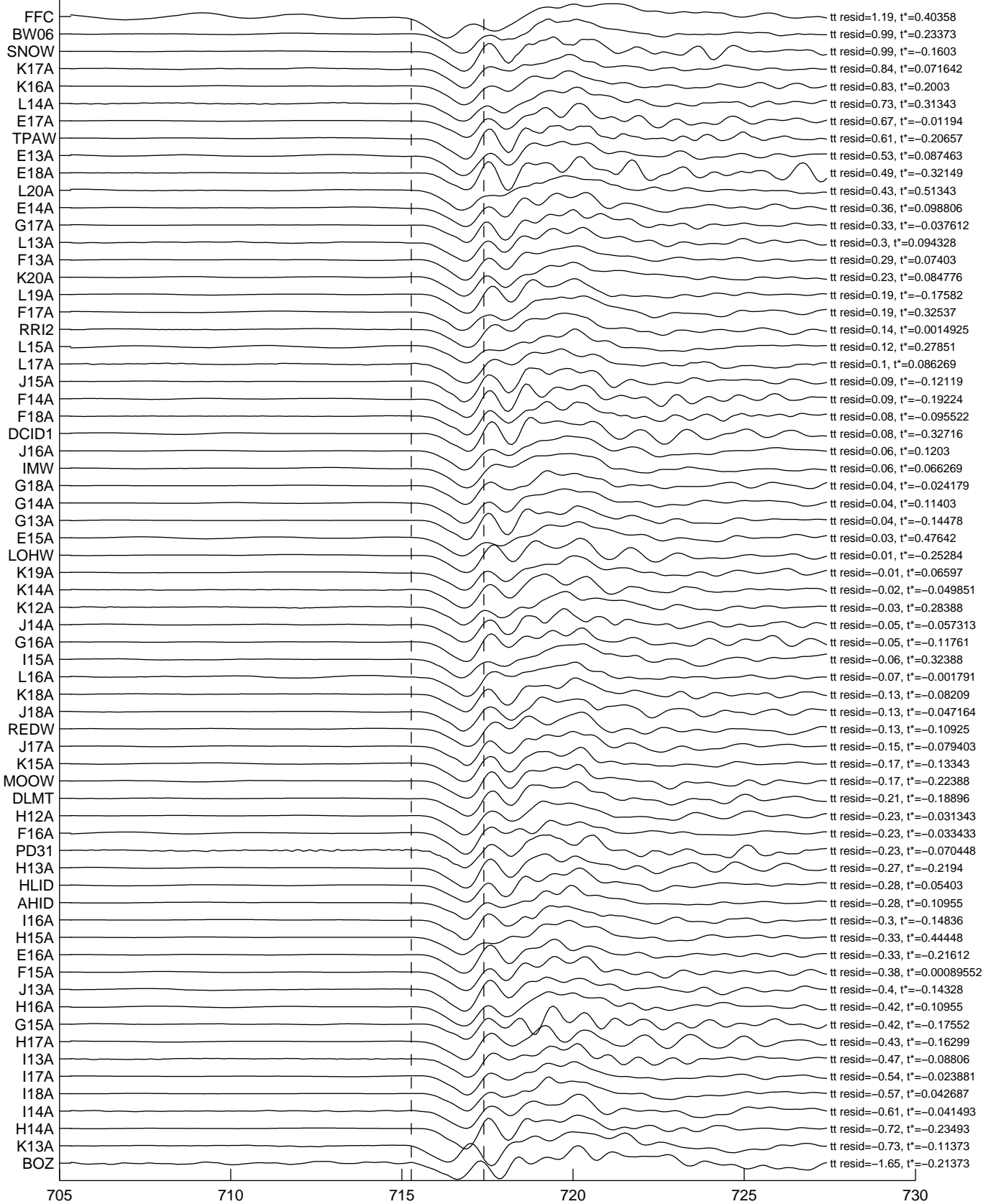




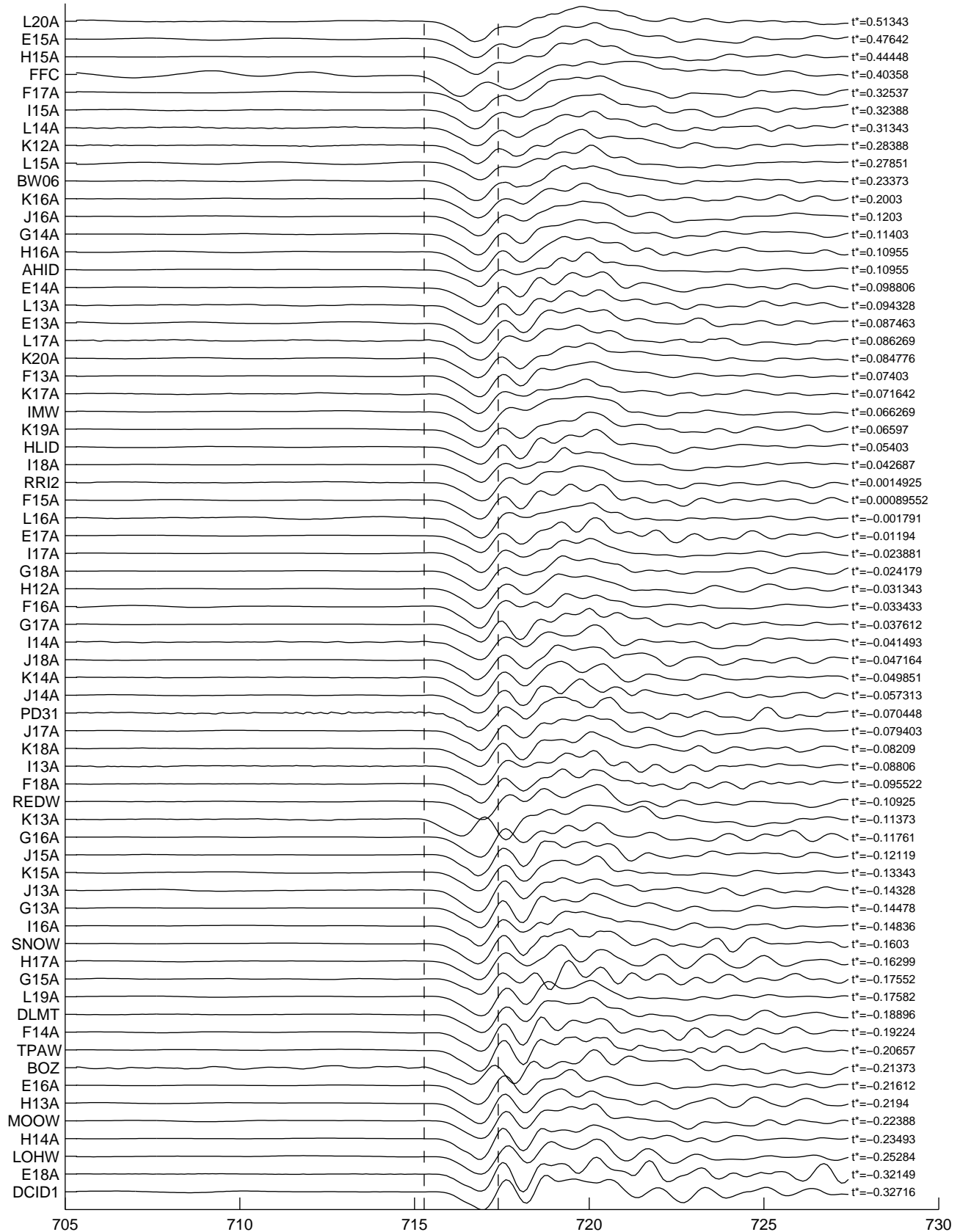
# Sorted by Delta:Event\_2008\_201\_22\_39\_52



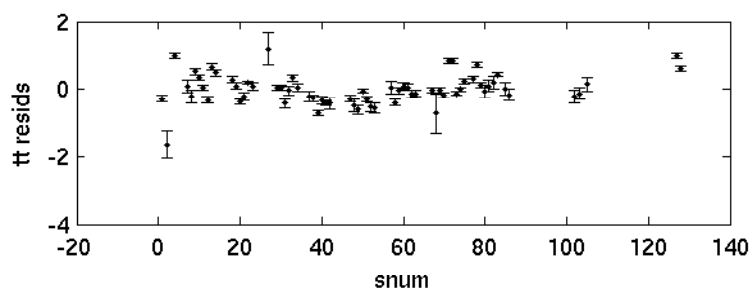
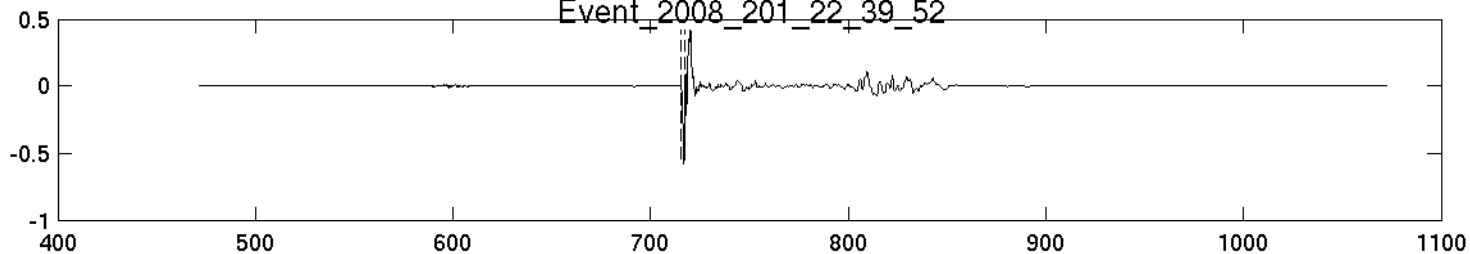
# Sorted by travel time:Event\_2008\_201\_22\_39\_52



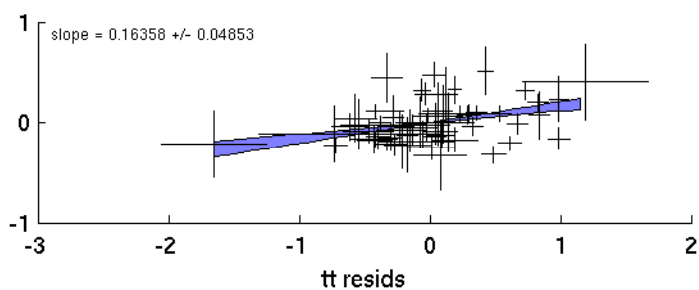
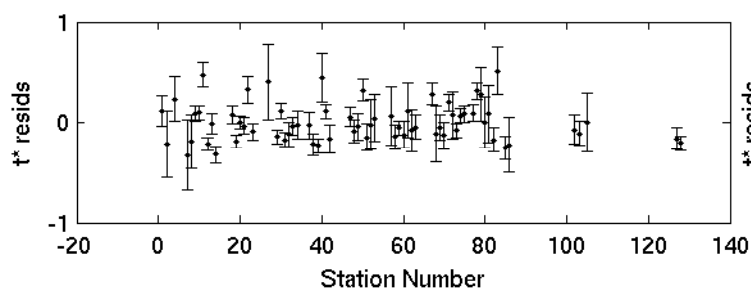
Sorted by  $t^*$ :Event\_2008\_201\_22\_39\_52



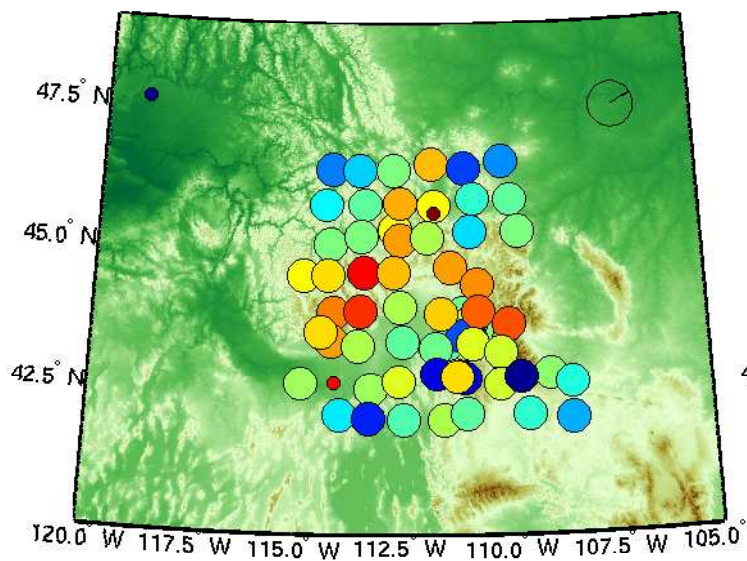
Stack  
Event\_2008\_201\_22\_39\_52



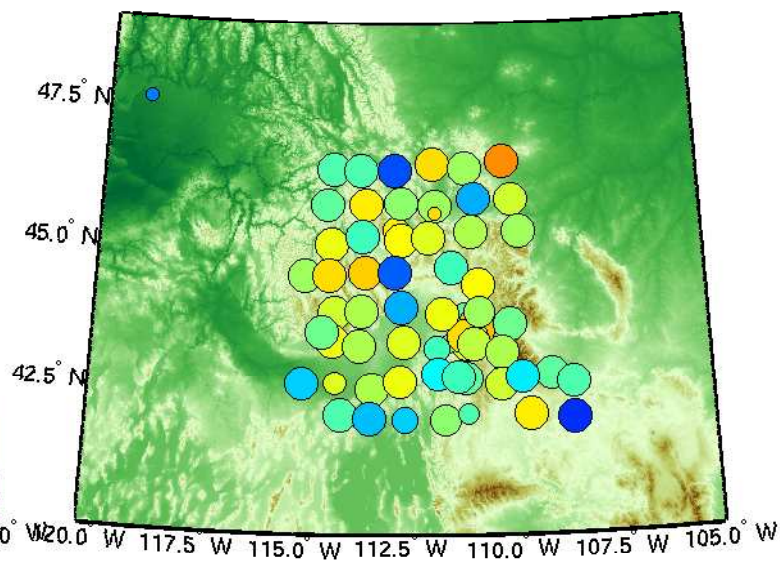
Baz = 240.7312  
Mean  $xcor$  value = 0.80269  
Range of  $t^*$  values is 0.8406  
Median  $t^*$  err is 0.12275  
Slope = 0.16358  $\pm$  0.04853



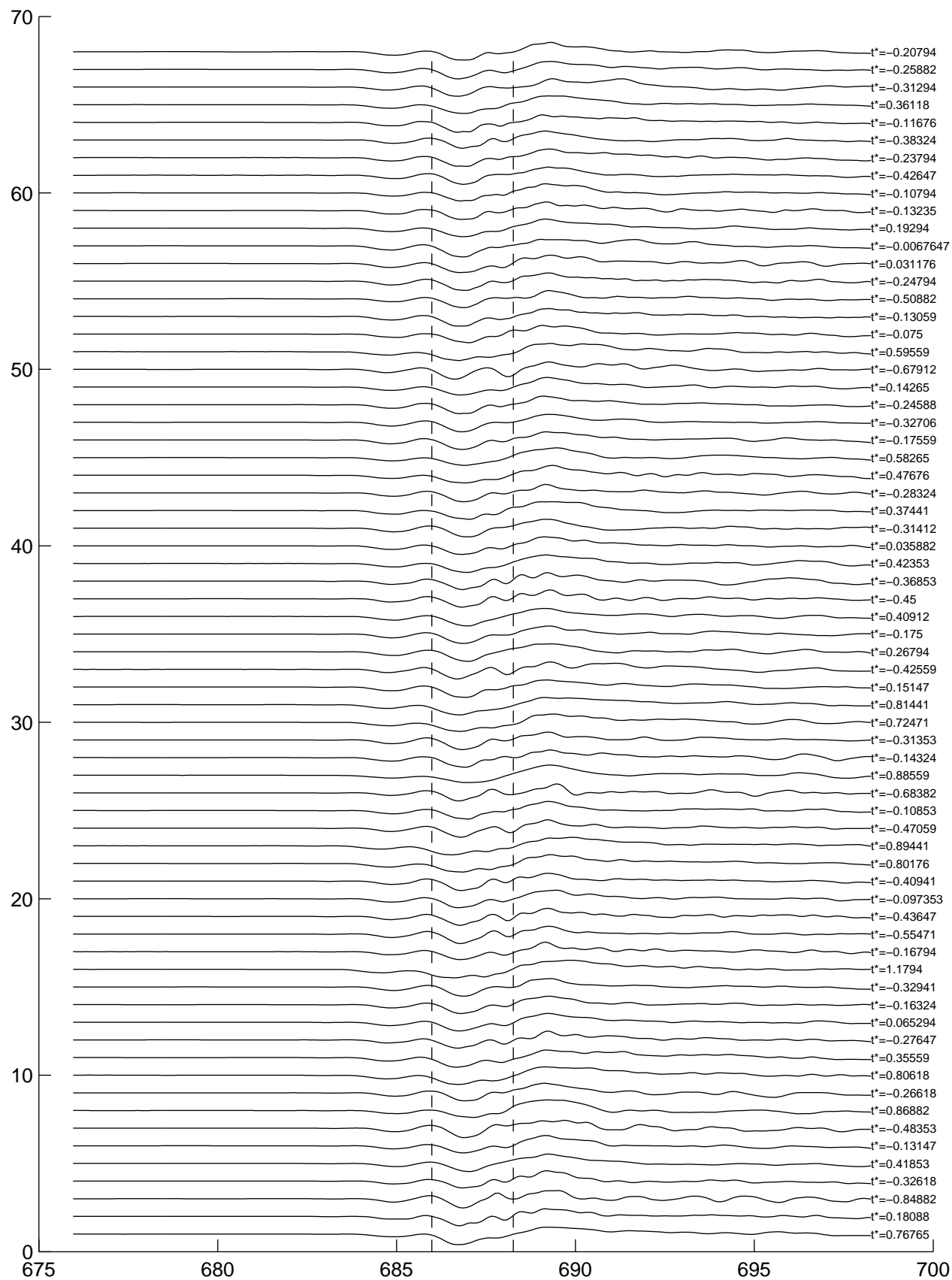
travel time residuals



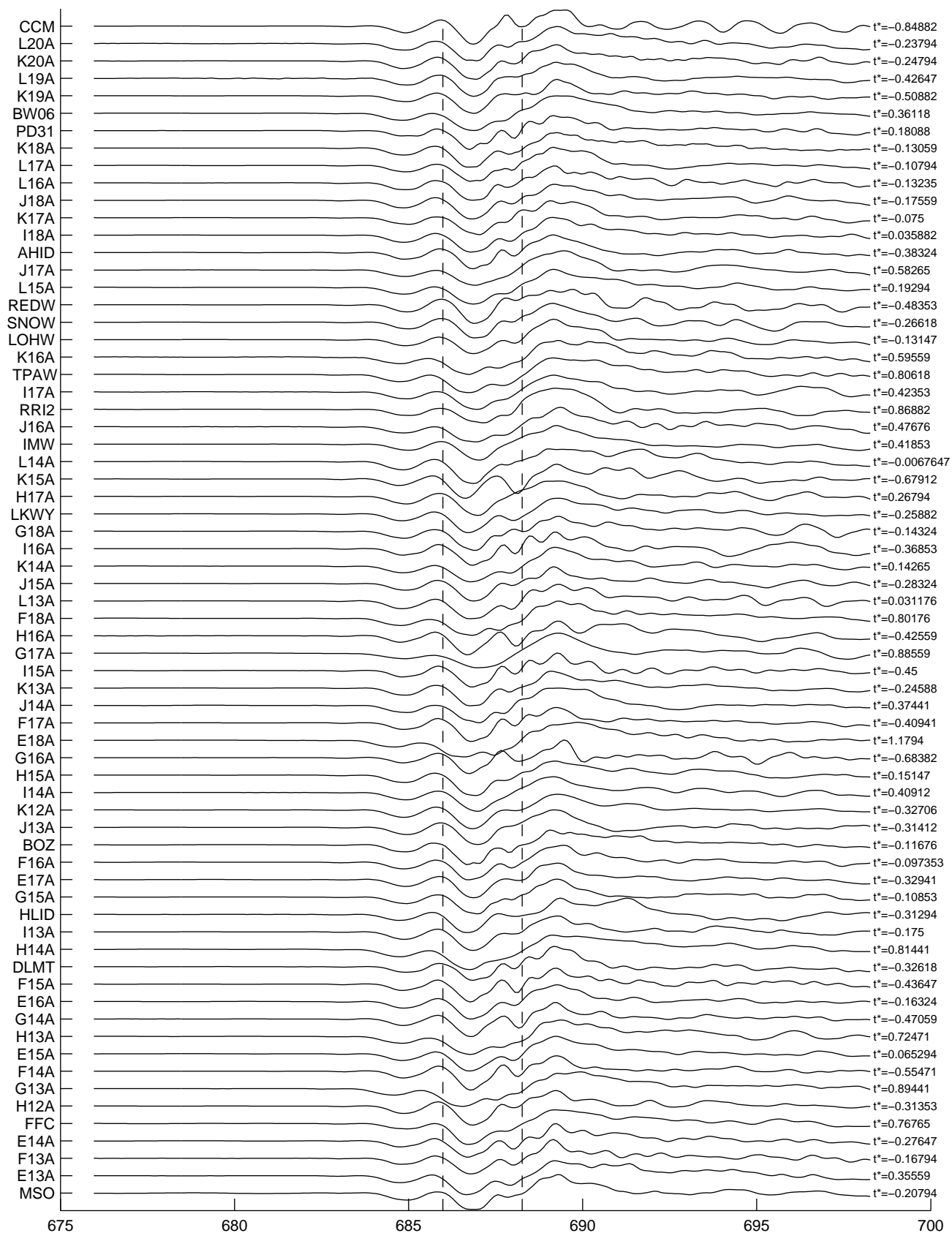
$t^*$  values



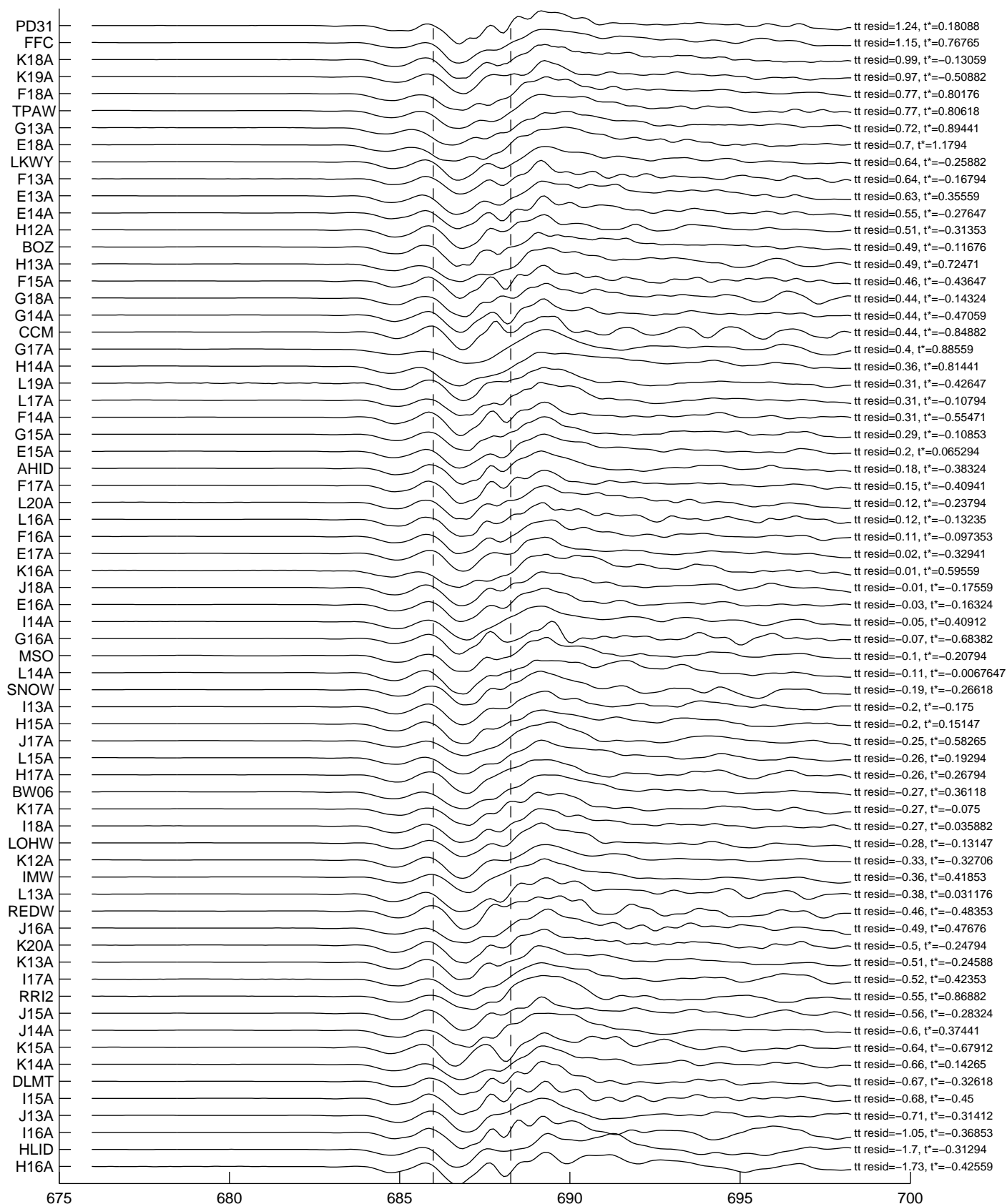
# Event\_2008\_205\_15\_26\_19



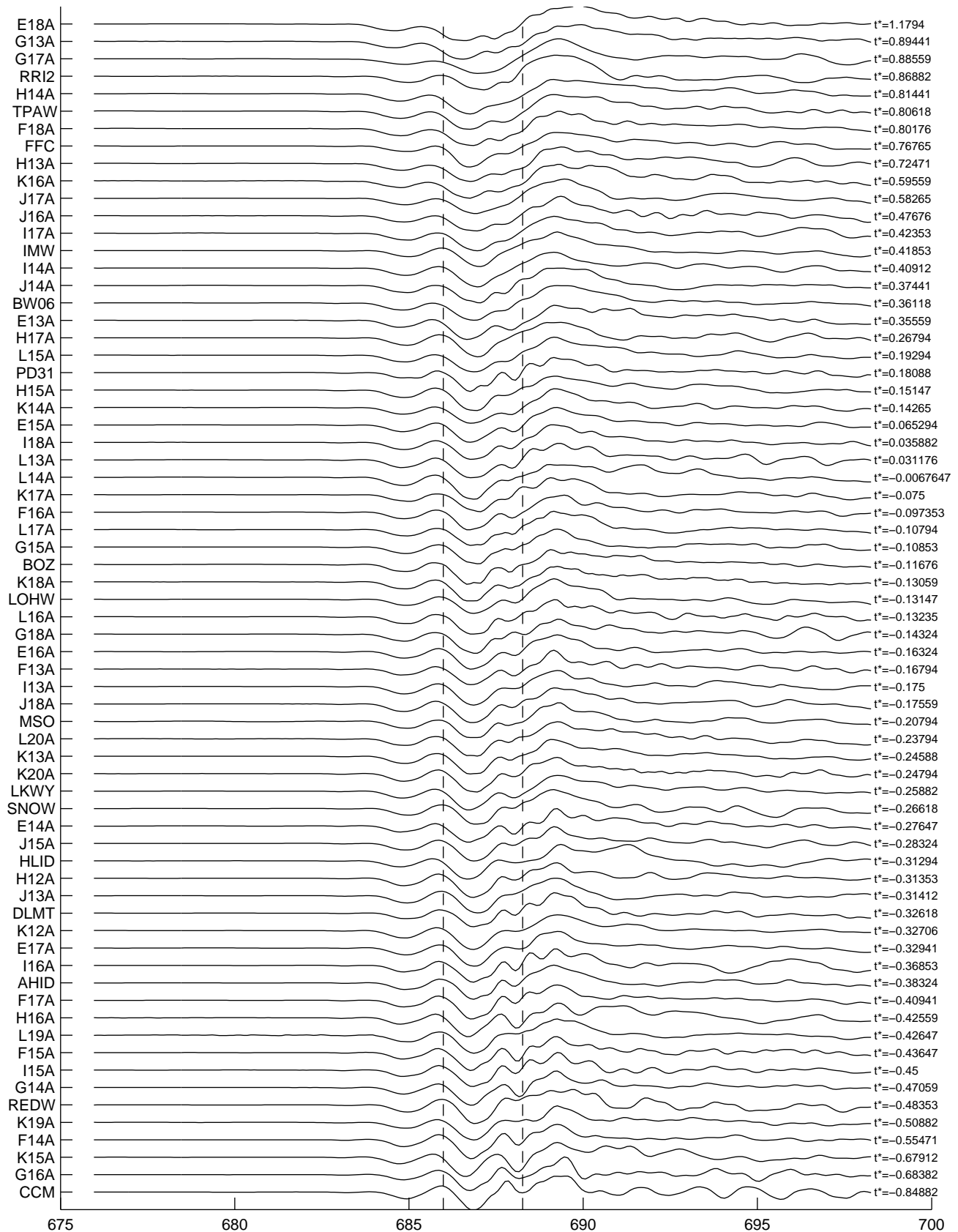
# Sorted by Delta:Event\_2008\_205\_15\_26\_19



# Sorted by travel time:Event\_2008\_205\_15\_26\_19



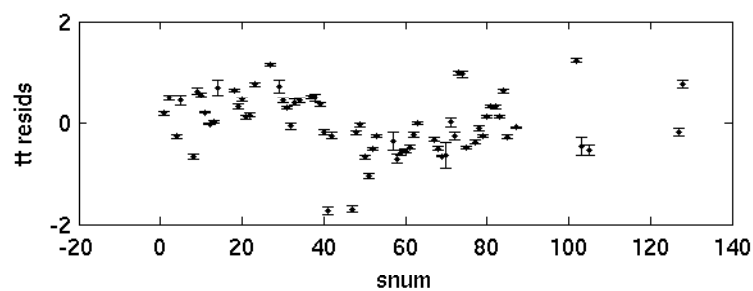
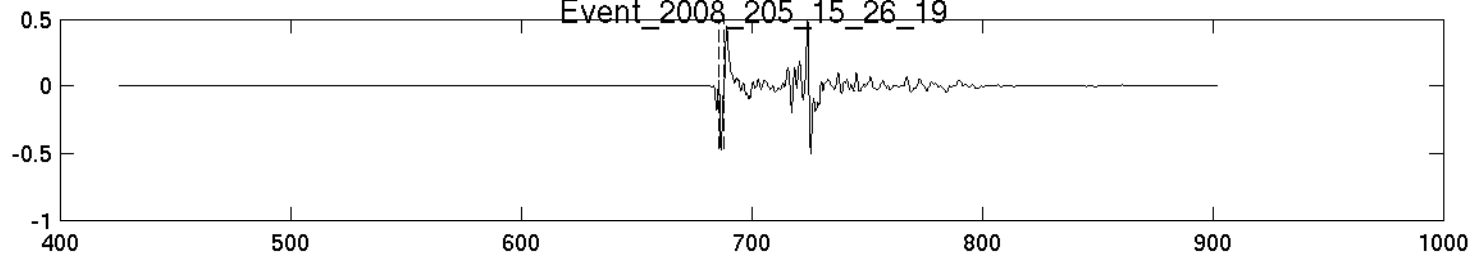
# Sorted by $t^*$ :Event\_2008\_205\_15\_26\_19



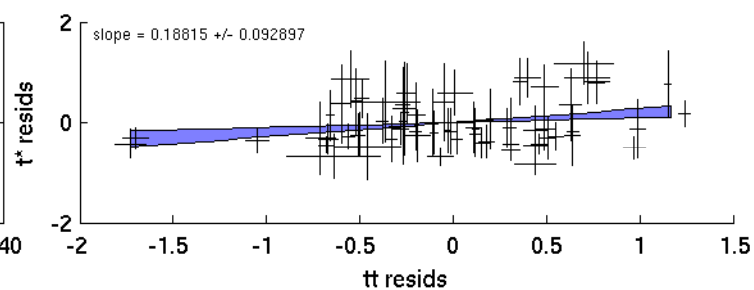
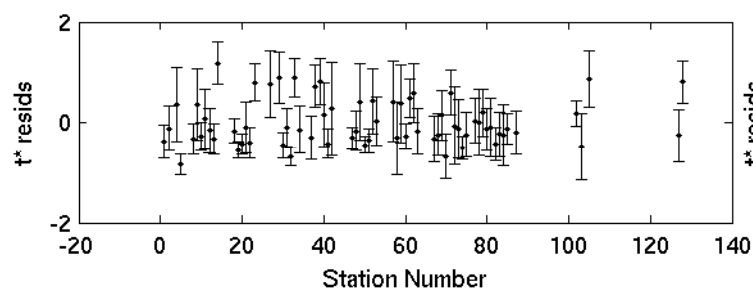


Event\_2008\_205\_15\_26\_19

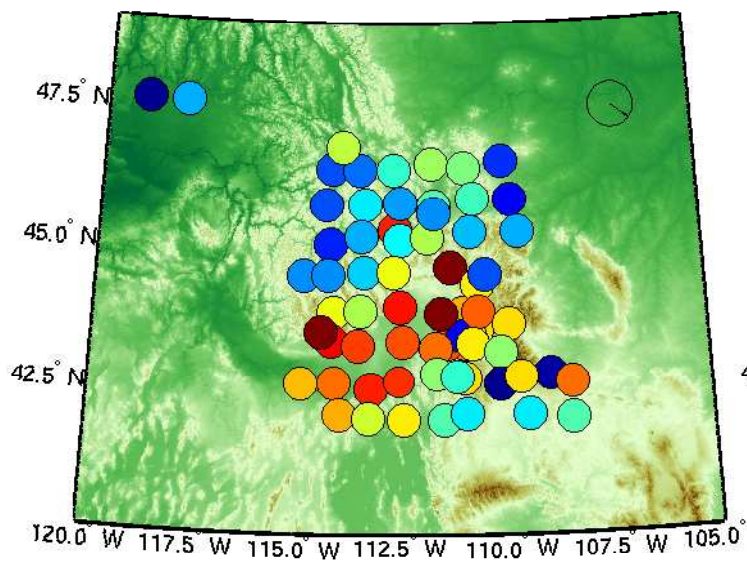
Stack



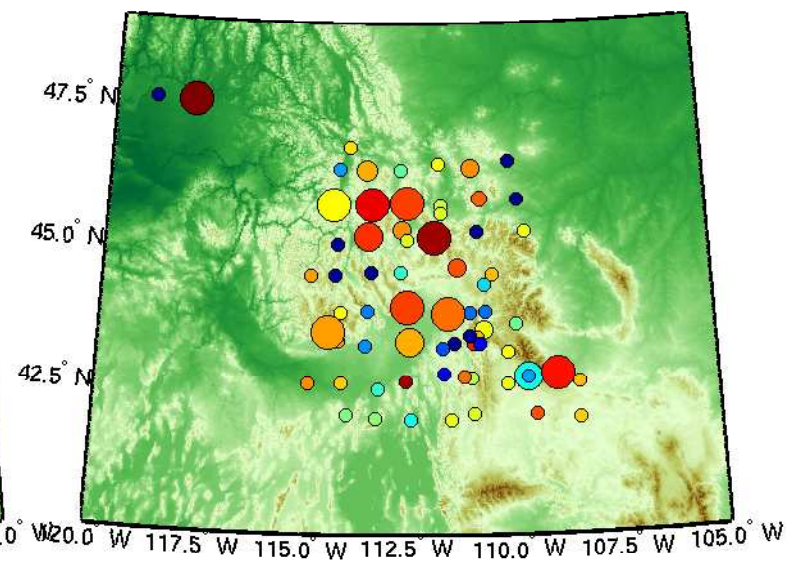
Baz = 310.0538  
 Mean xcor value = 0.85  
 Range of  $t^*$  values is 2.0282  
 Median  $t^*$  err is 0.4436  
 Slope = 0.18815 +/- 0.092897



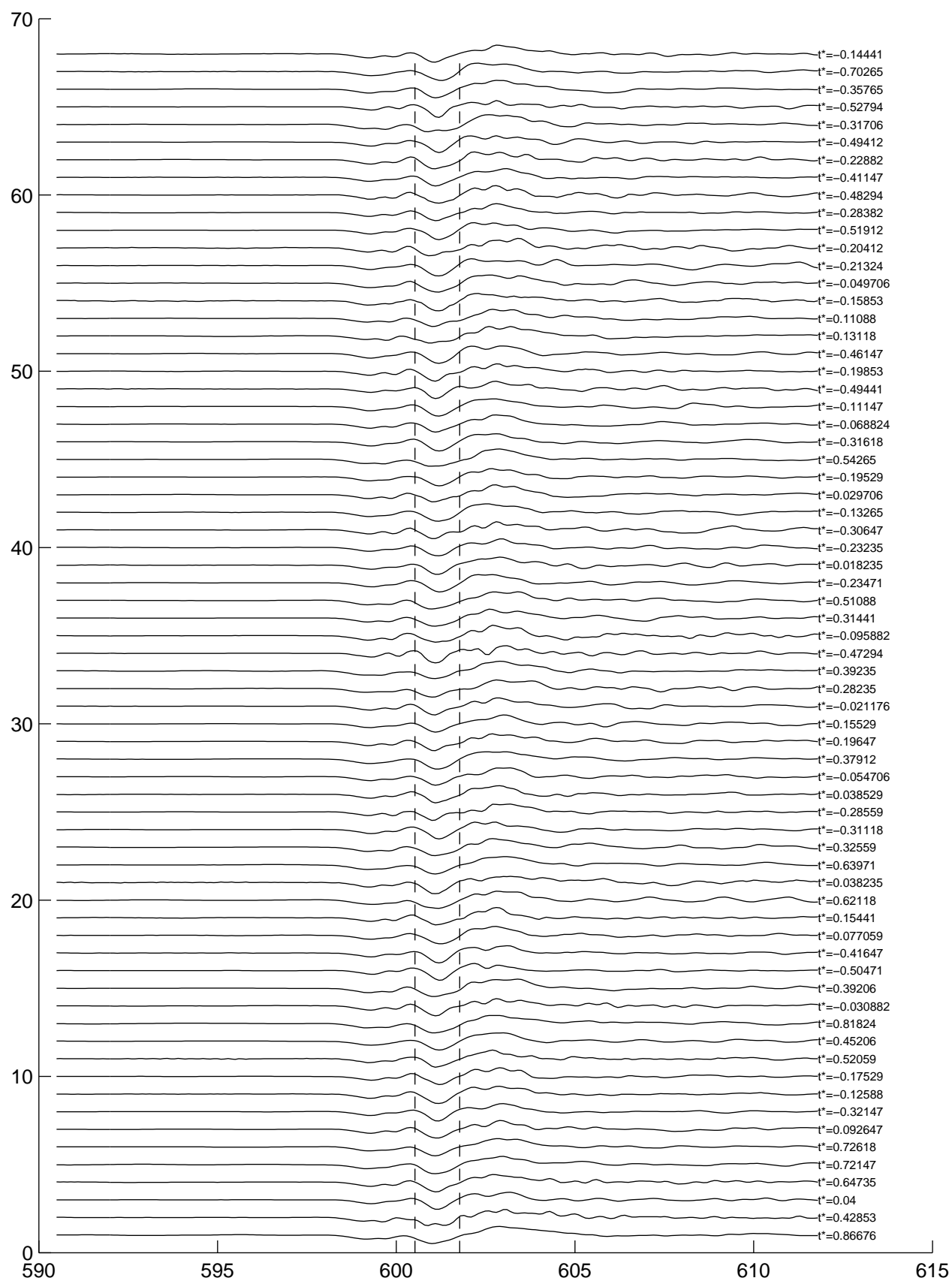
travel time residuals



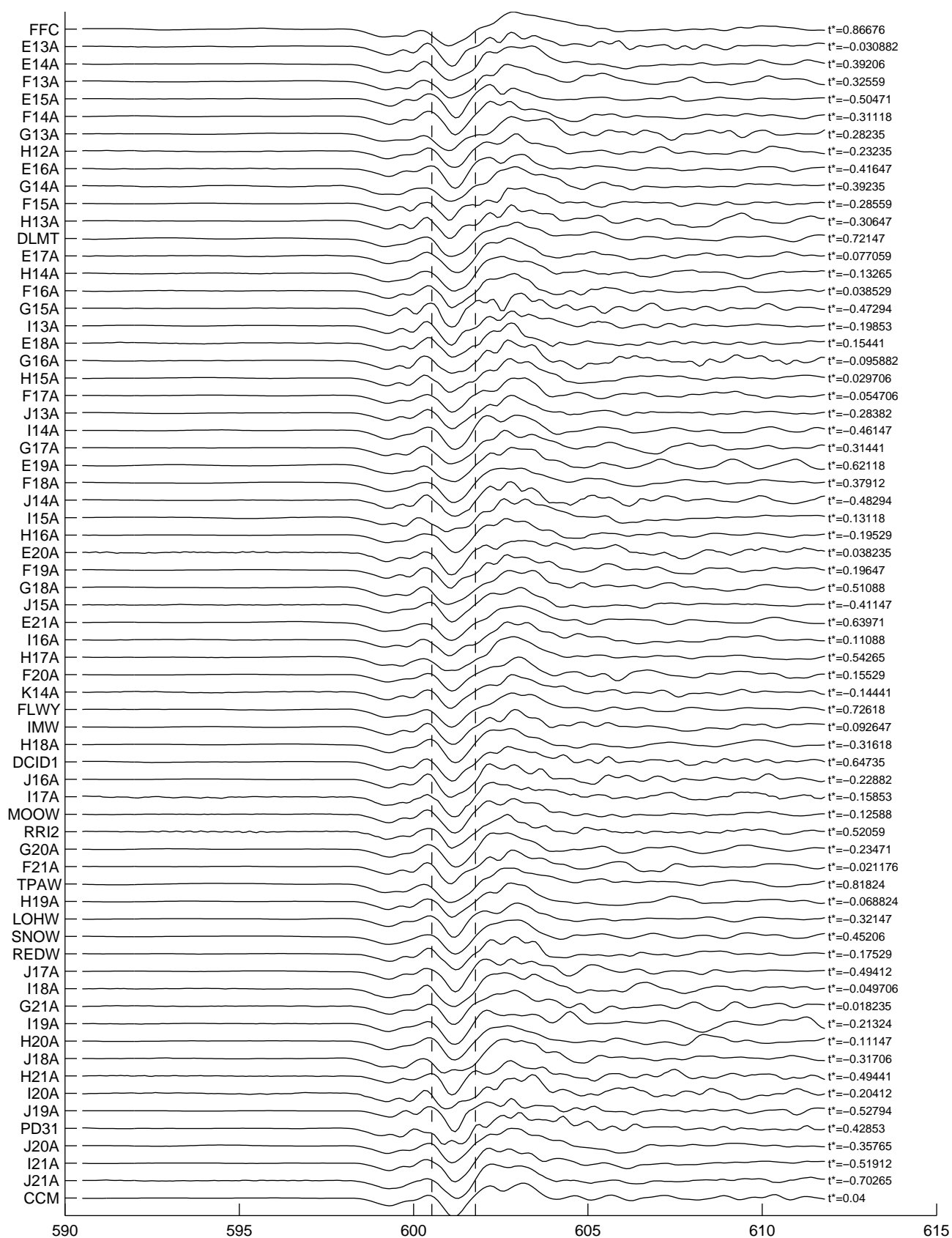
$t^*$  values



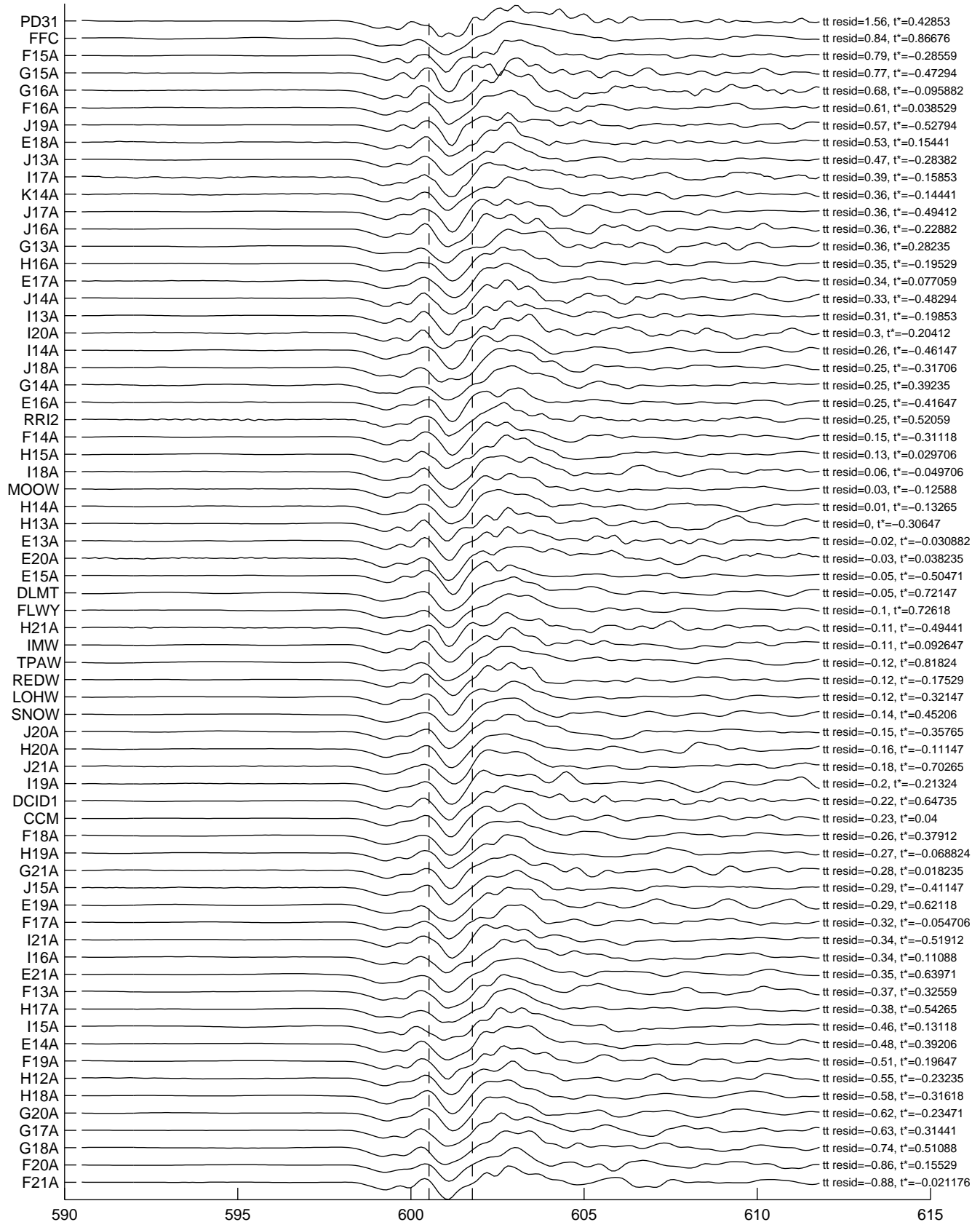
# Event\_2008\_239\_21\_00\_36



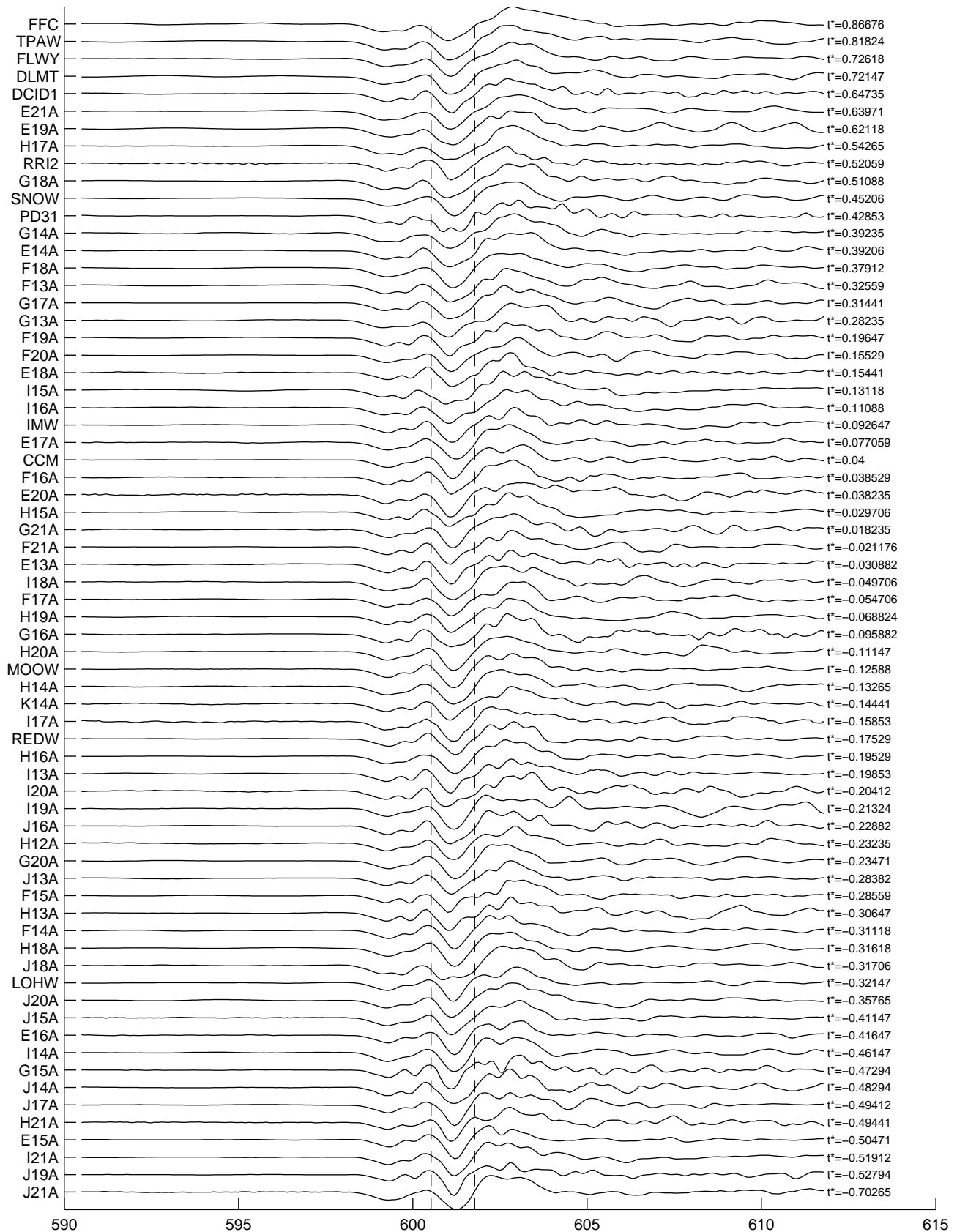
# Sorted by Delta:Event\_2008\_239\_21\_00\_36



# Sorted by travel time:Event\_2008\_239\_21\_00\_36

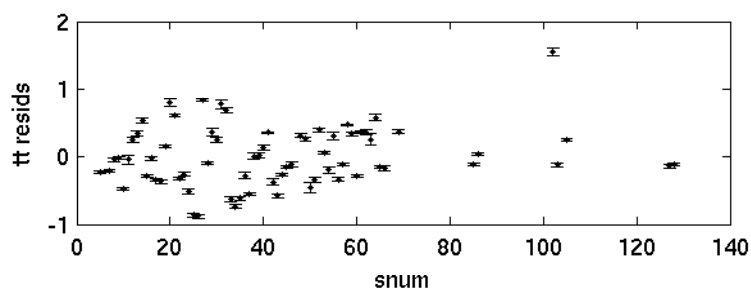
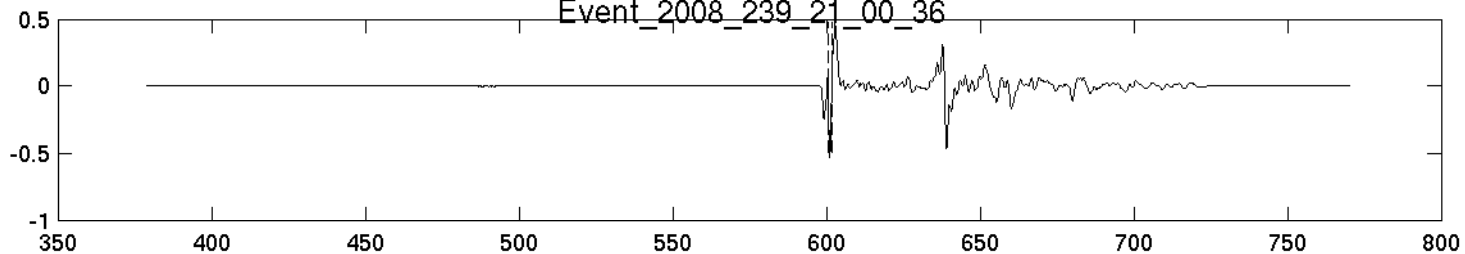


Sorted by t\*:Event\_2008\_239\_21\_00\_36

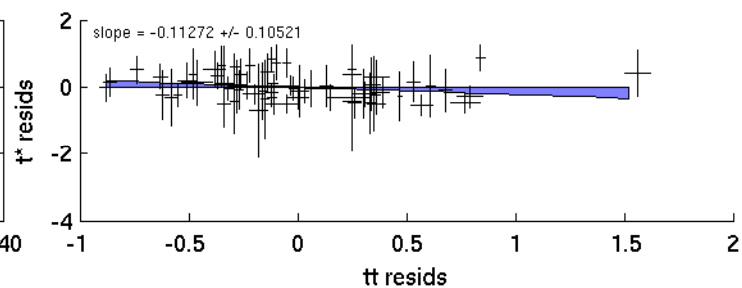
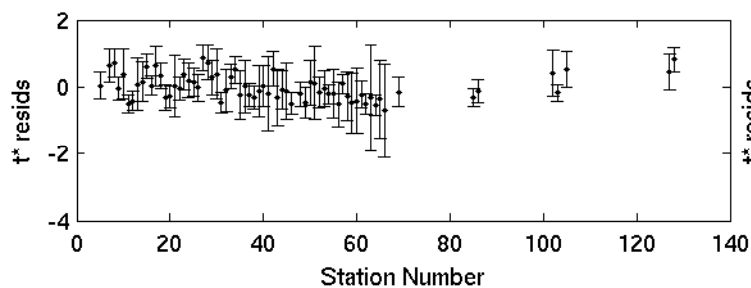


# Event\_2008\_239\_21\_00\_36

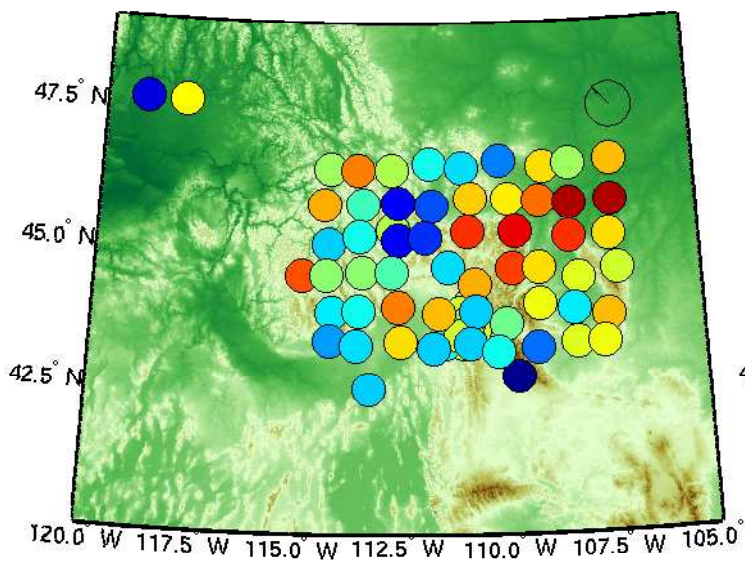
Stack



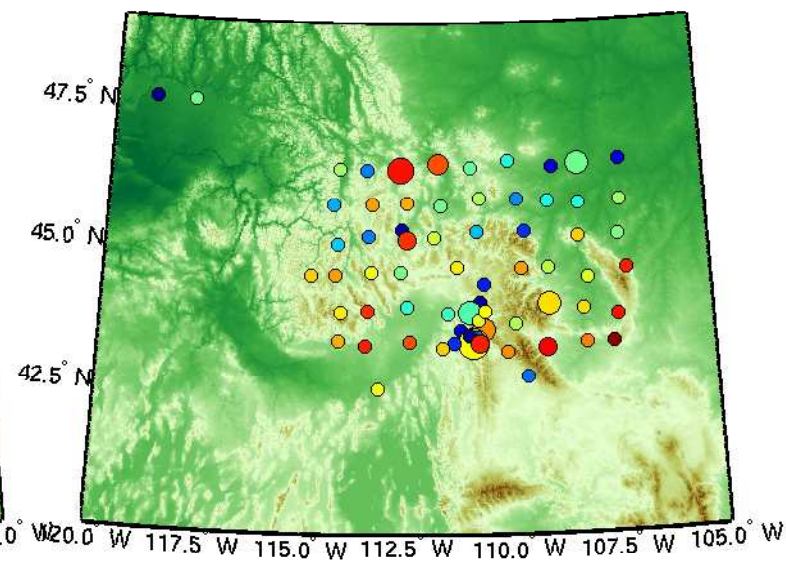
Baz = 138.2483  
Mean xcor value = 0.67794  
Range of t\* values is 1.5694  
Median t\* err is 0.47889  
Slope = -0.11272 +/- 0.10521



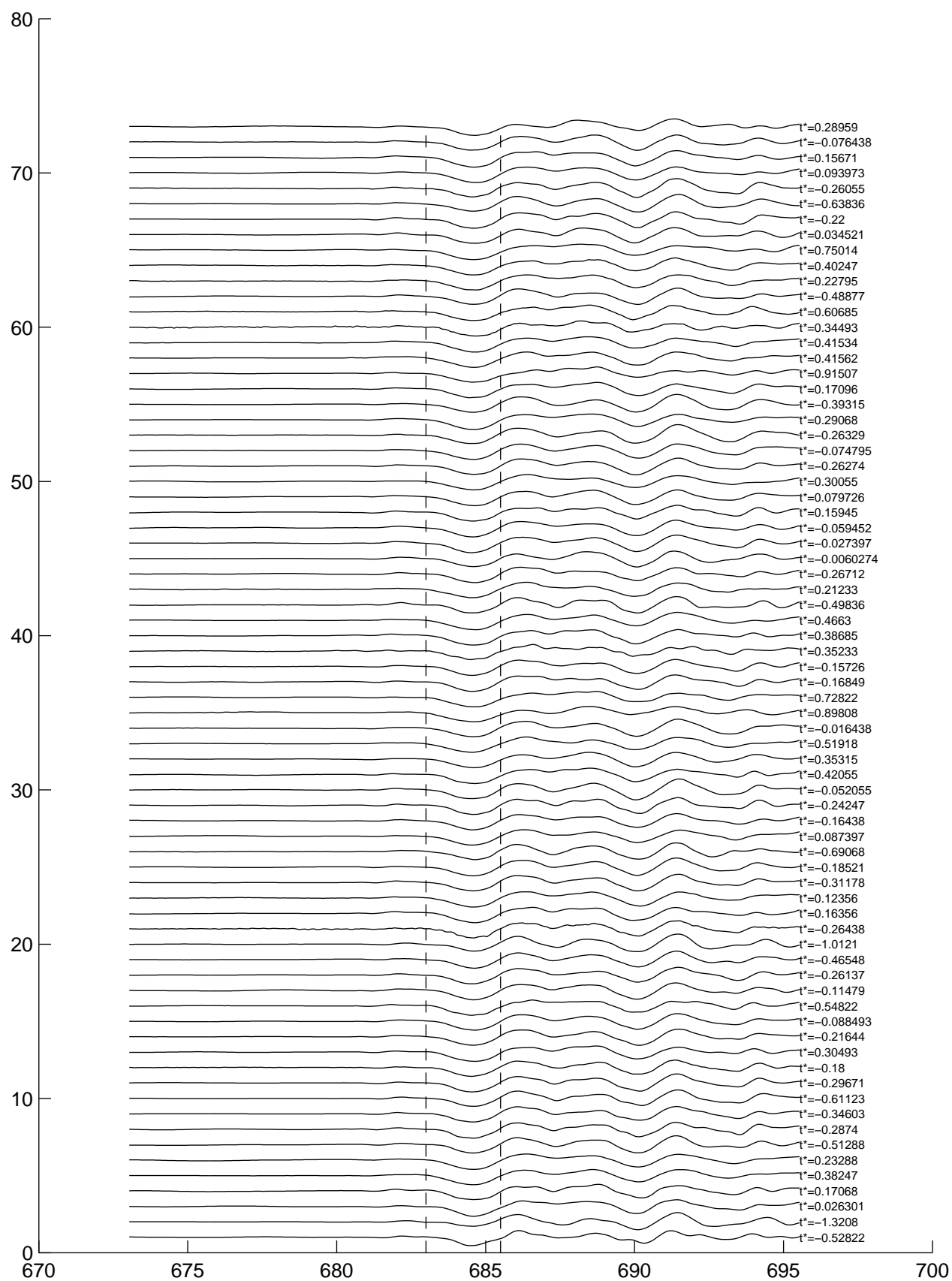
travel time residuals



t\* values

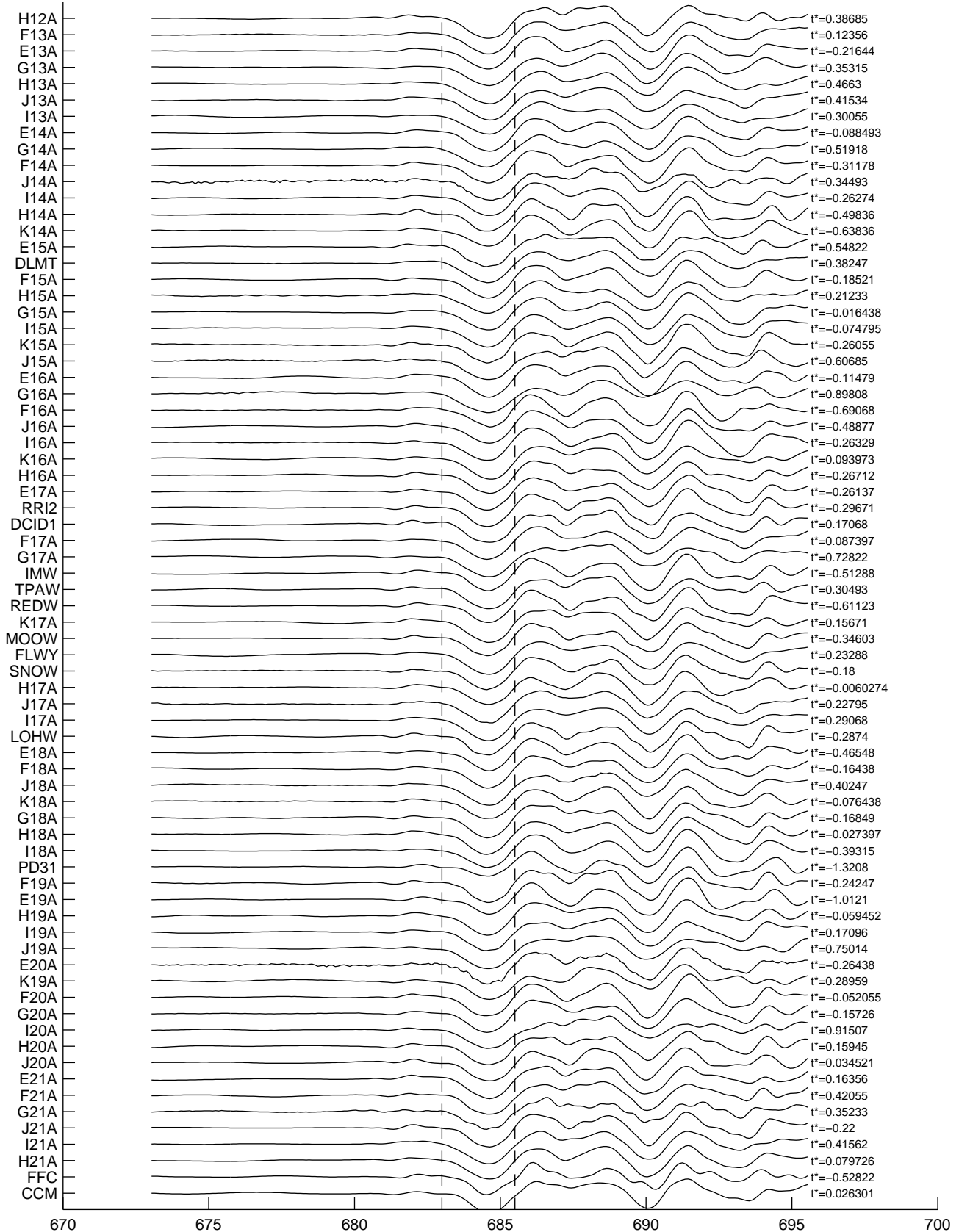


# Event\_2008\_254\_13\_08\_14



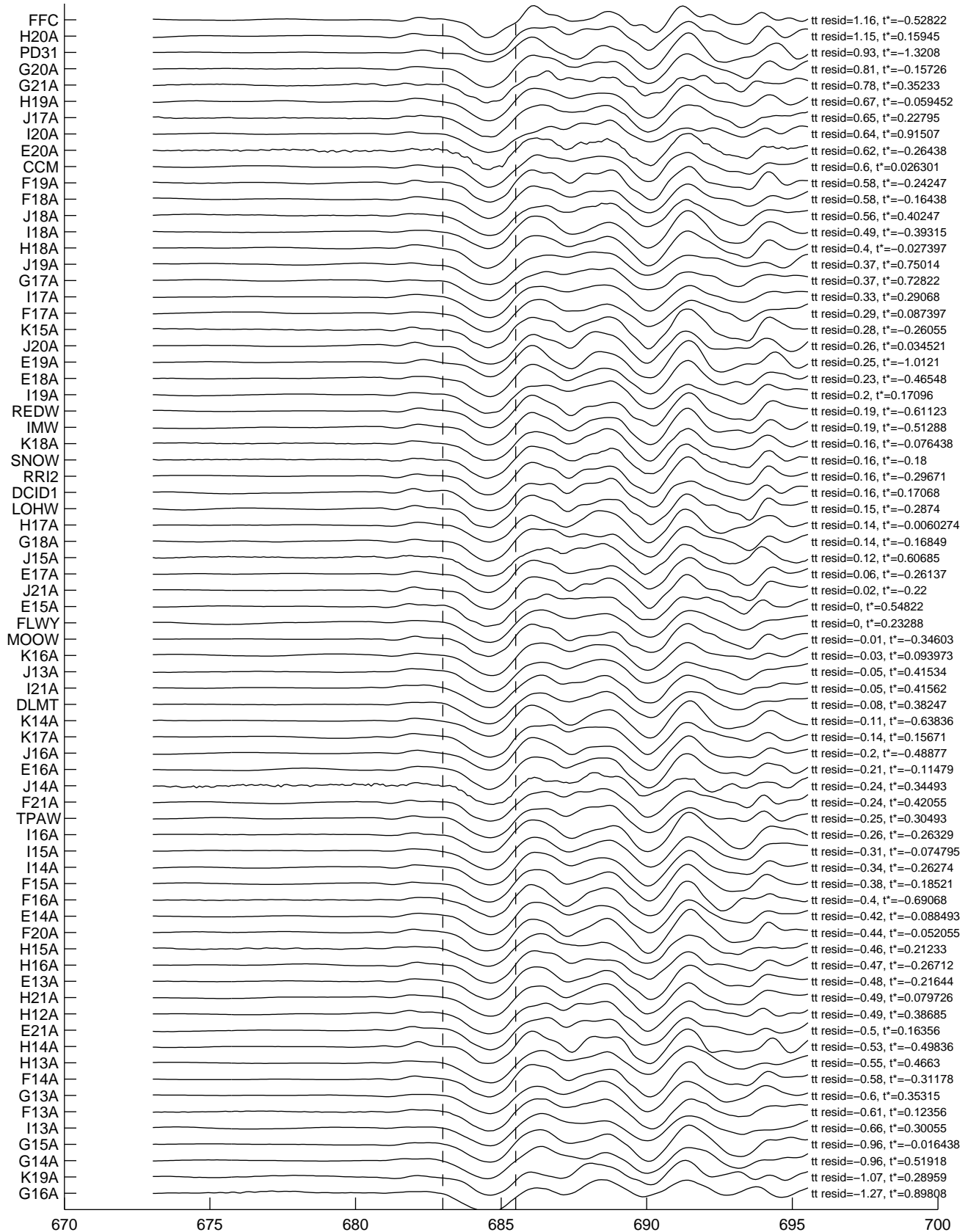


# Sorted by Delta:Event\_2008\_254\_13\_08\_14

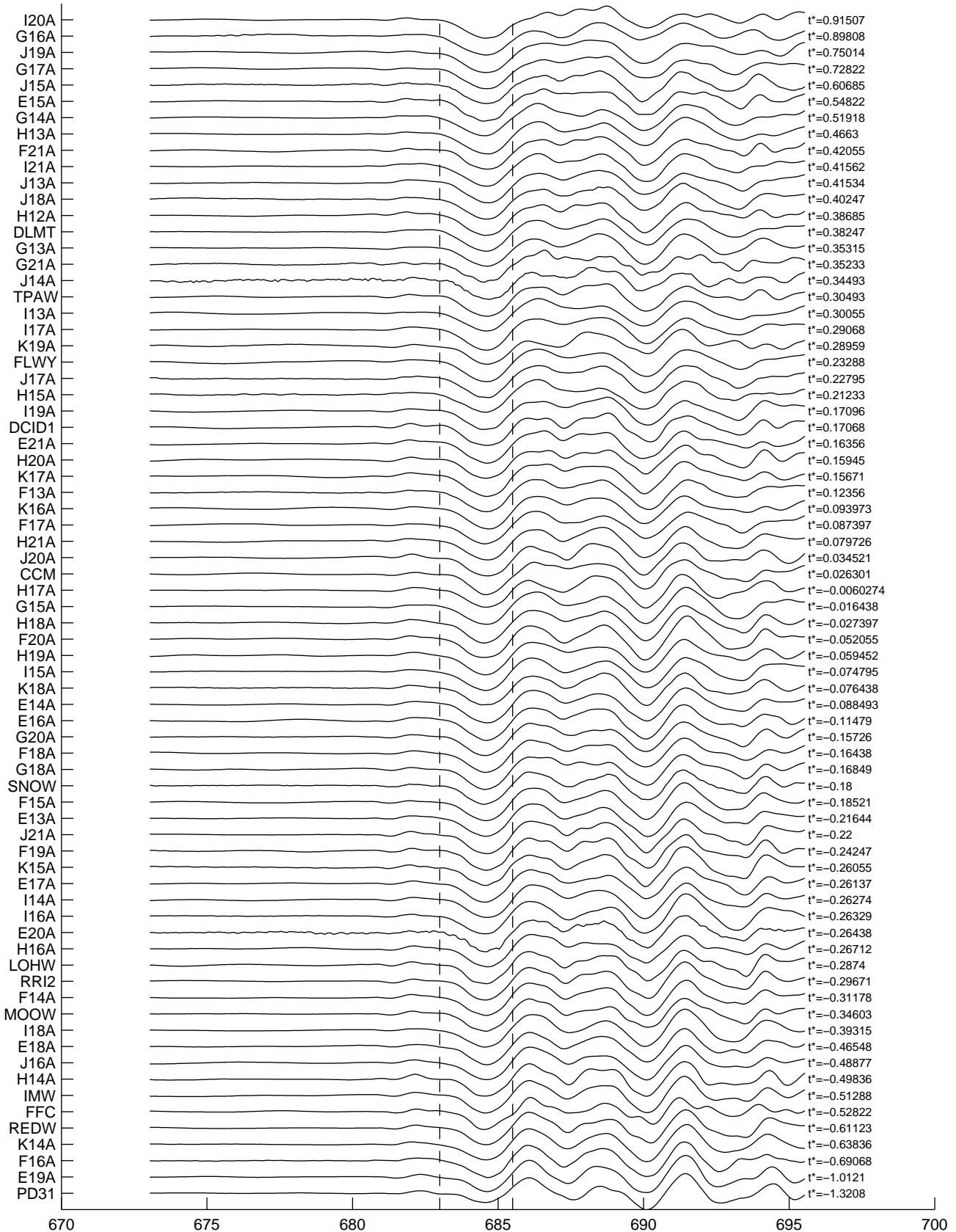




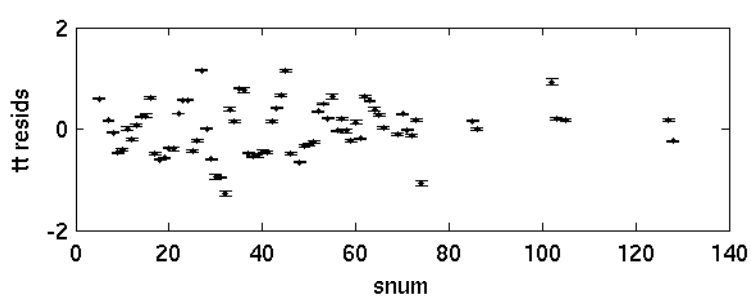
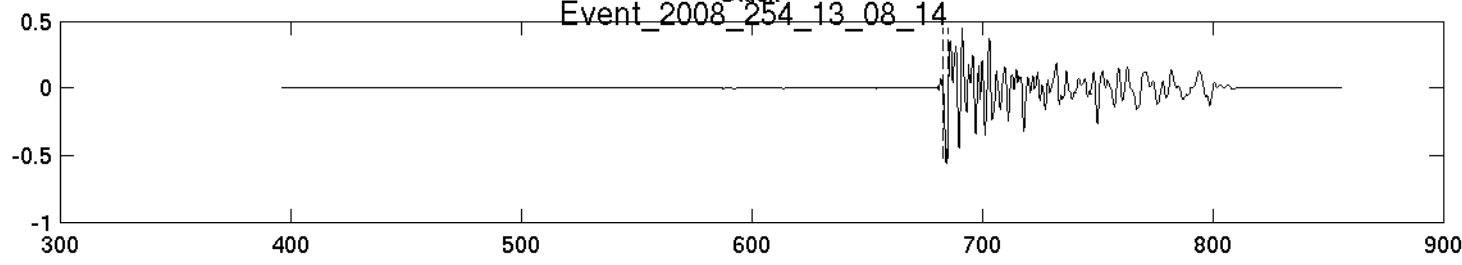
# Sorted by travel time:Event\_2008\_254\_13\_08\_14



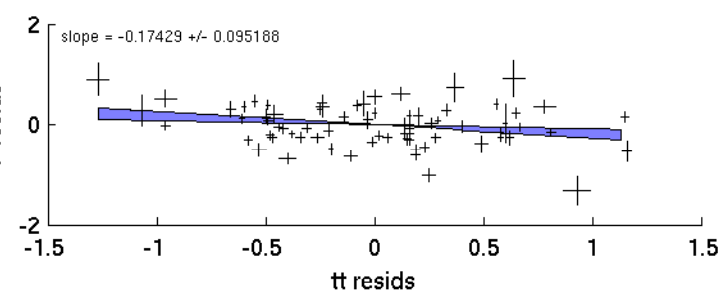
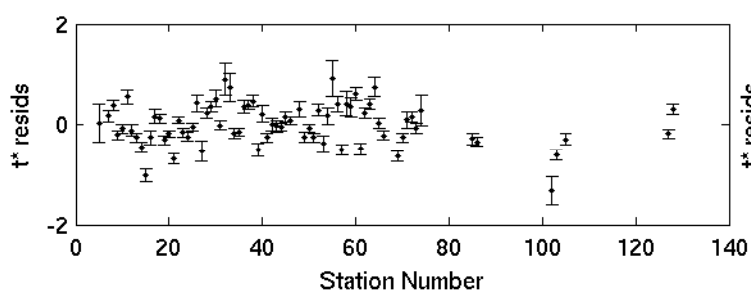
# Sorted by t\*:Event\_2008\_254\_13\_08\_14



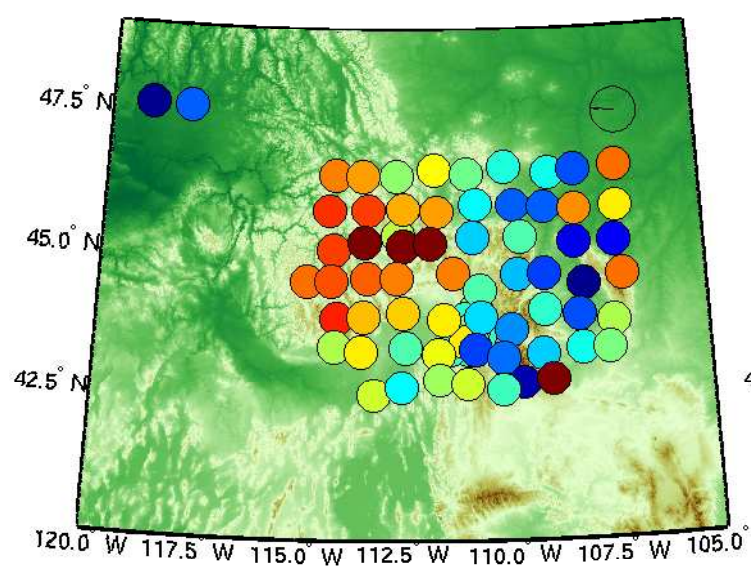
Stack  
Event\_2008\_254\_13\_08\_14



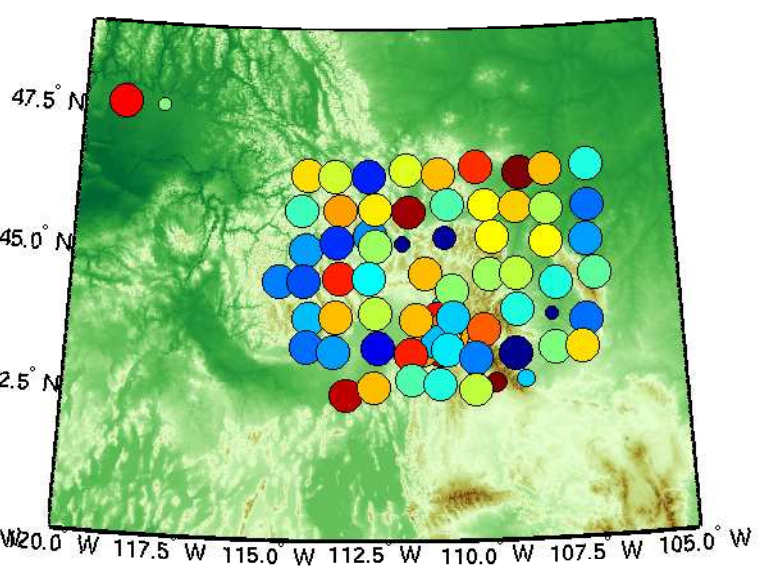
Baz = 96.9978  
Mean xcor value = 0.73151  
Range of t\* values is 2.2359  
Median t\* err is 0.10585  
Slope = -0.17429 +/- 0.095188



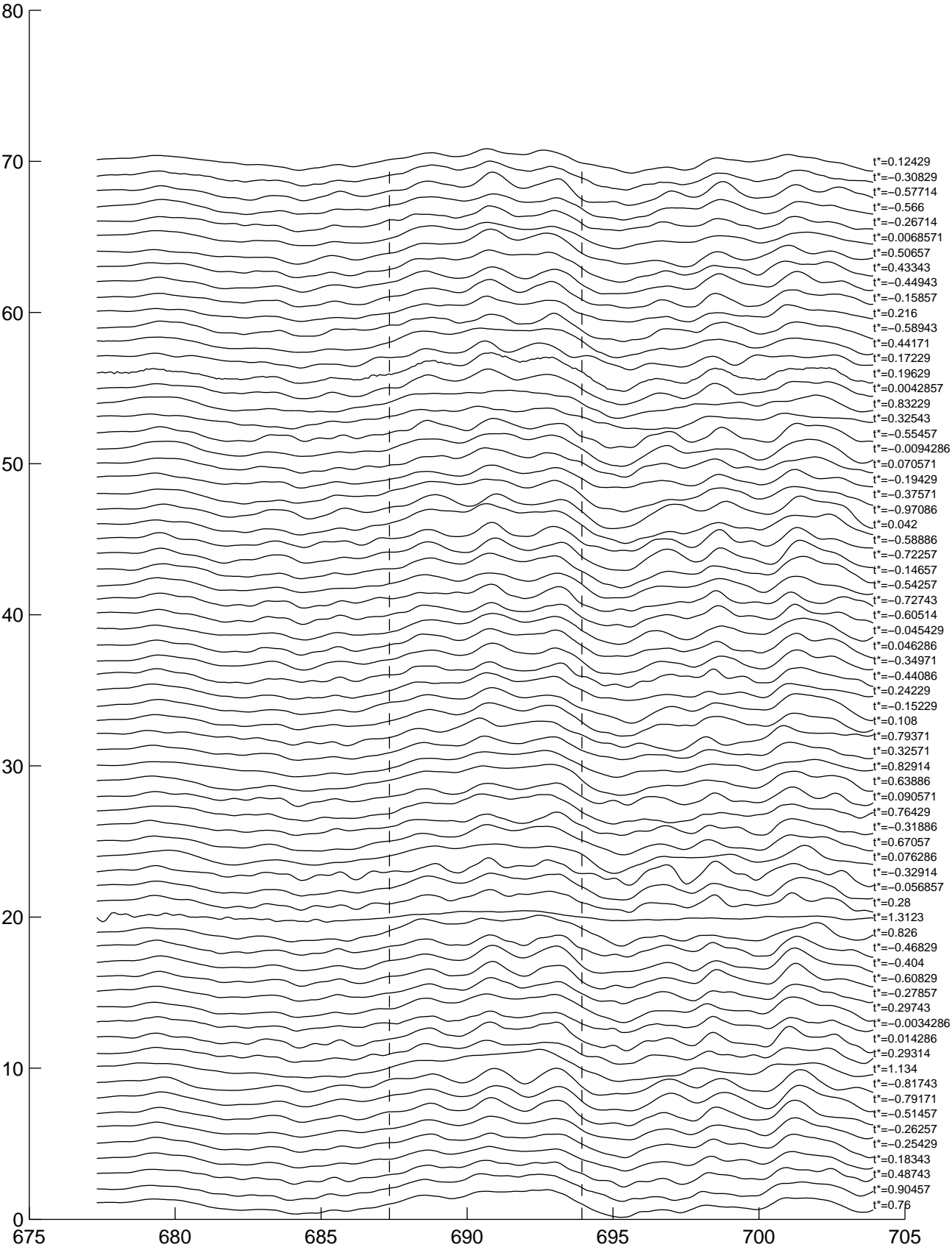
travel time residuals



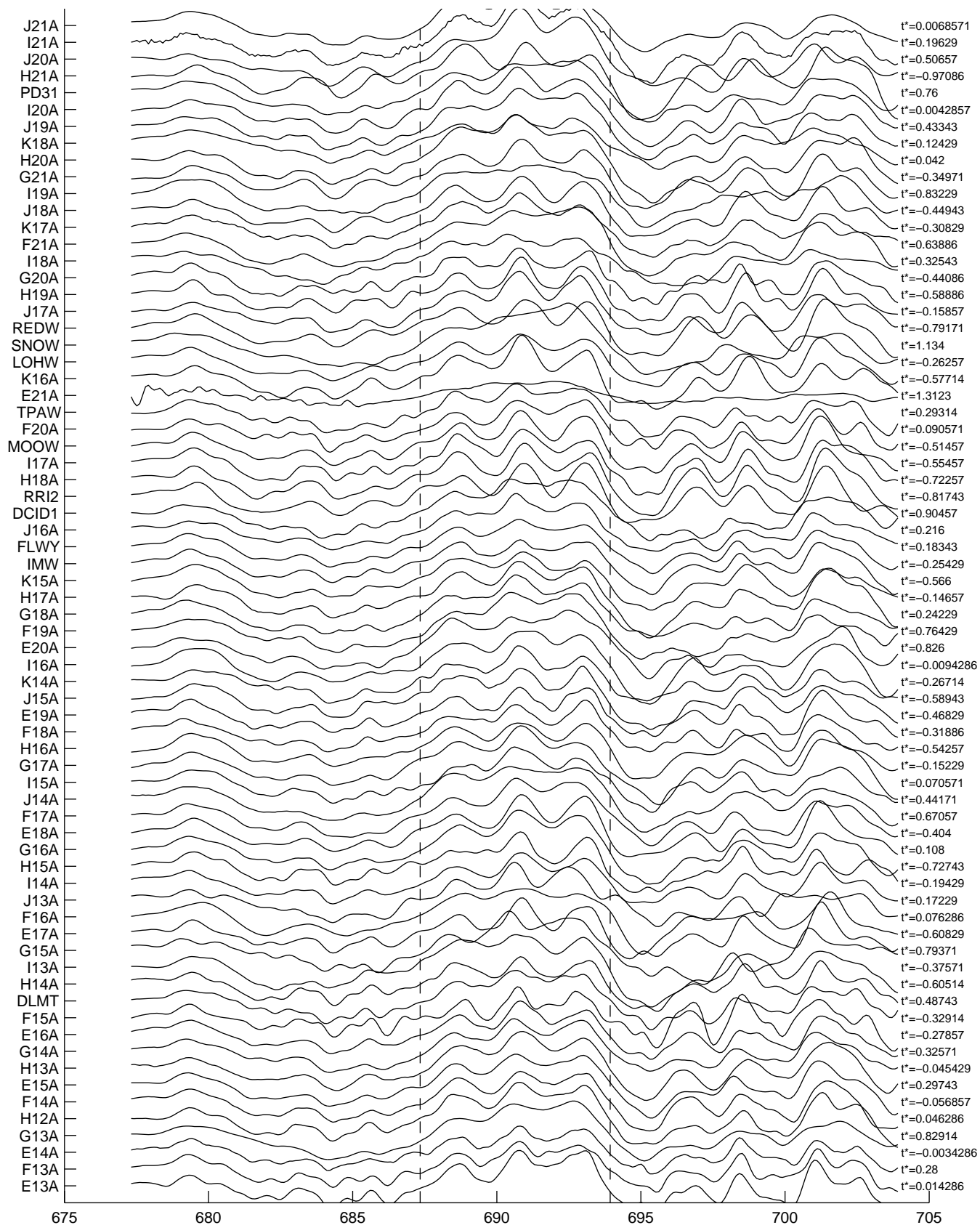
t\* values



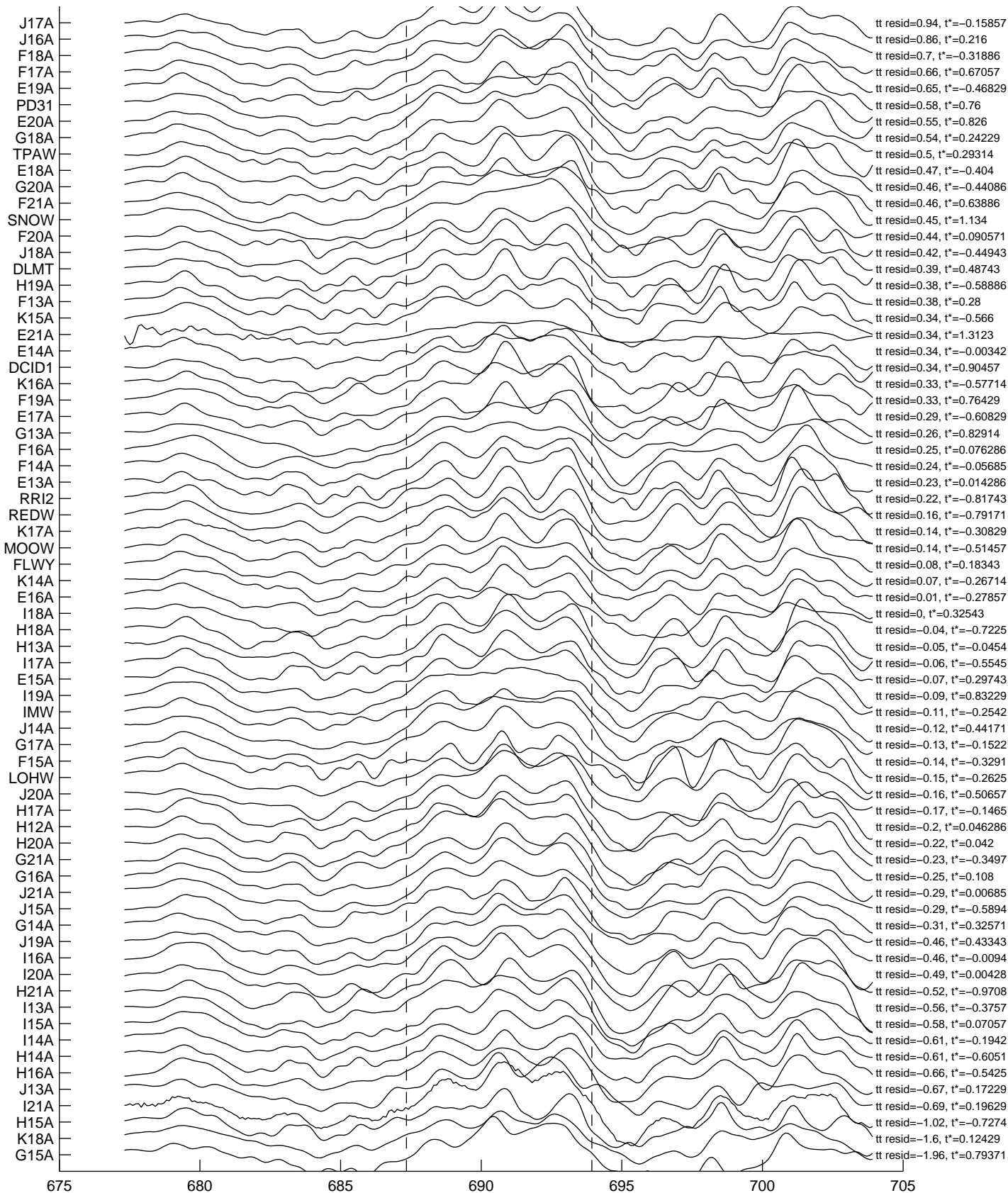
Event\_2008\_255\_00\_20\_50



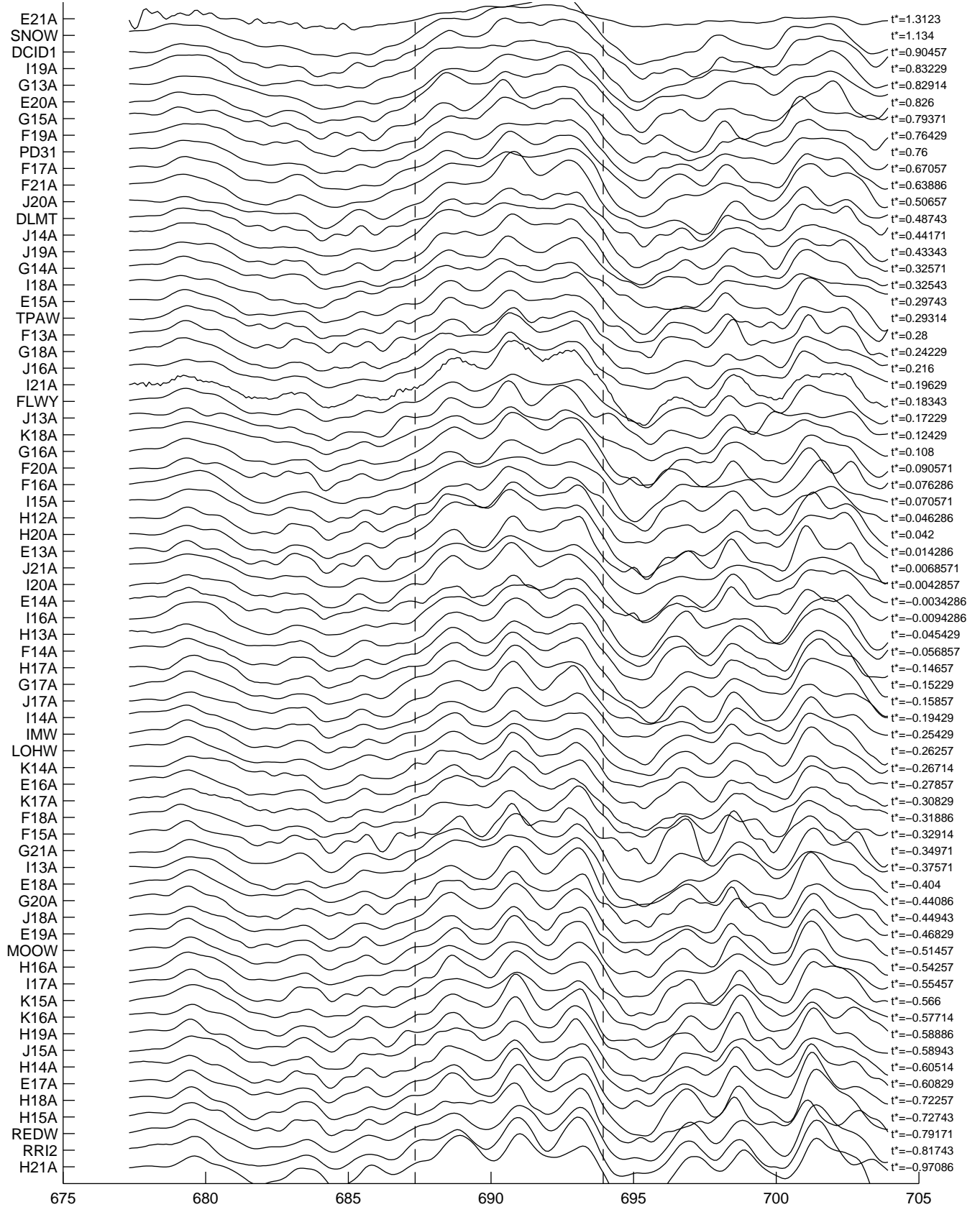
# Sorted by Delta:Event\_2008\_255\_00\_20\_50



# Sorted by travel time:Event\_2008\_255\_00\_20\_50

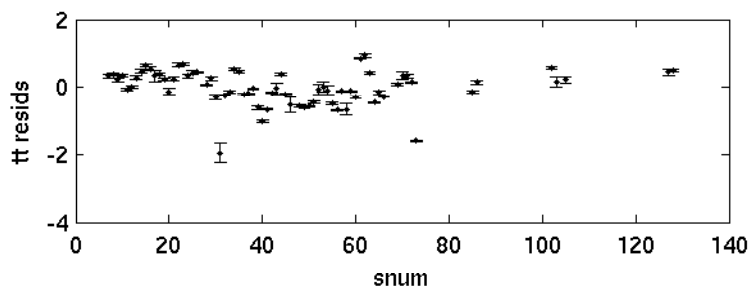
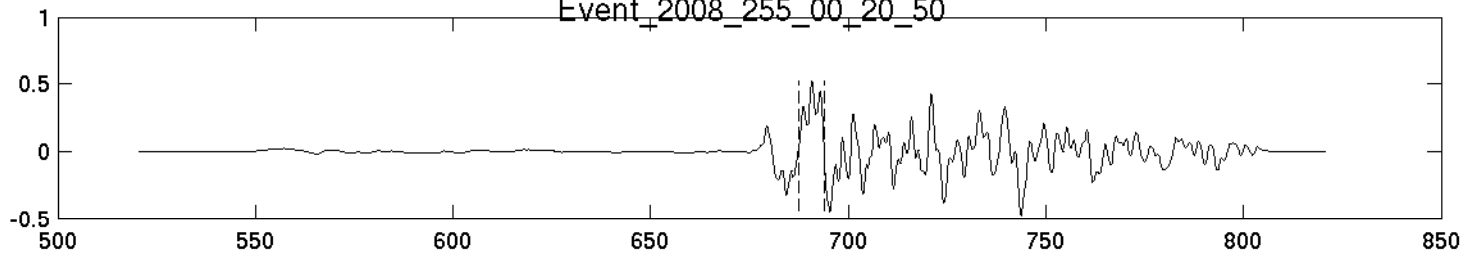


# Sorted by t\*:Event\_2008\_255\_00\_20\_50

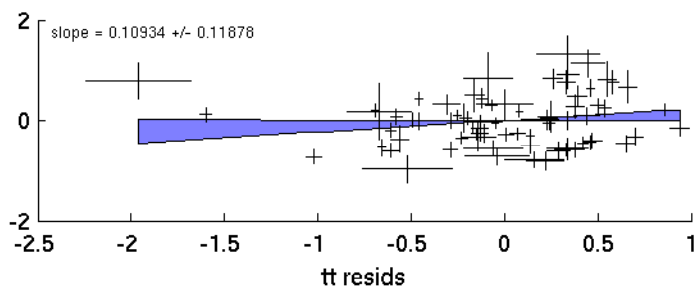
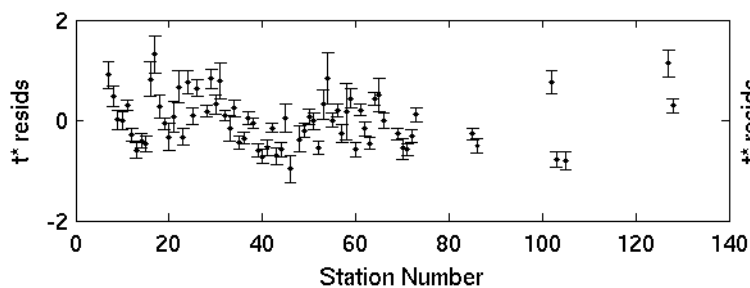




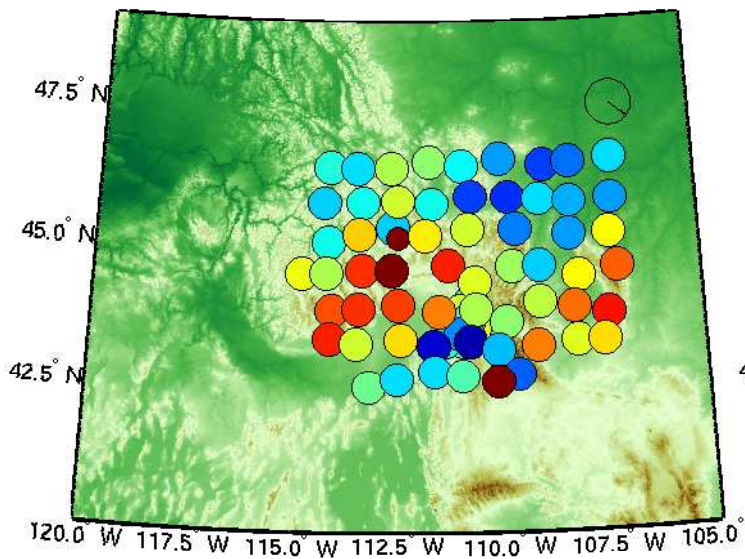
# Stack Event\_2008\_255\_00\_20\_50



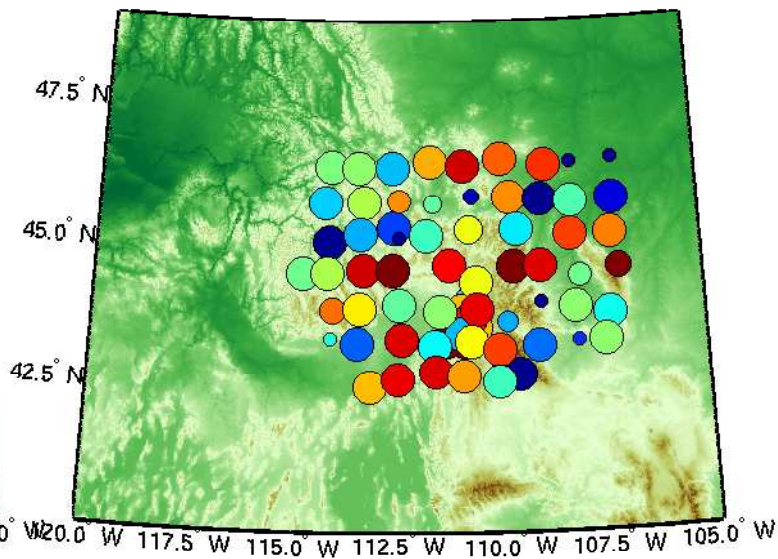
Baz = 310.6285  
Mean xcor value = 0.75157  
Range of t\* values is 2.2831  
Median t\* err is 0.16164  
Slope = 0.10934 +/- 0.11878



travel time residuals

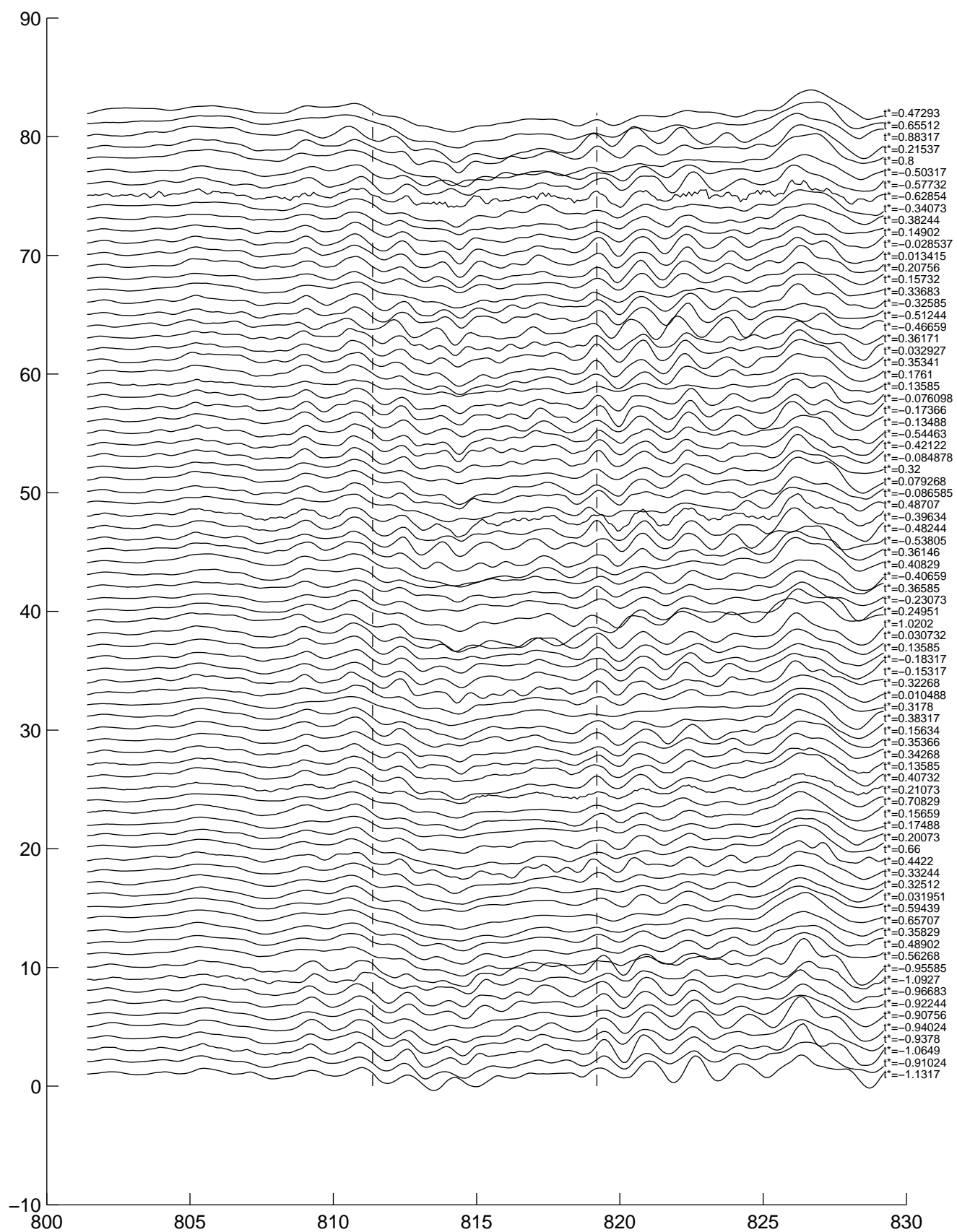


t\* values

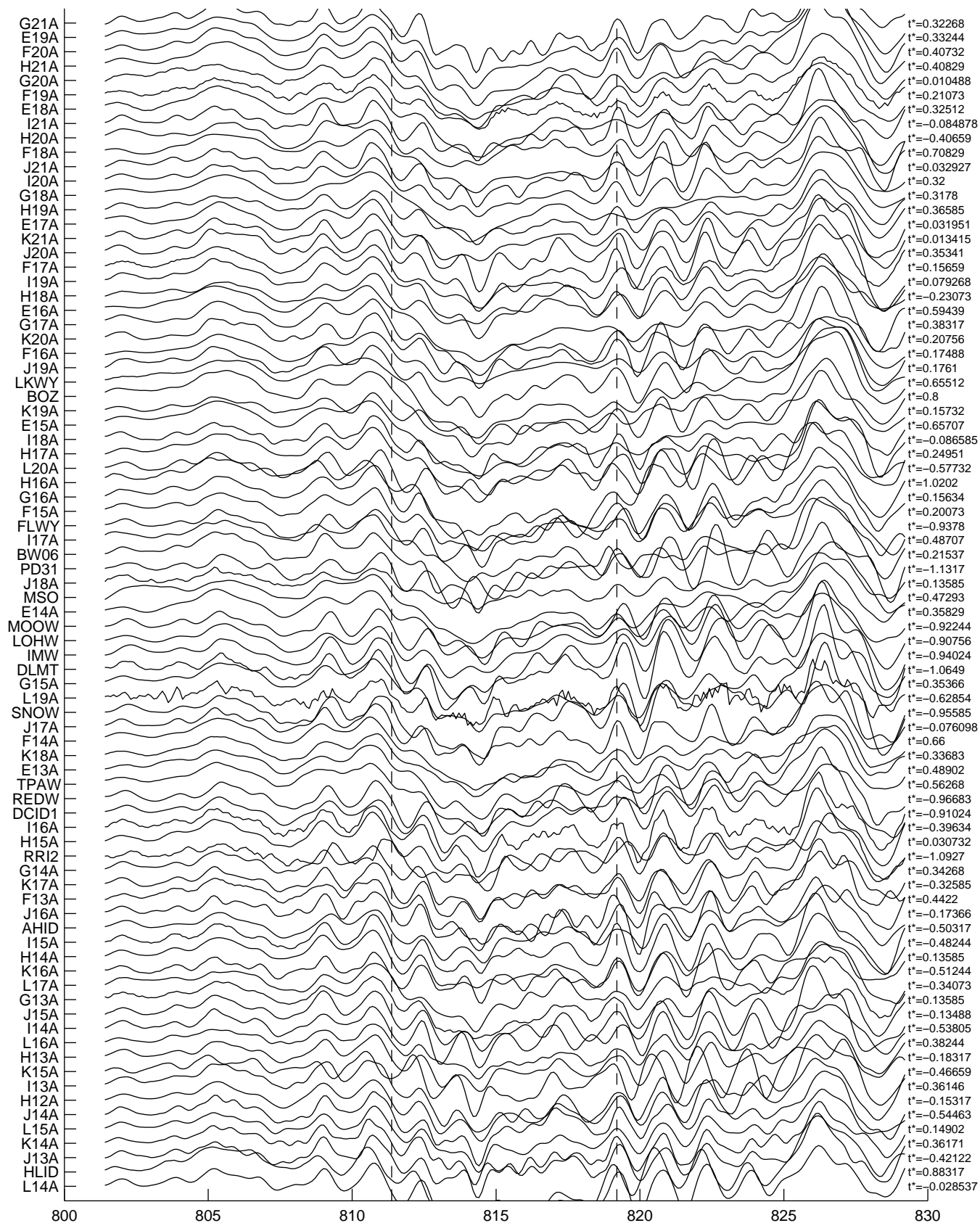




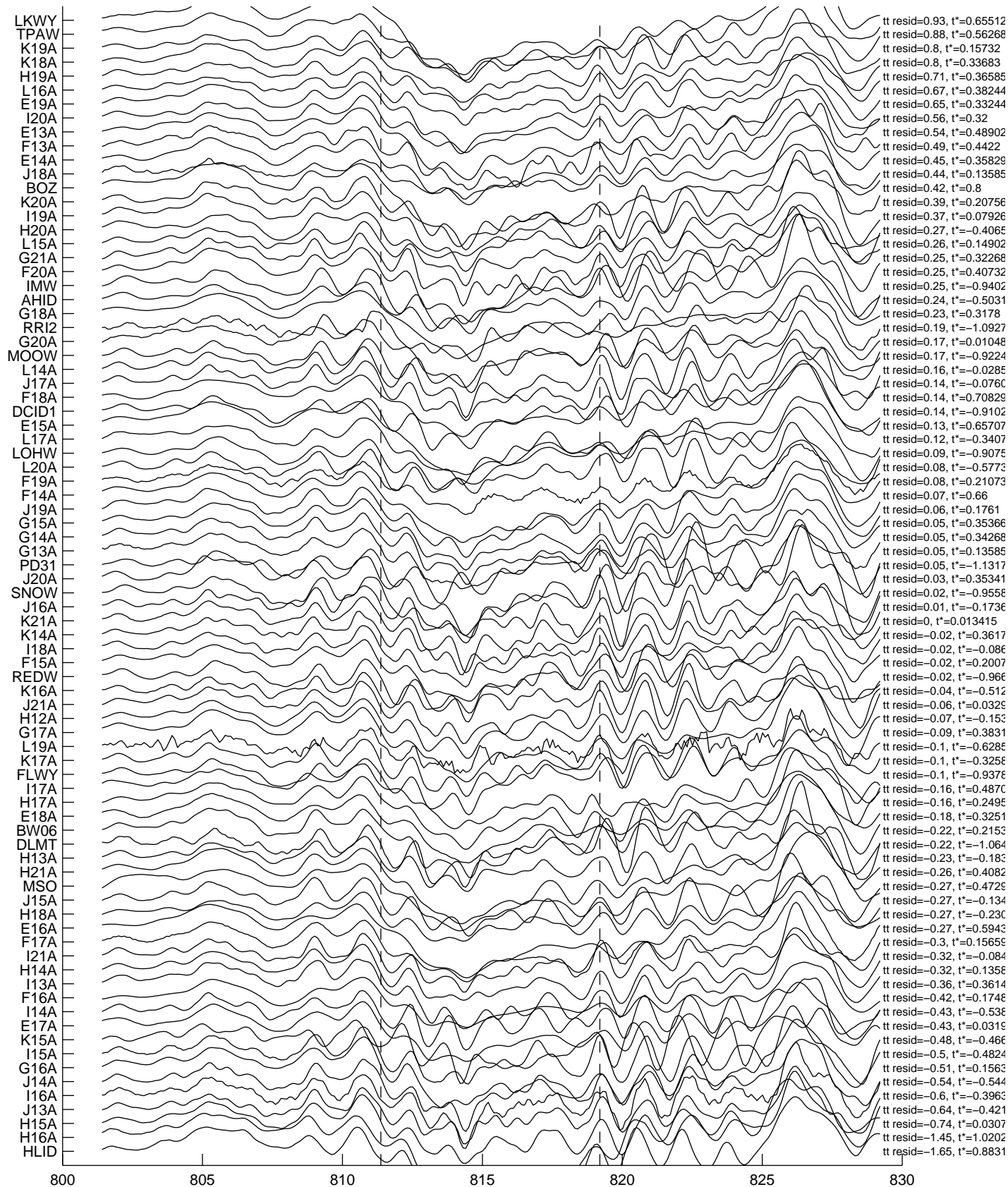
# Event\_2008\_273\_15\_19\_31



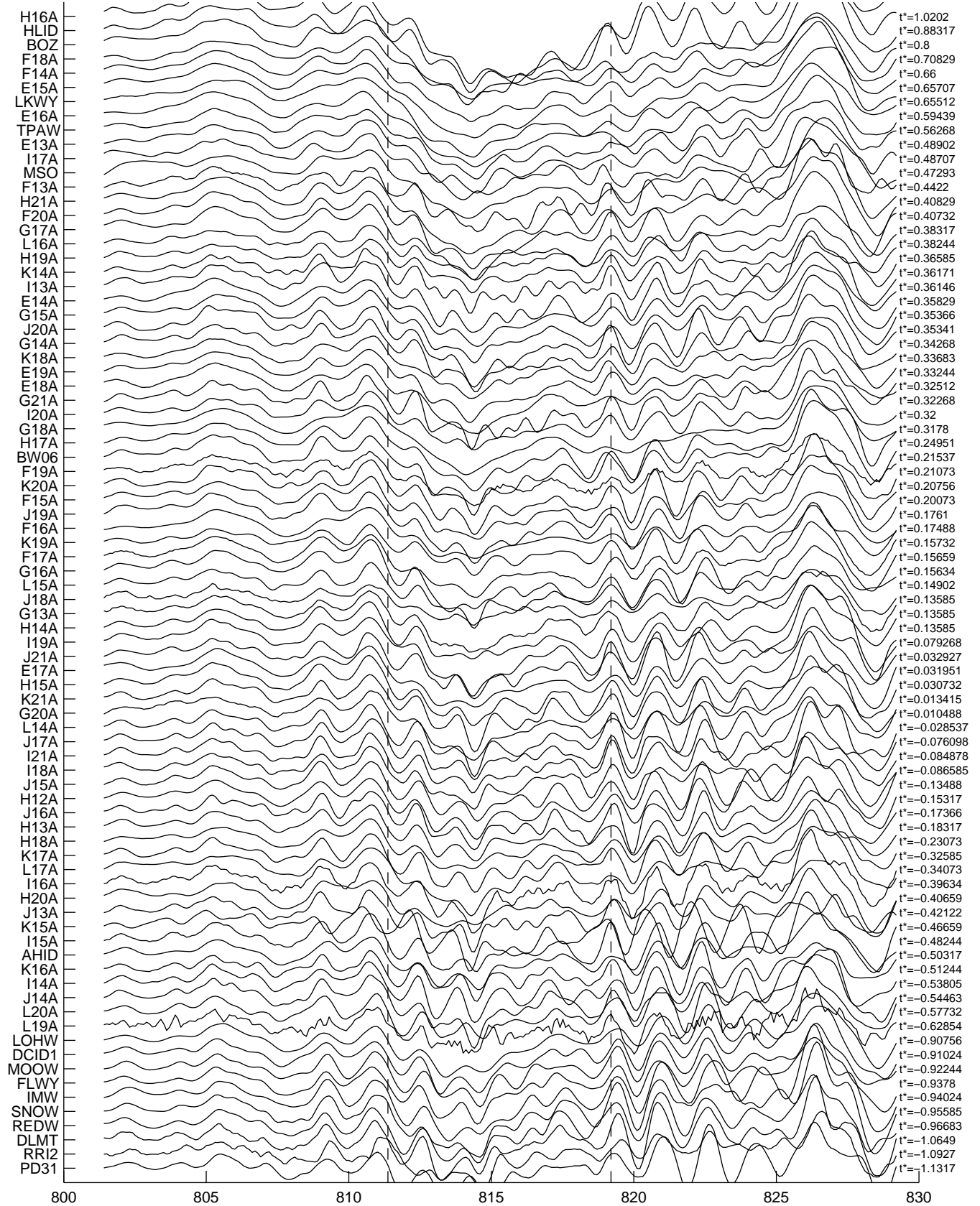
# Sorted by Delta:Event\_2008\_273\_15\_19\_31



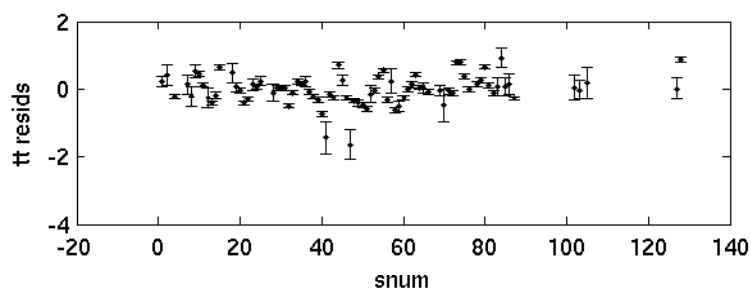
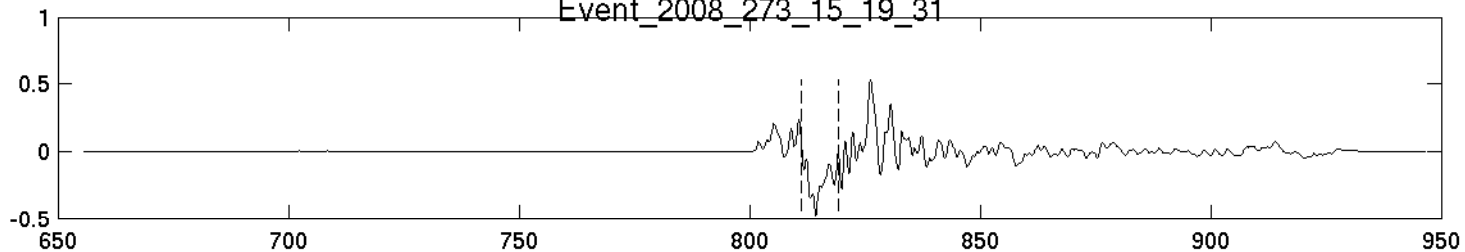
# Sorted by travel time:Event\_2008\_273\_15\_19\_31



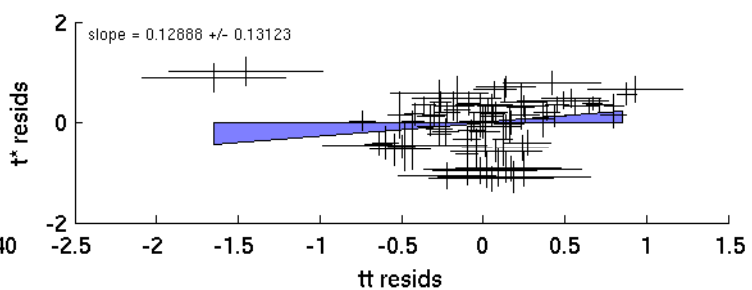
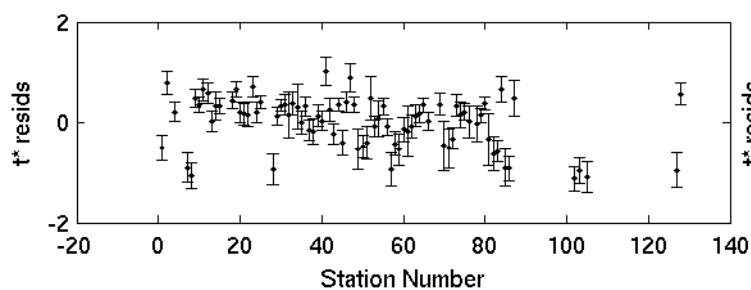
# Sorted by t\*:Event\_2008\_273\_15\_19\_31



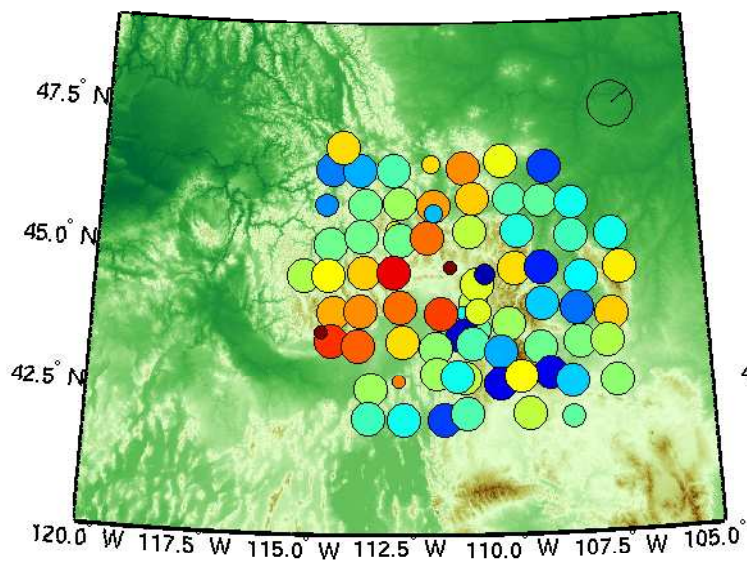
Stack  
Event\_2008\_273\_15\_19\_31



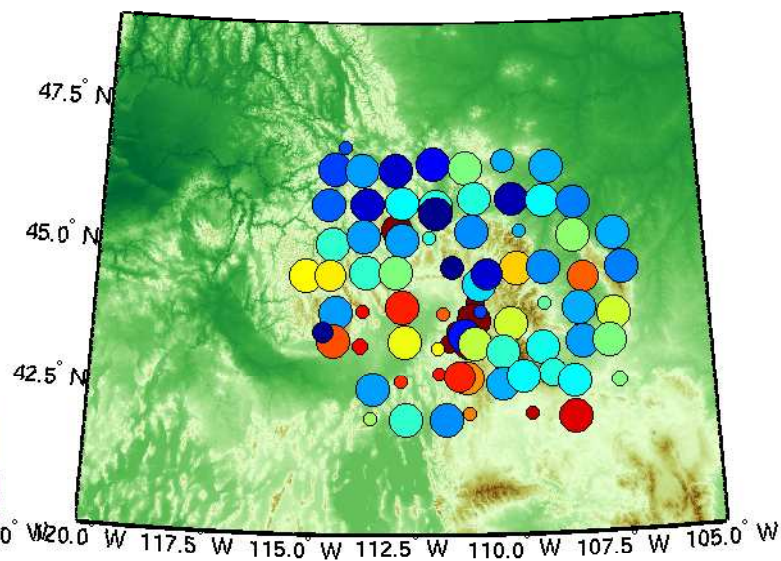
Baz = 233.2587  
Mean xcor value = 0.87122  
Range of  $t^*$  values is 2.152  
Median  $t^*$  err is 0.22467  
Slope = 0.12888 +/- 0.13123



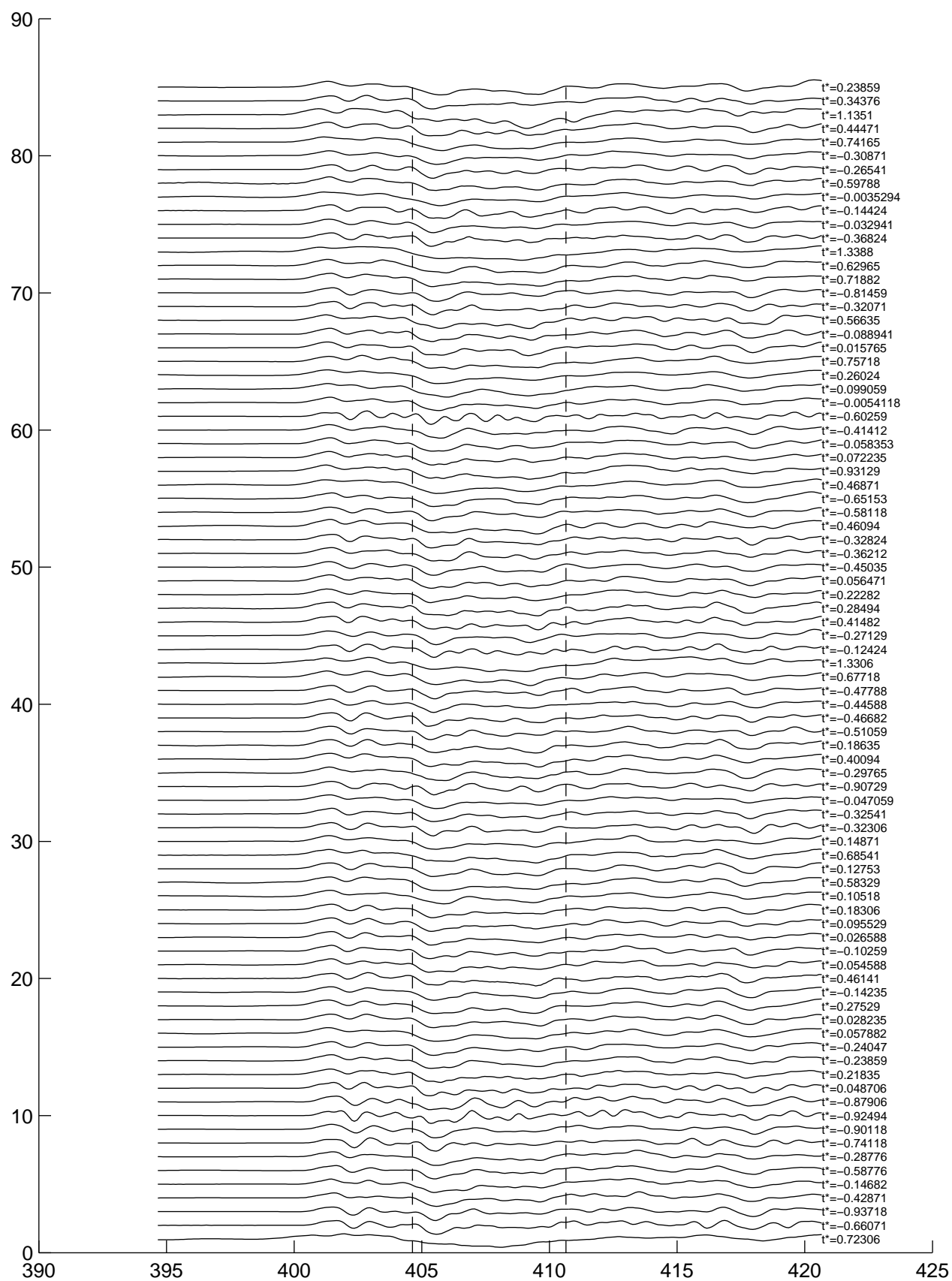
travel time residuals



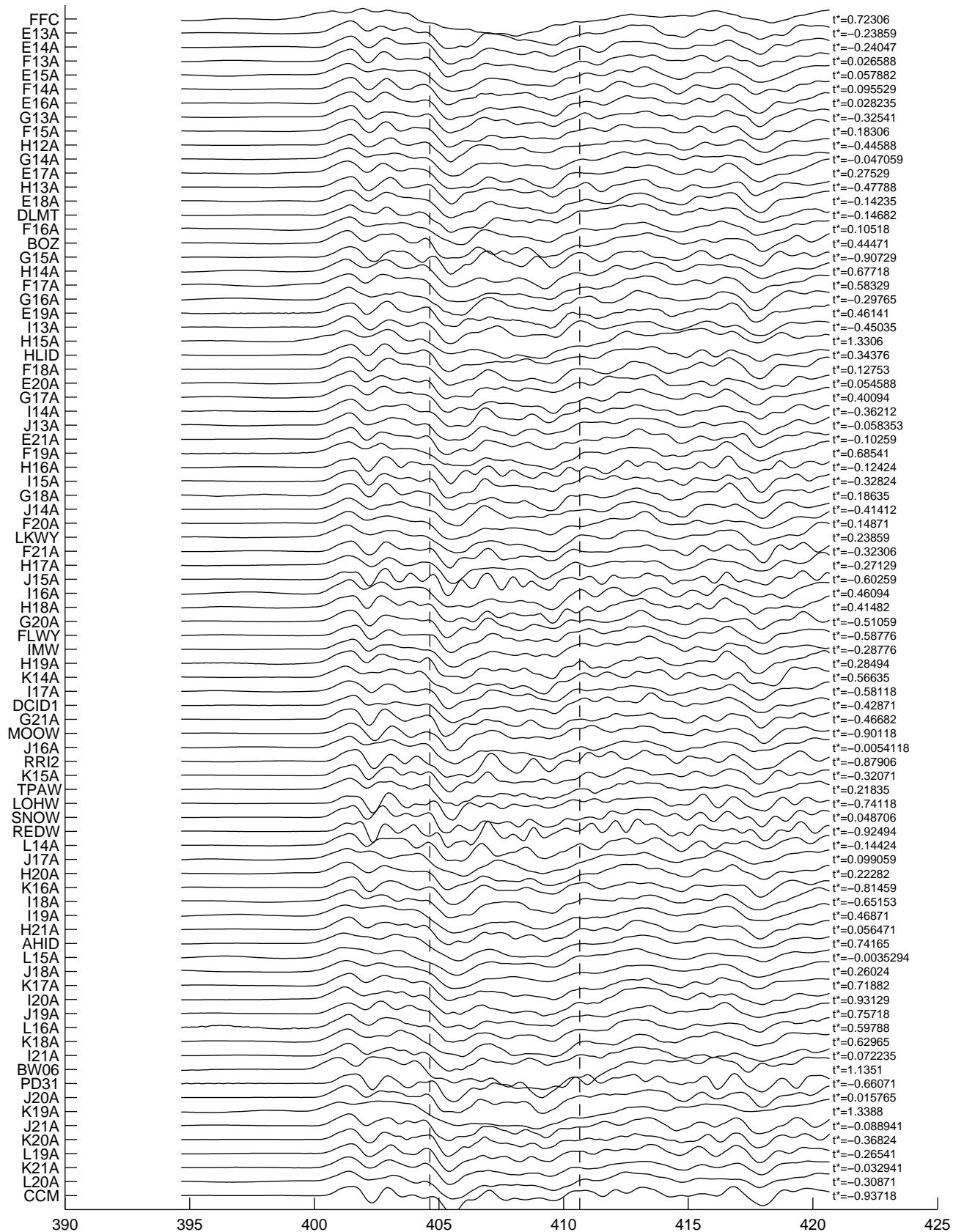
$t^*$  values



# Event\_2008\_290\_19\_41\_25

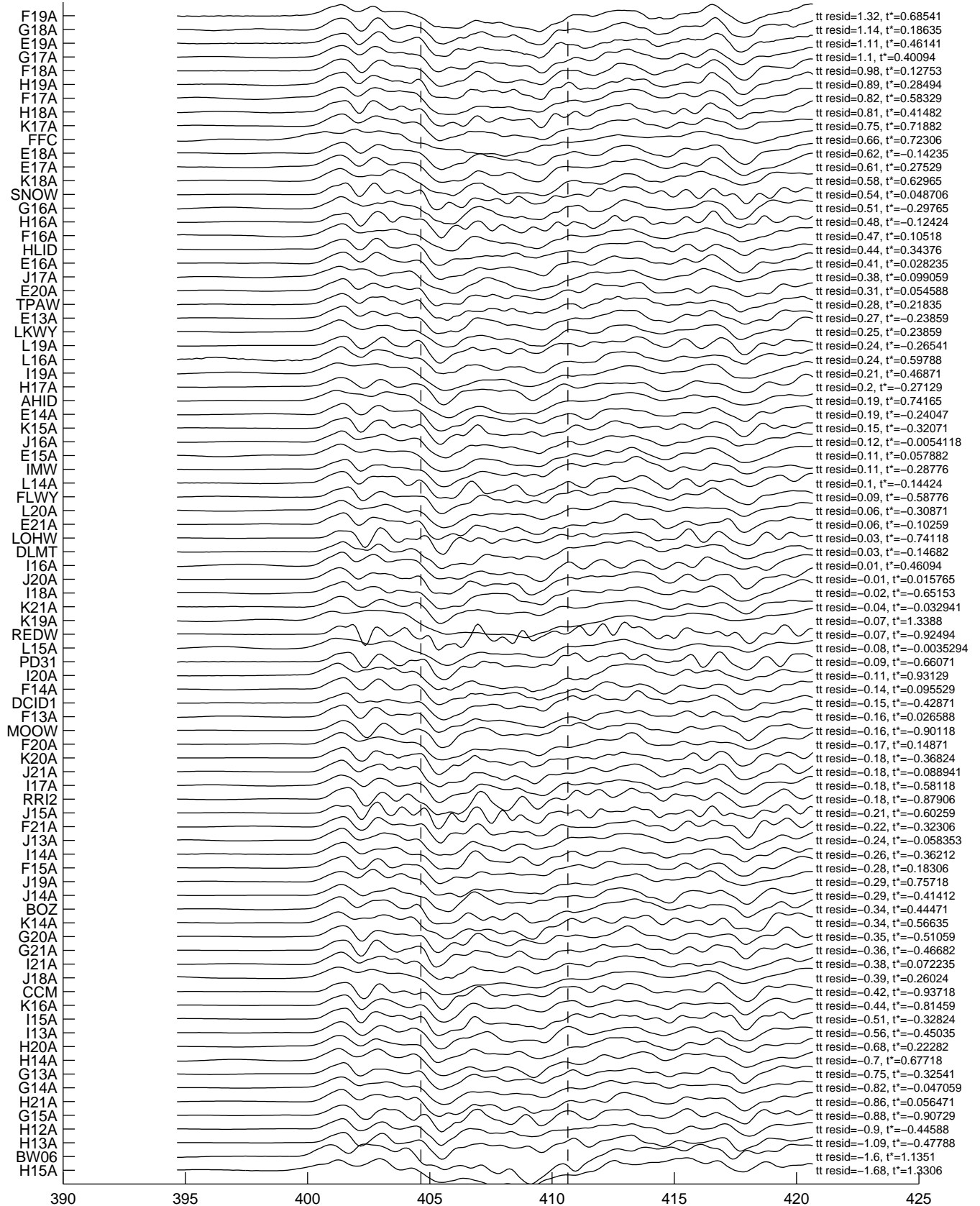


# Sorted by Delta:Event\_2008\_290\_19\_41\_25



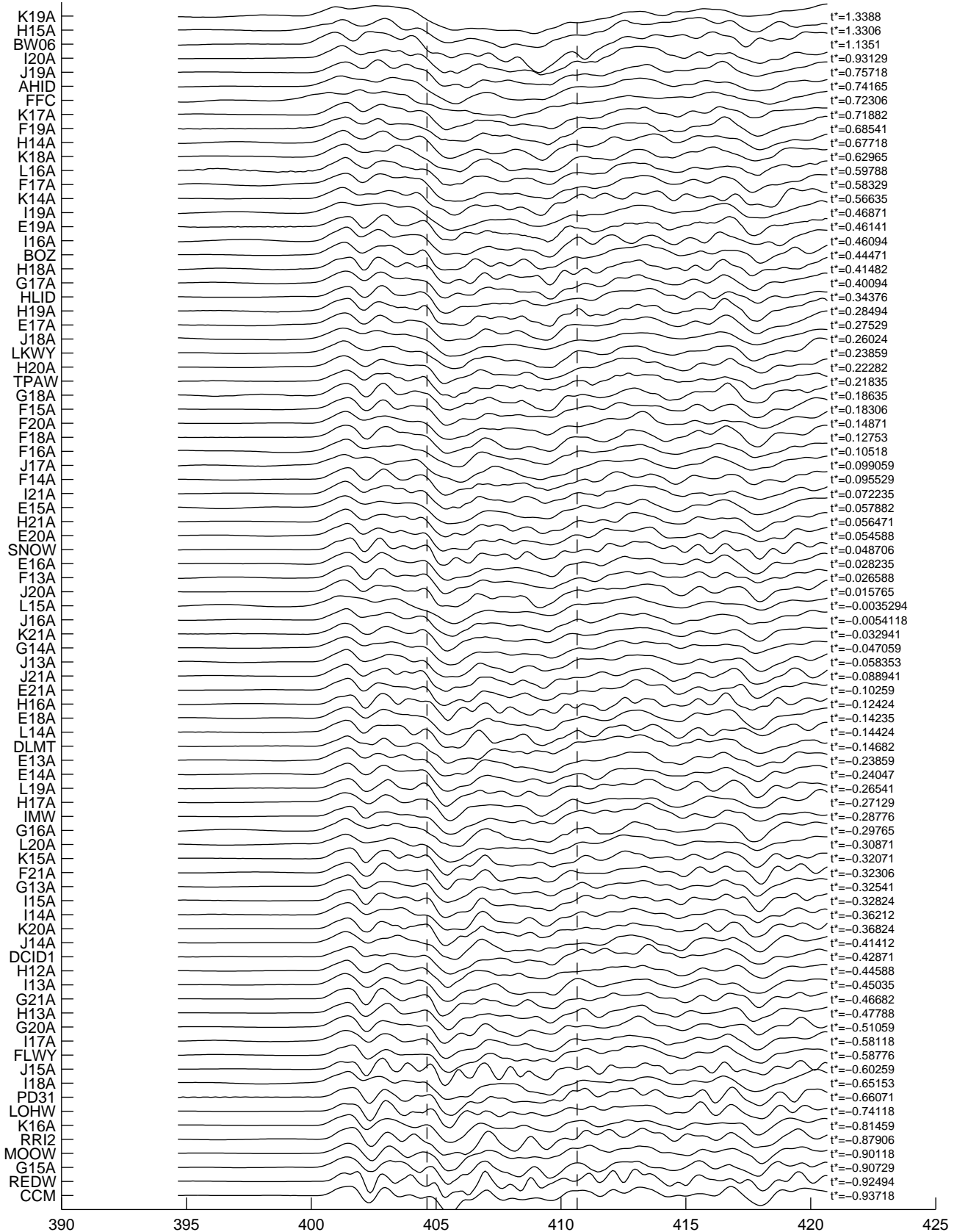


# Sorted by travel time:Event\_2008\_290\_19\_41\_25



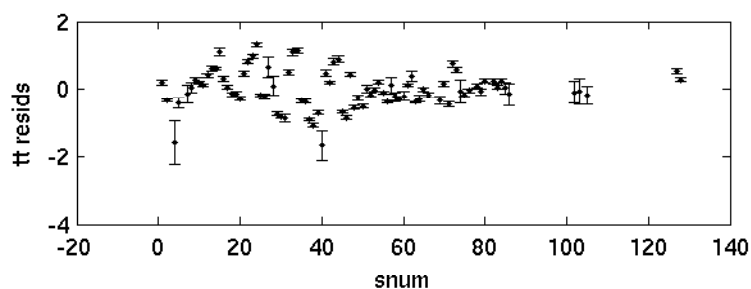
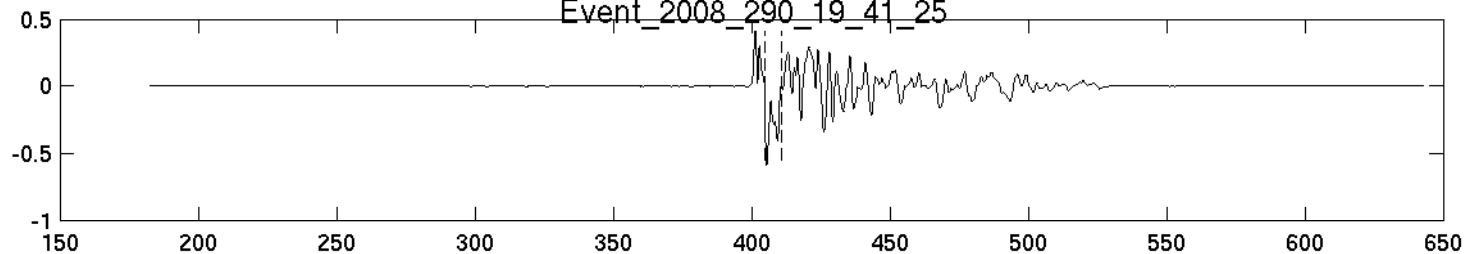


# Sorted by t\*:Event\_2008\_290\_19\_41\_25

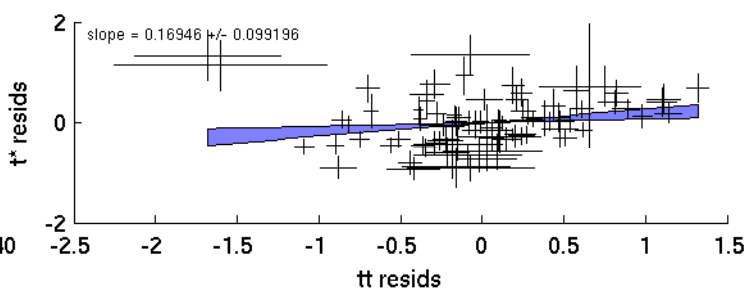
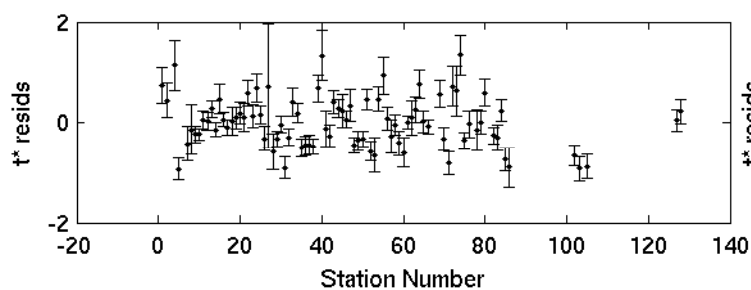


# Event\_2008\_290\_19\_41\_25

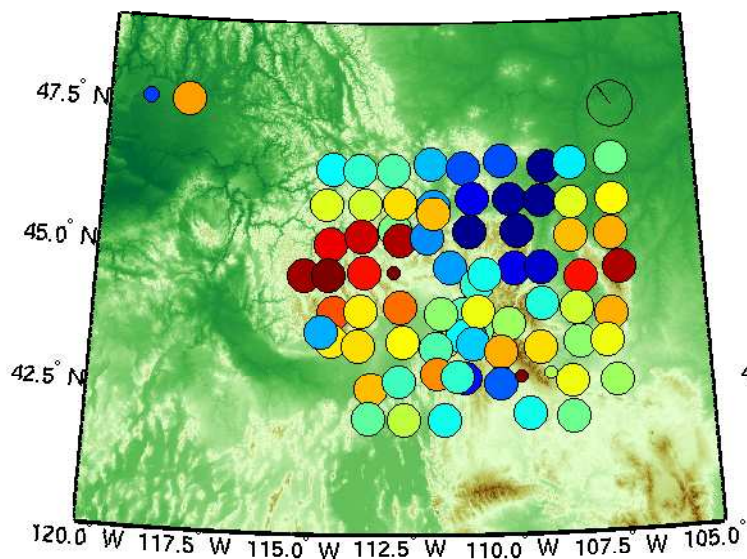
Stack



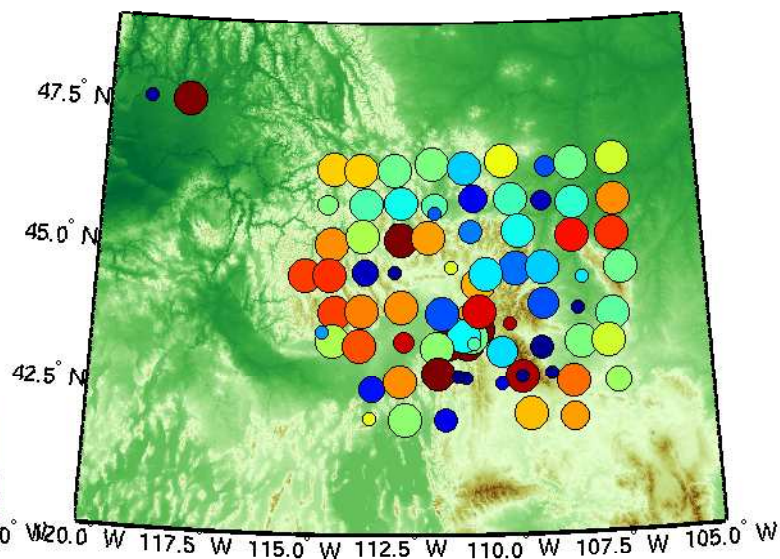
Baz = 147.1324  
Mean xcor value = 0.83447  
Range of t\* values is 2.276  
Median t\* err is 0.23115  
Slope = 0.16946 +/- 0.099196



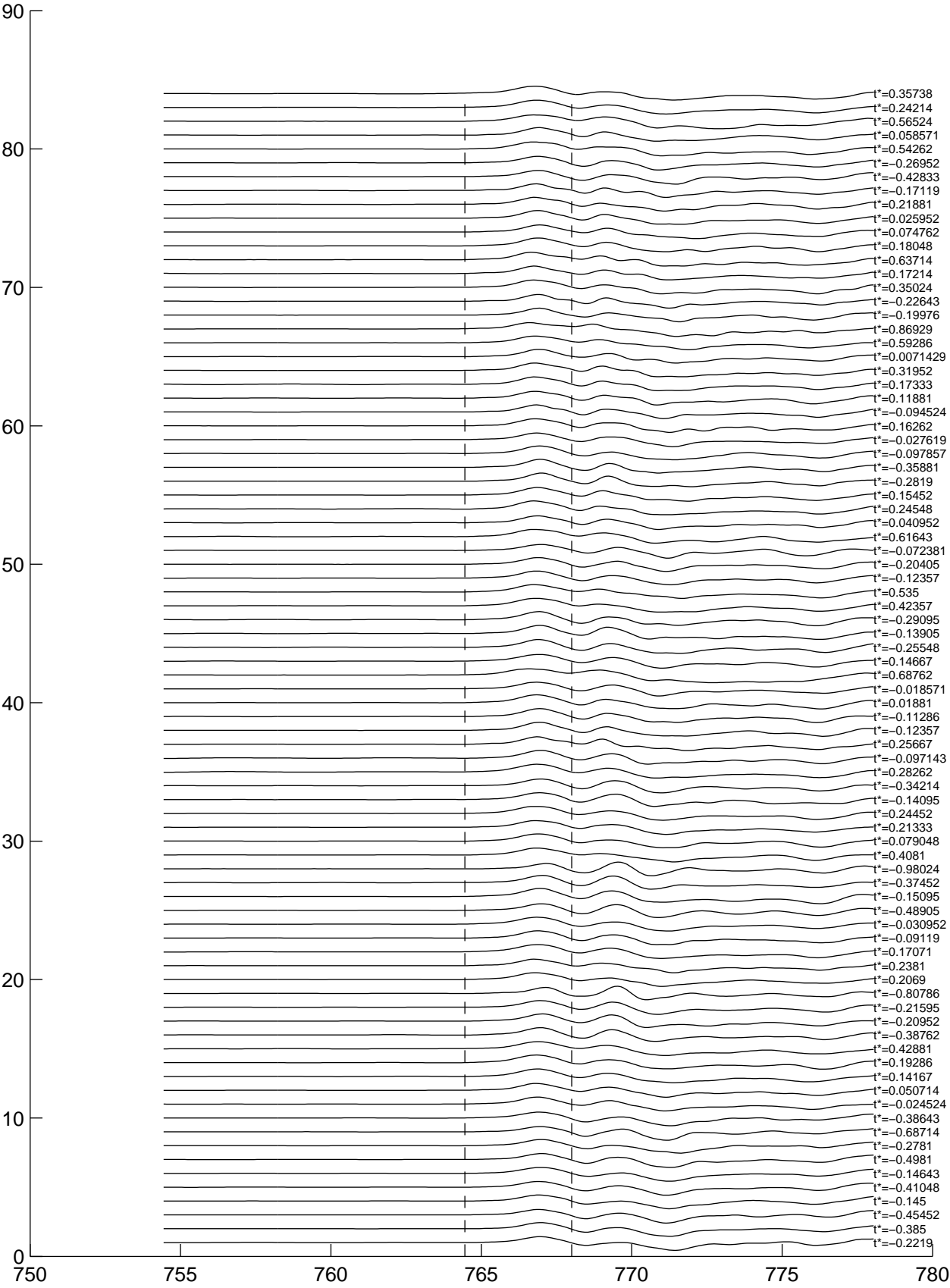
travel time residuals



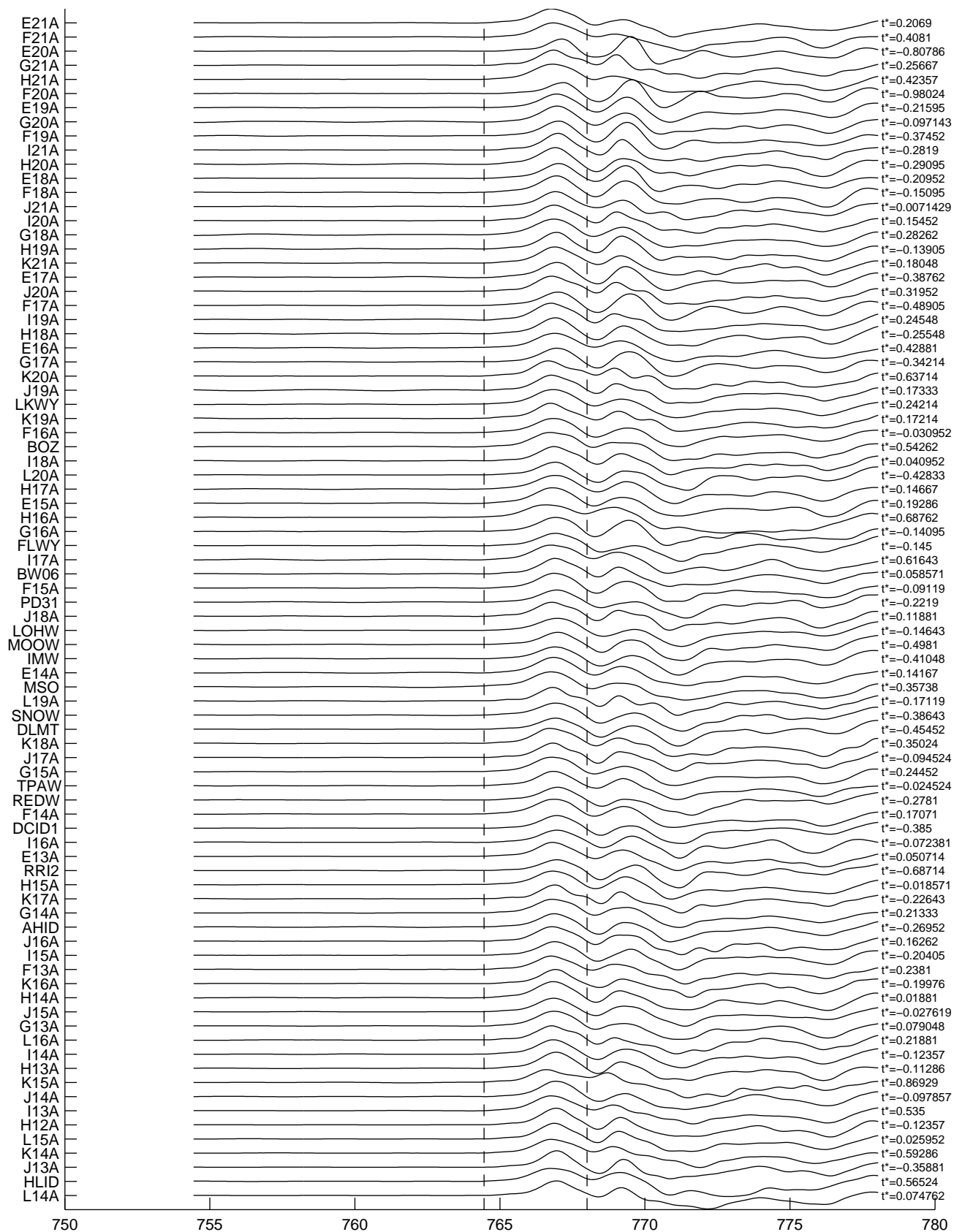
t\* values



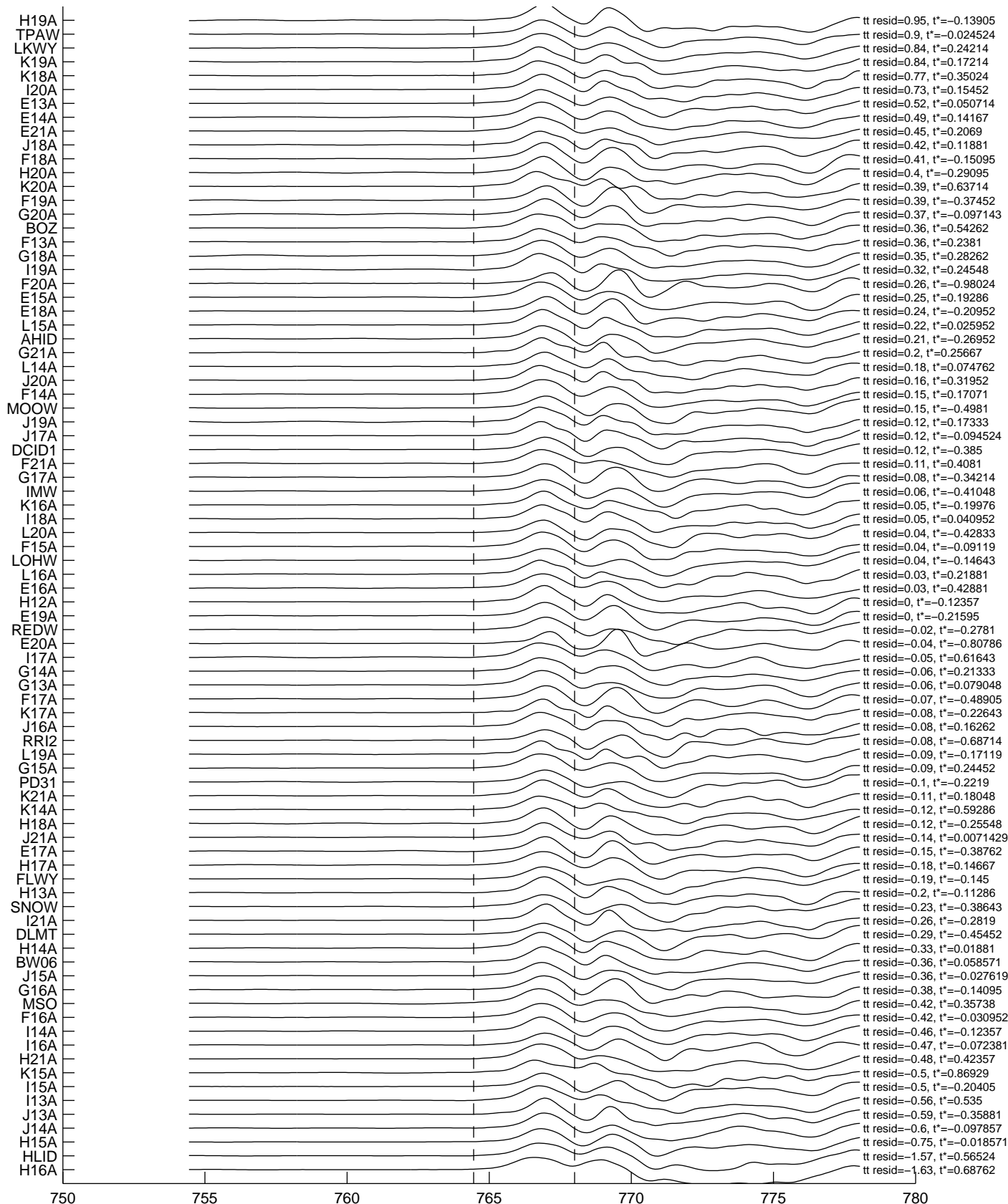
Event\_2008\_293\_05\_10\_33



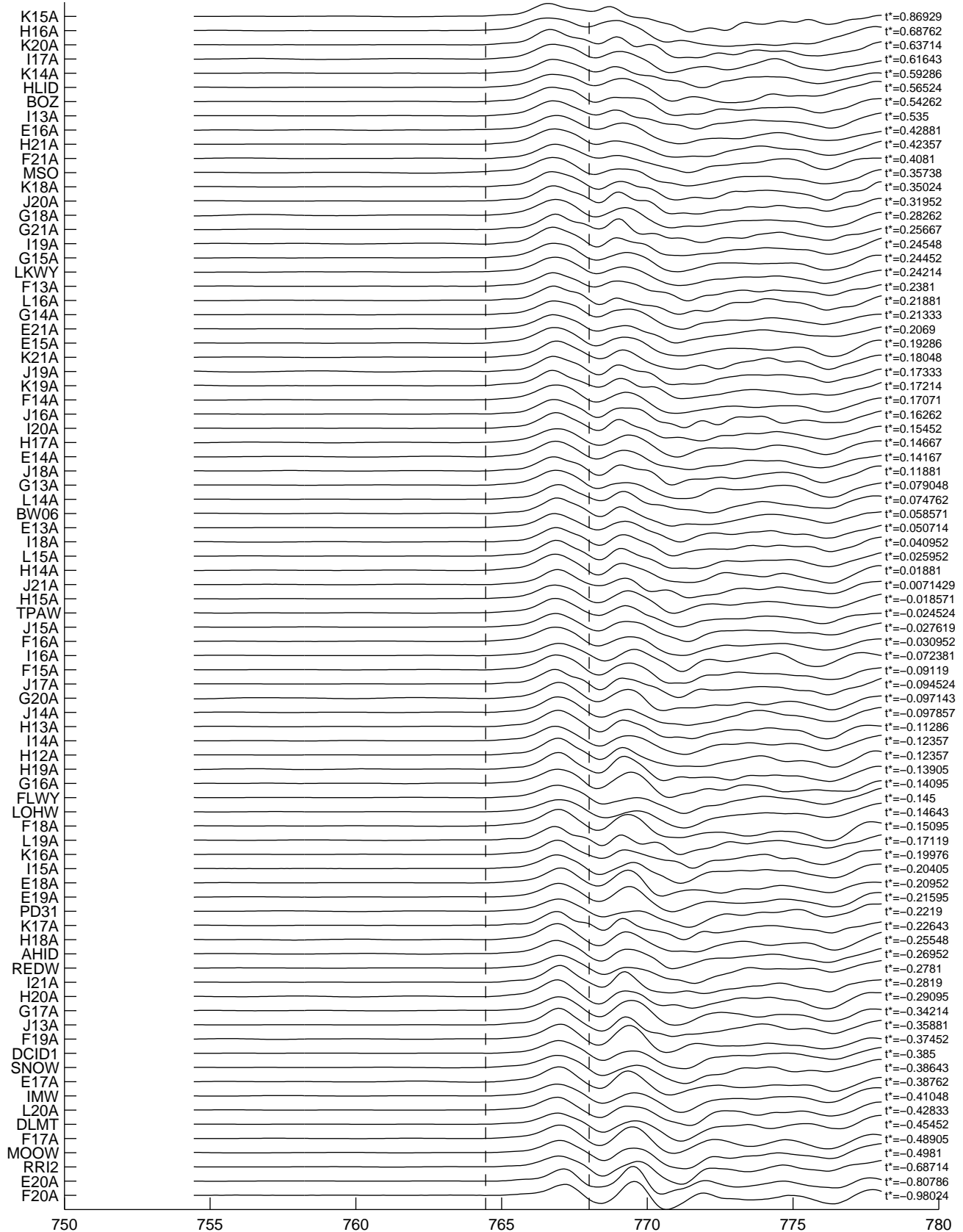
# Sorted by Delta:Event\_2008\_293\_05\_10\_33



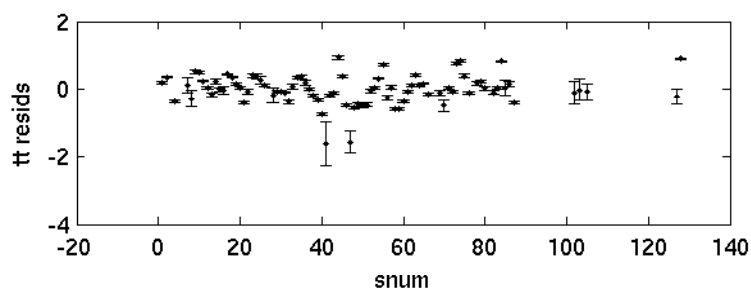
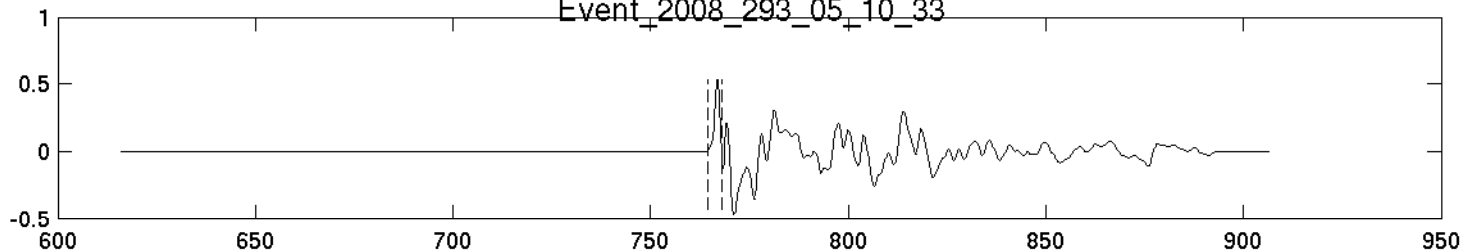
# Sorted by travel time:Event\_2008\_293\_05\_10\_33



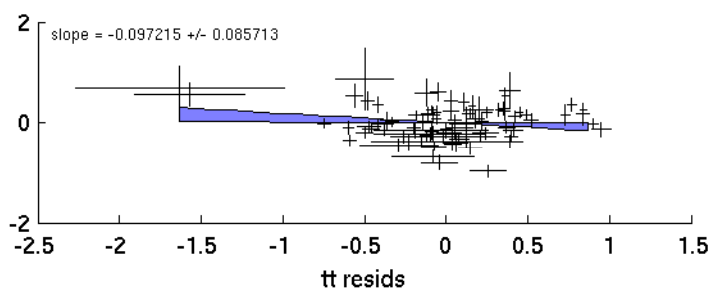
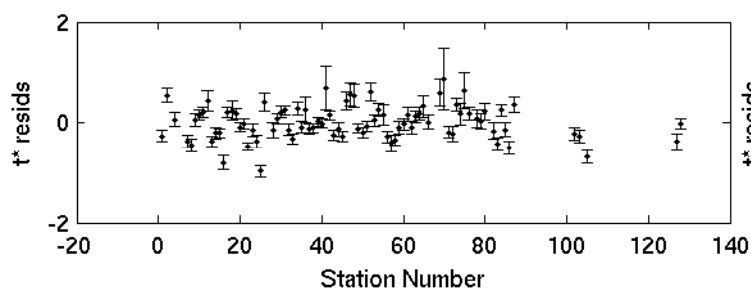
# Sorted by t\*:Event\_2008\_293\_05\_10\_33



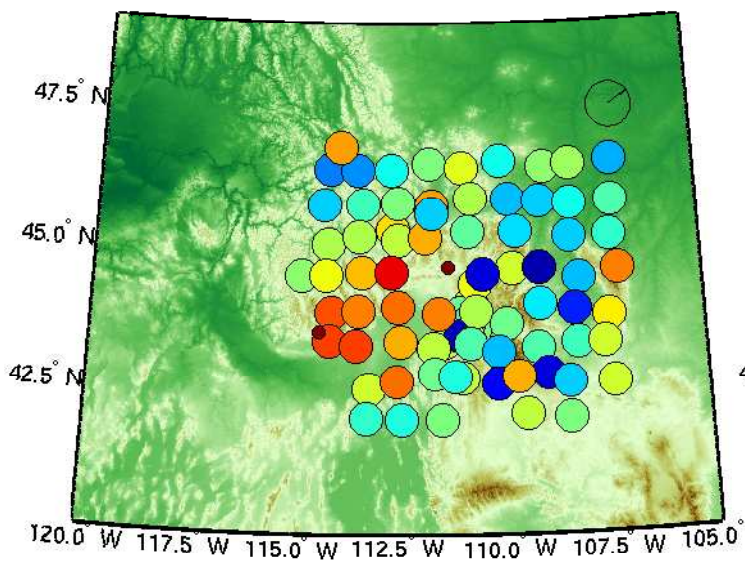
Stack  
Event\_2008\_293\_05\_10\_33



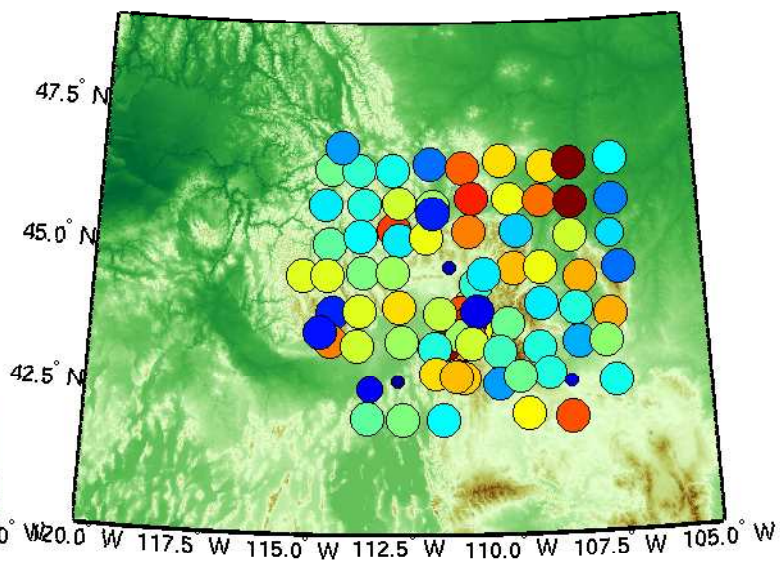
Baz = 235.8244  
Mean xcor value = 0.88429  
Range of t\* values is 1.8495  
Median t\* err is 0.12574  
Slope = -0.097215 +/- 0.085713



travel time residuals

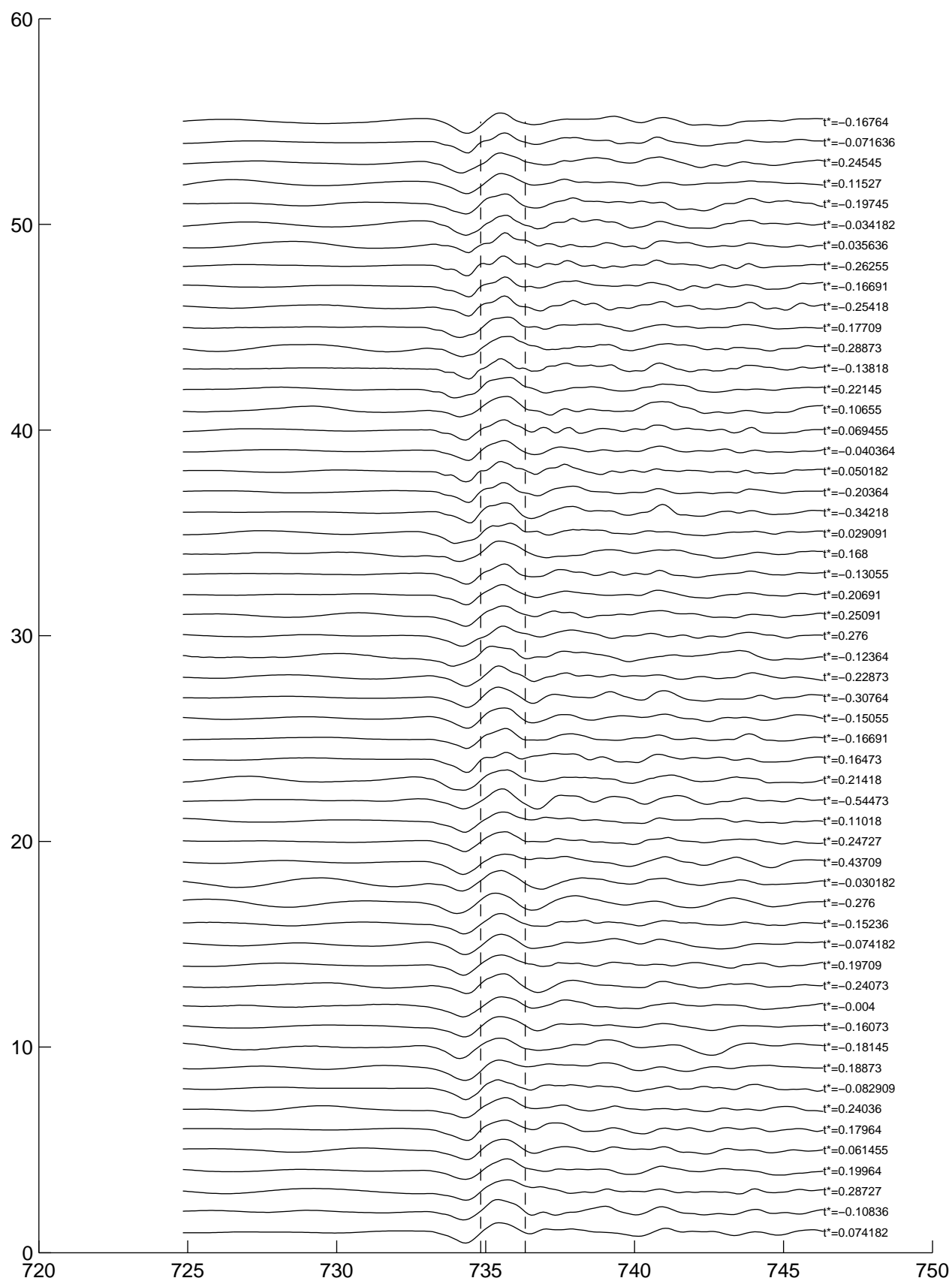


t\* values



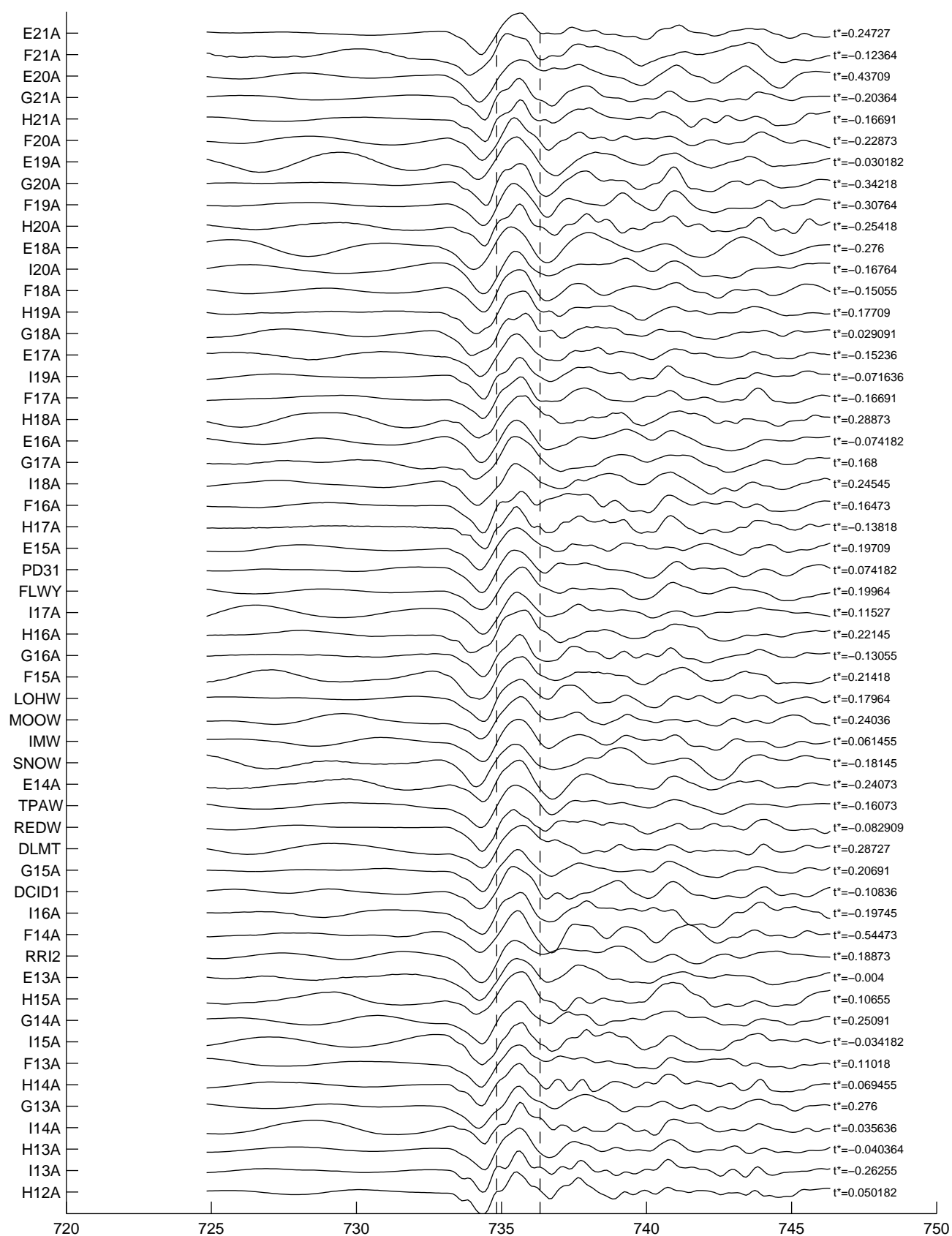


# Event\_2008\_296\_12\_55\_57

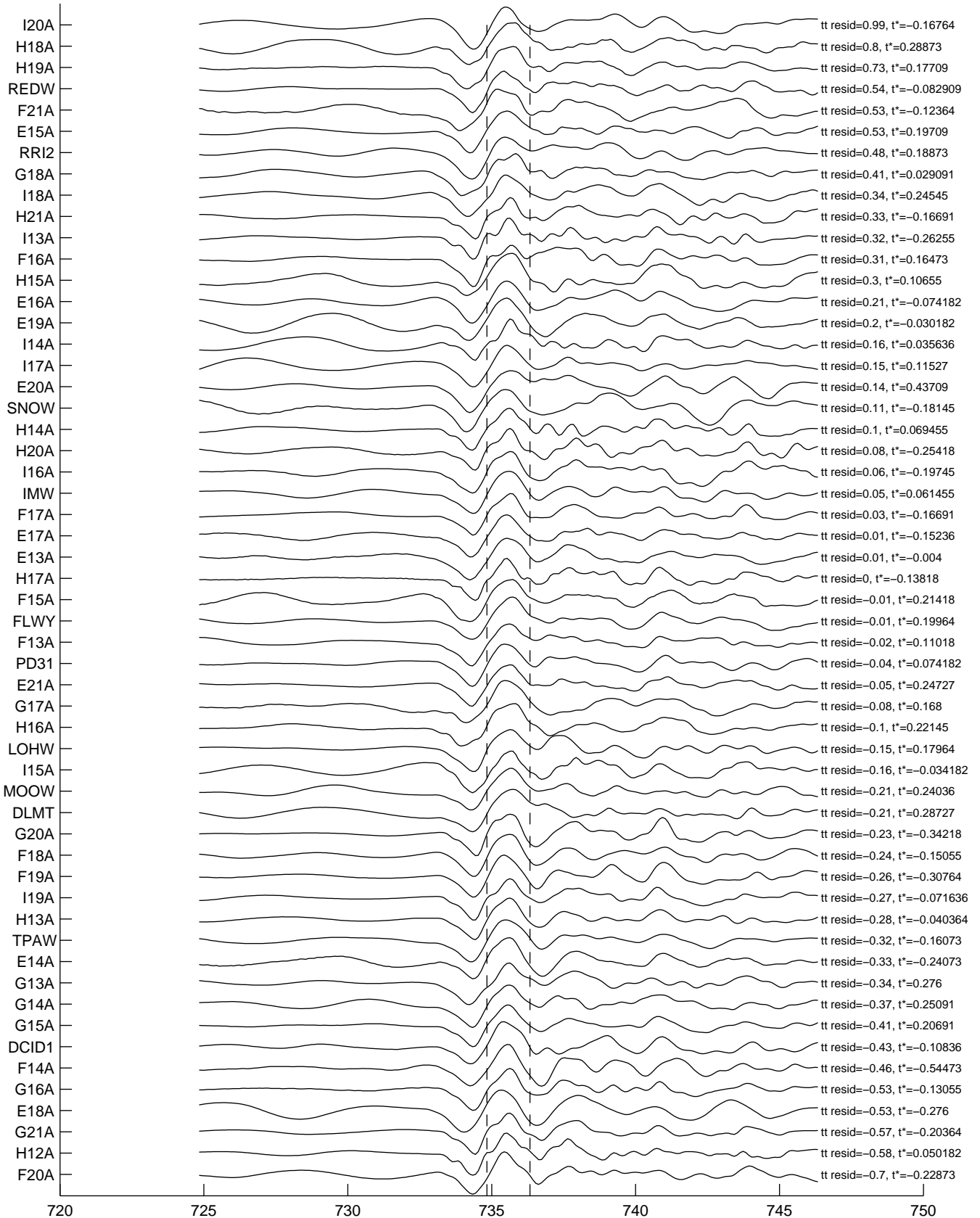




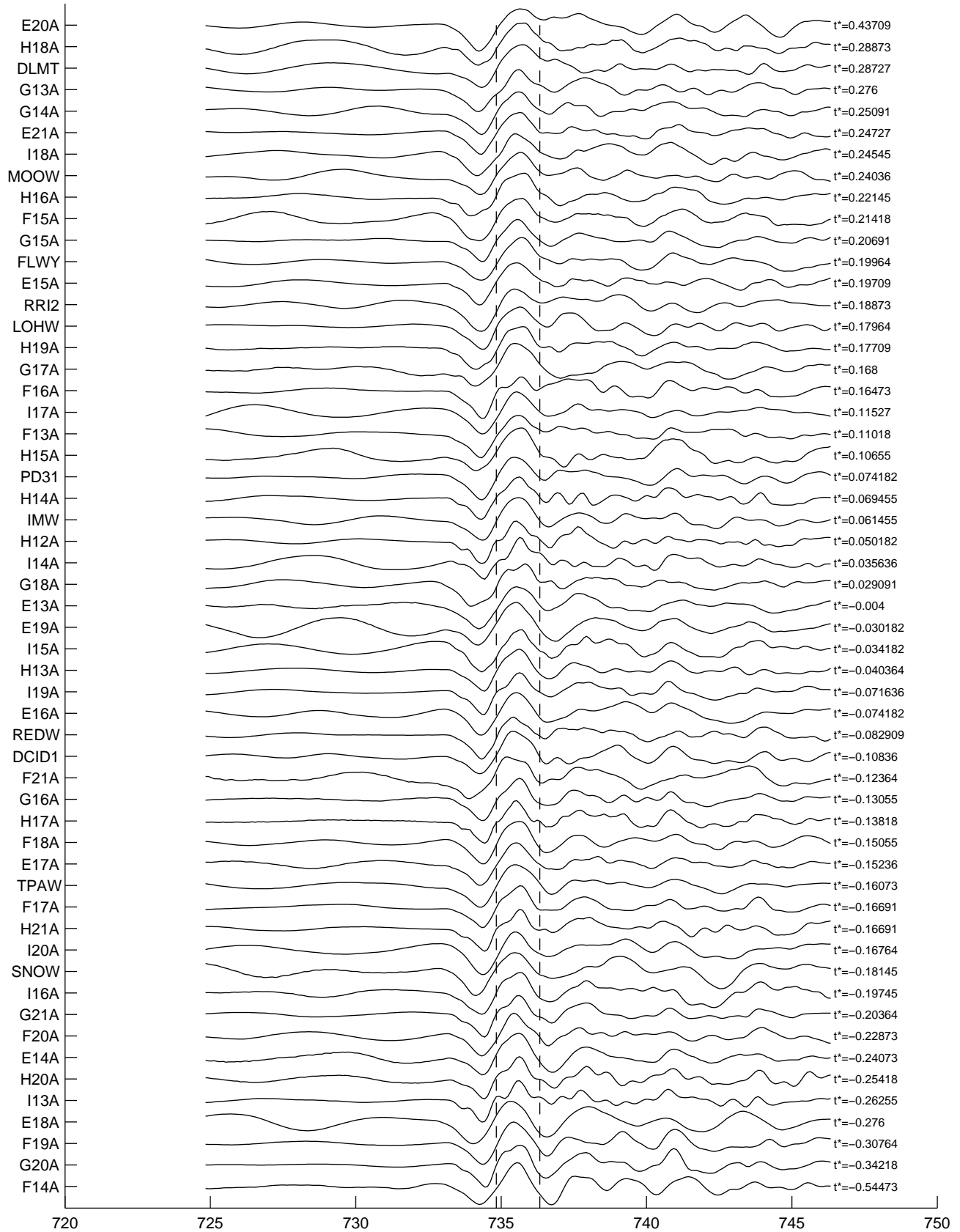
# Sorted by Delta:Event\_2008\_296\_12\_55\_57



# Sorted by travel time:Event\_2008\_296\_12\_55\_57

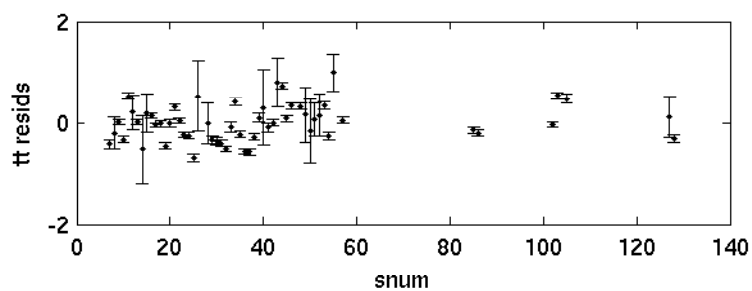
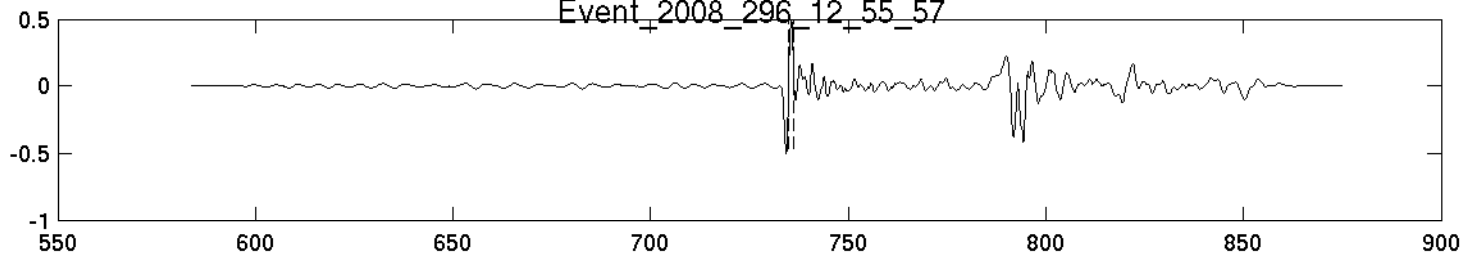


# Sorted by t\*:Event\_2008\_296\_12\_55\_57

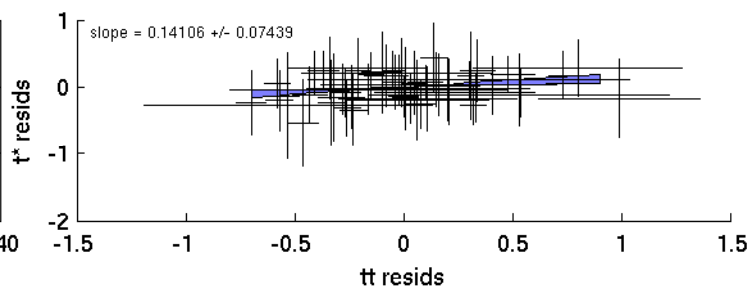
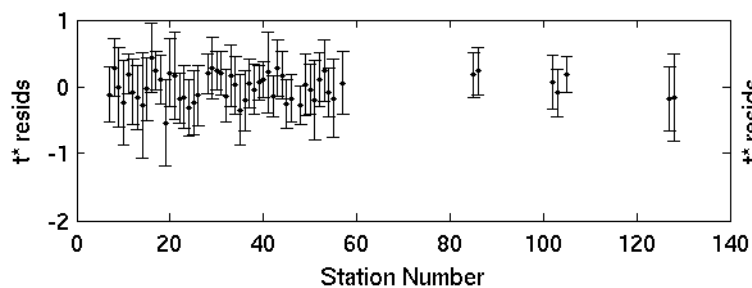


Event\_2008\_296\_12\_55\_57

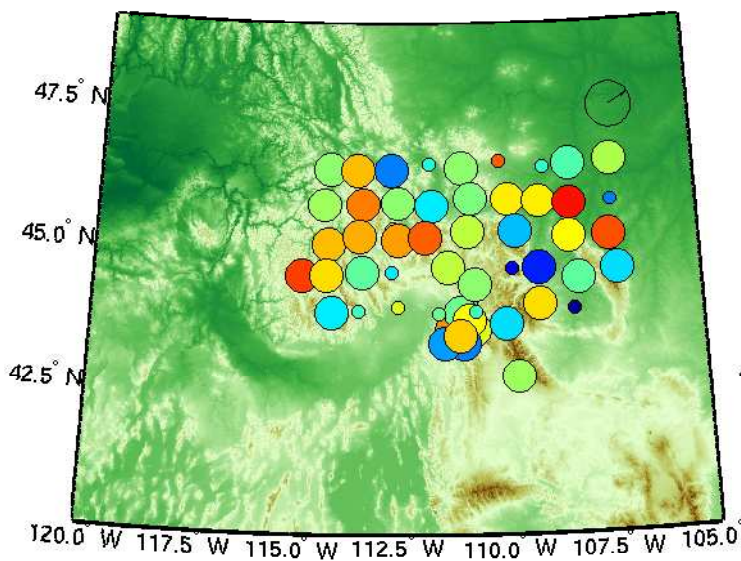
Stack



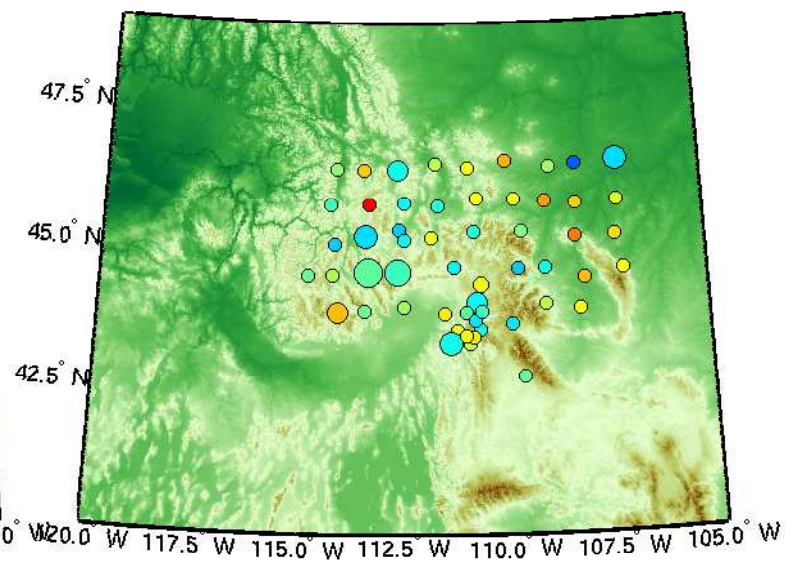
Baz = 239.1475  
Mean xcor value = 0.66255  
Range of  $t^*$  values is 0.98182  
Median  $t^*$  err is 0.42218  
Slope = 0.14106 +/- 0.07439



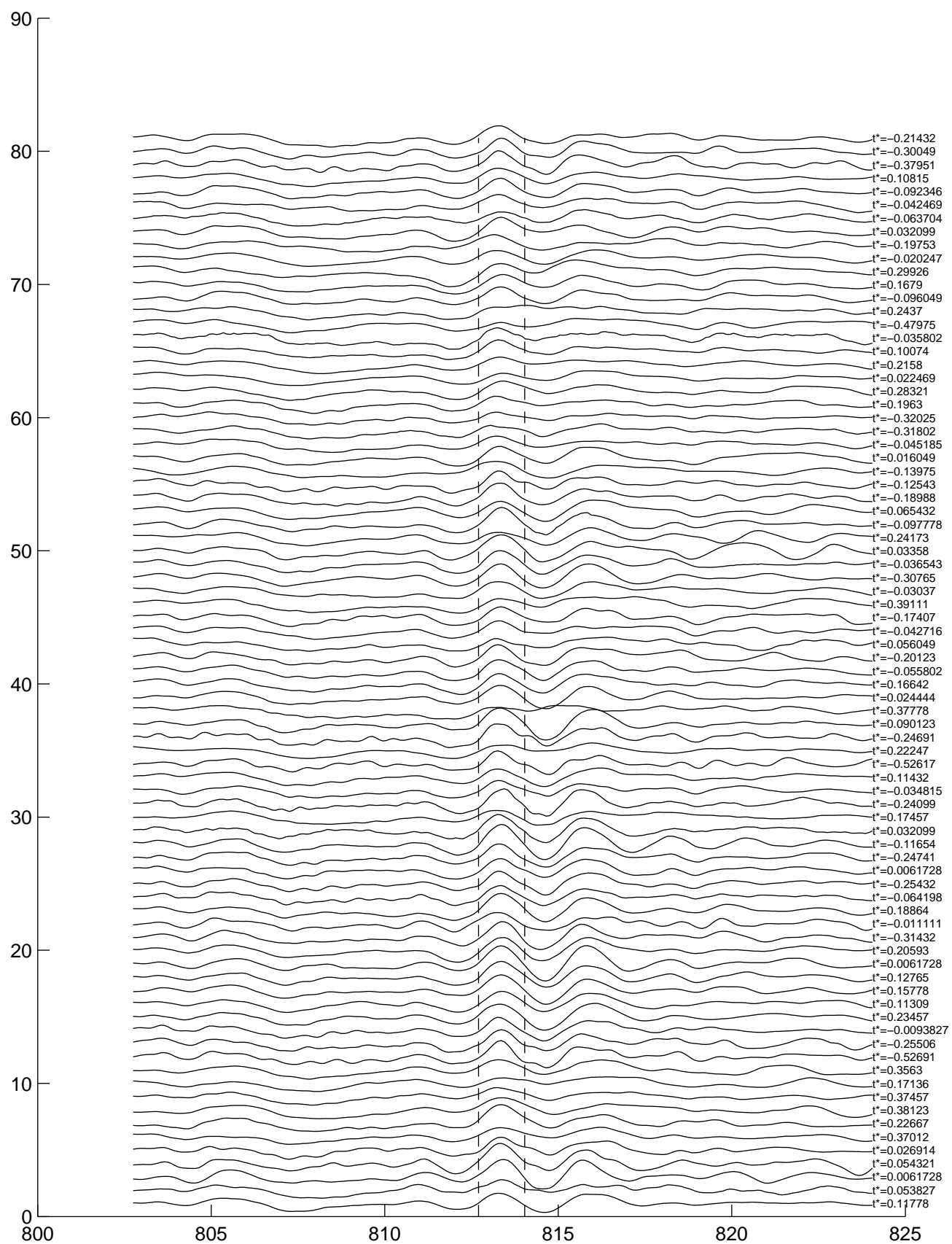
travel time residuals



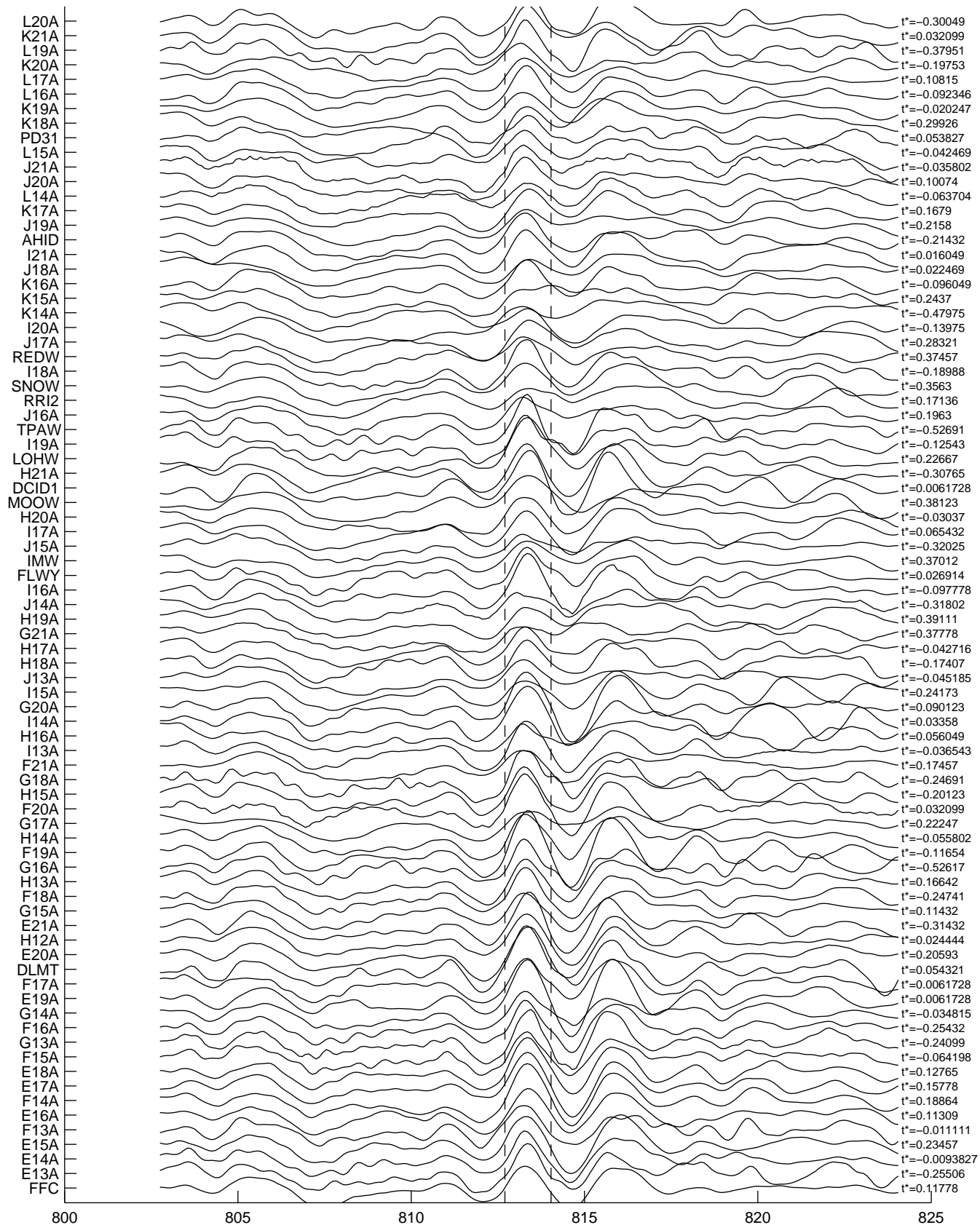
$t^*$  values



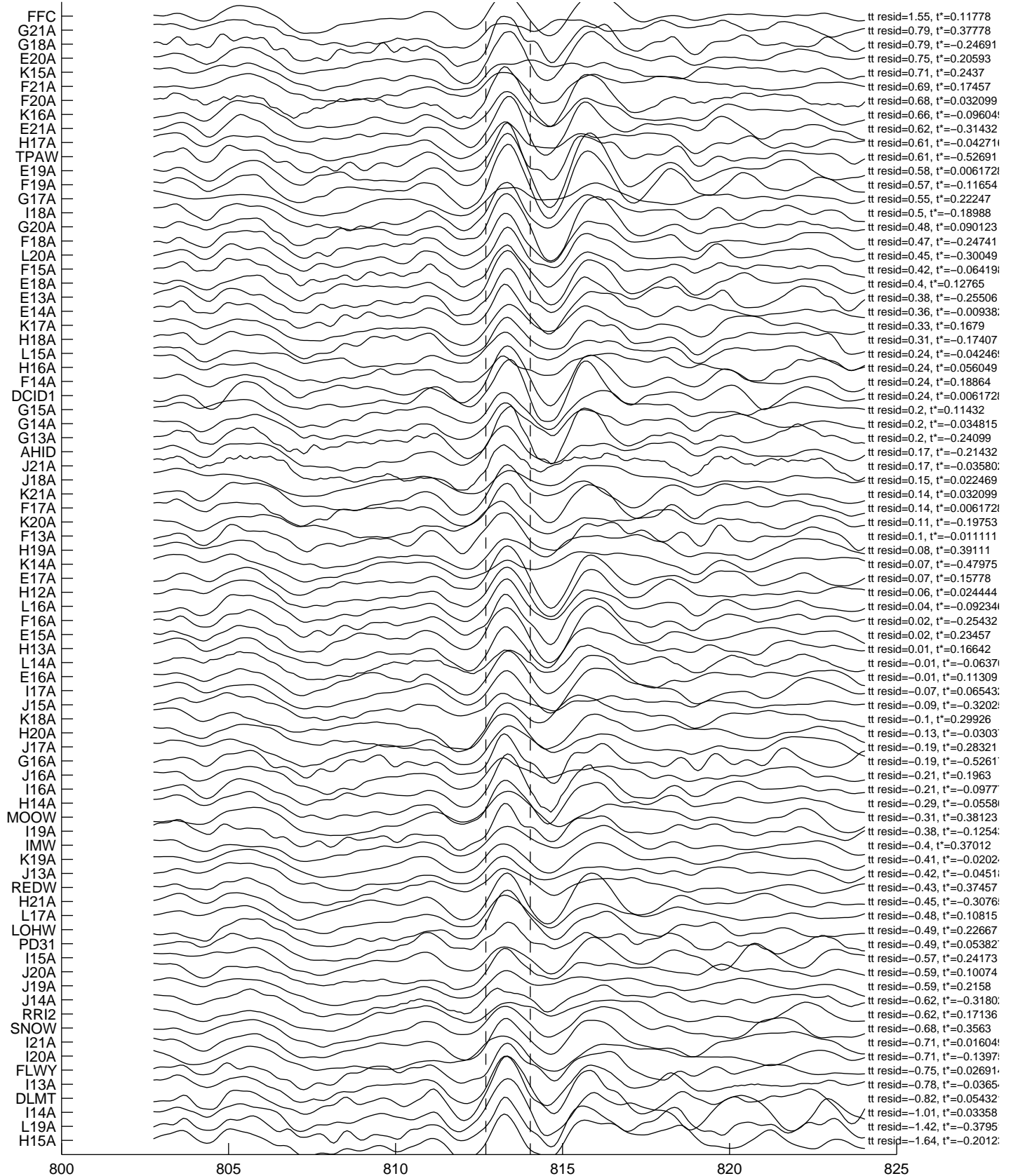
# Event\_2008\_315\_01\_22\_02



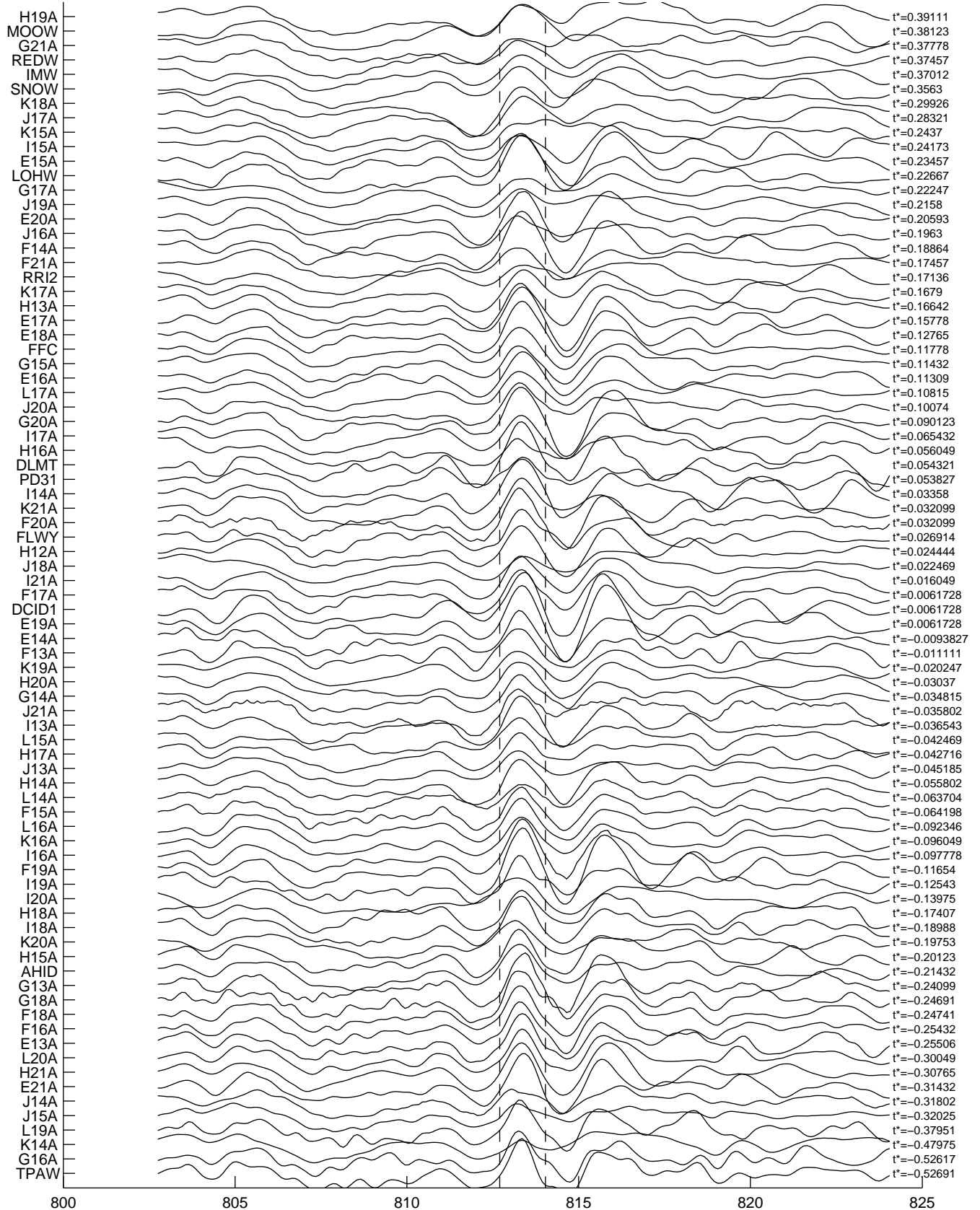
# Sorted by Delta:Event\_2008\_315\_01\_22\_02



# Sorted by travel time:Event\_2008\_315\_01\_22\_02

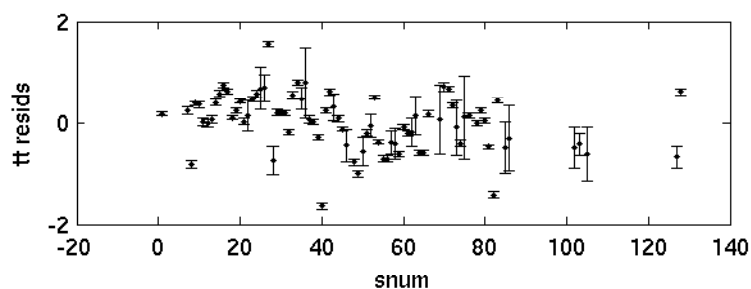
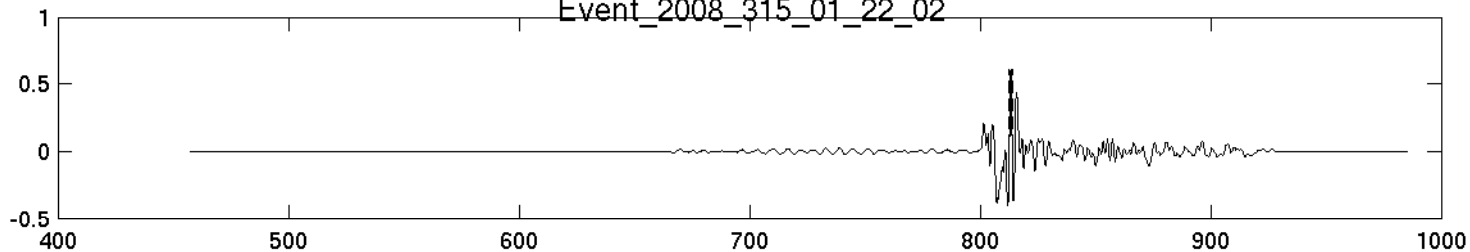


Sorted by t\*:Event\_2008\_315\_01\_22\_02

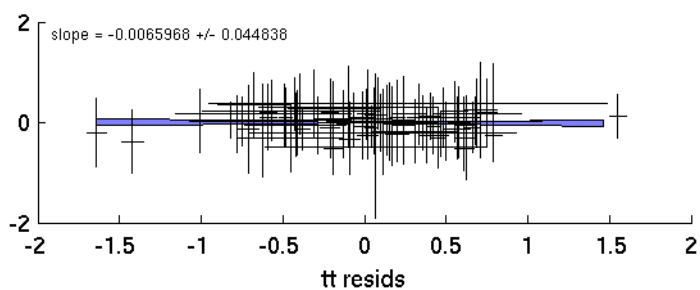
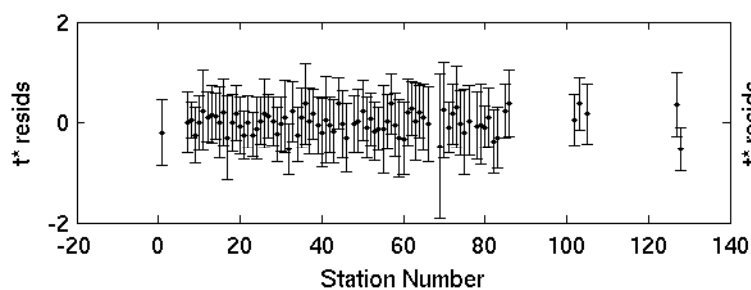




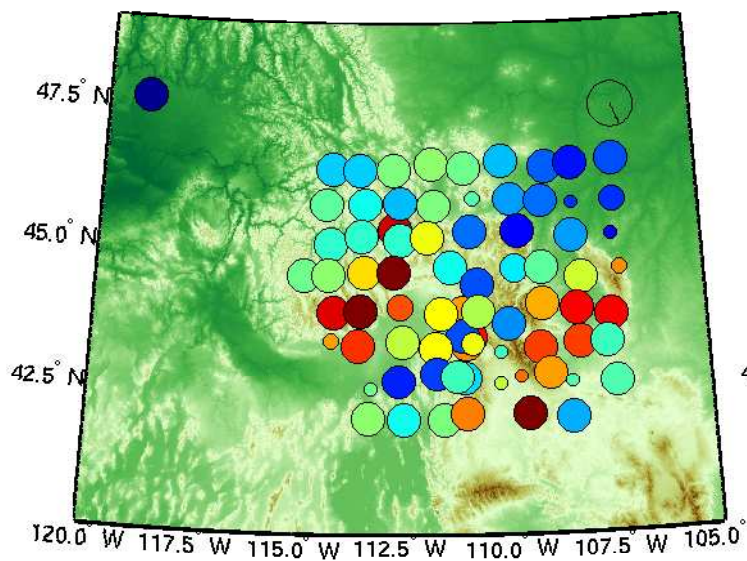
# Stack Event\_2008\_315\_01\_22\_02



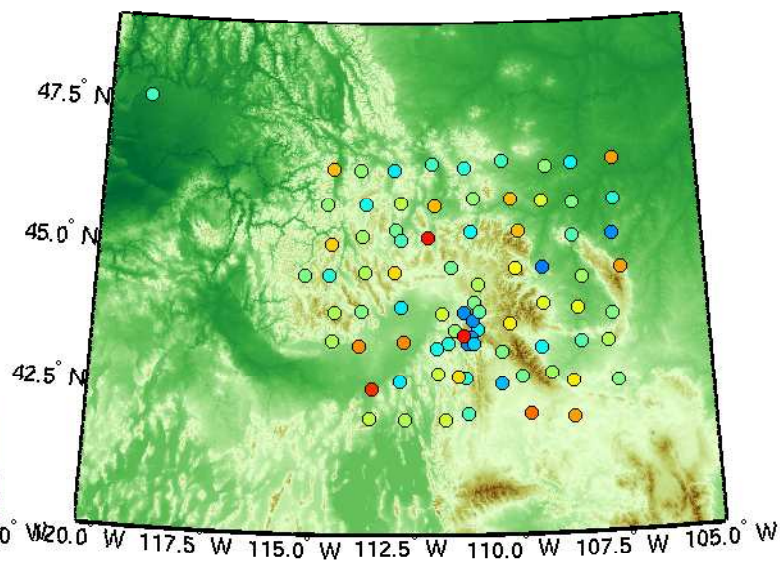
Baz = 339.1511  
Mean xcor value = 0.74321  
Range of  $t^*$  values is 0.91802  
Median  $t^*$  err is 0.59981  
Slope = -0.0065968 +/- 0.044838



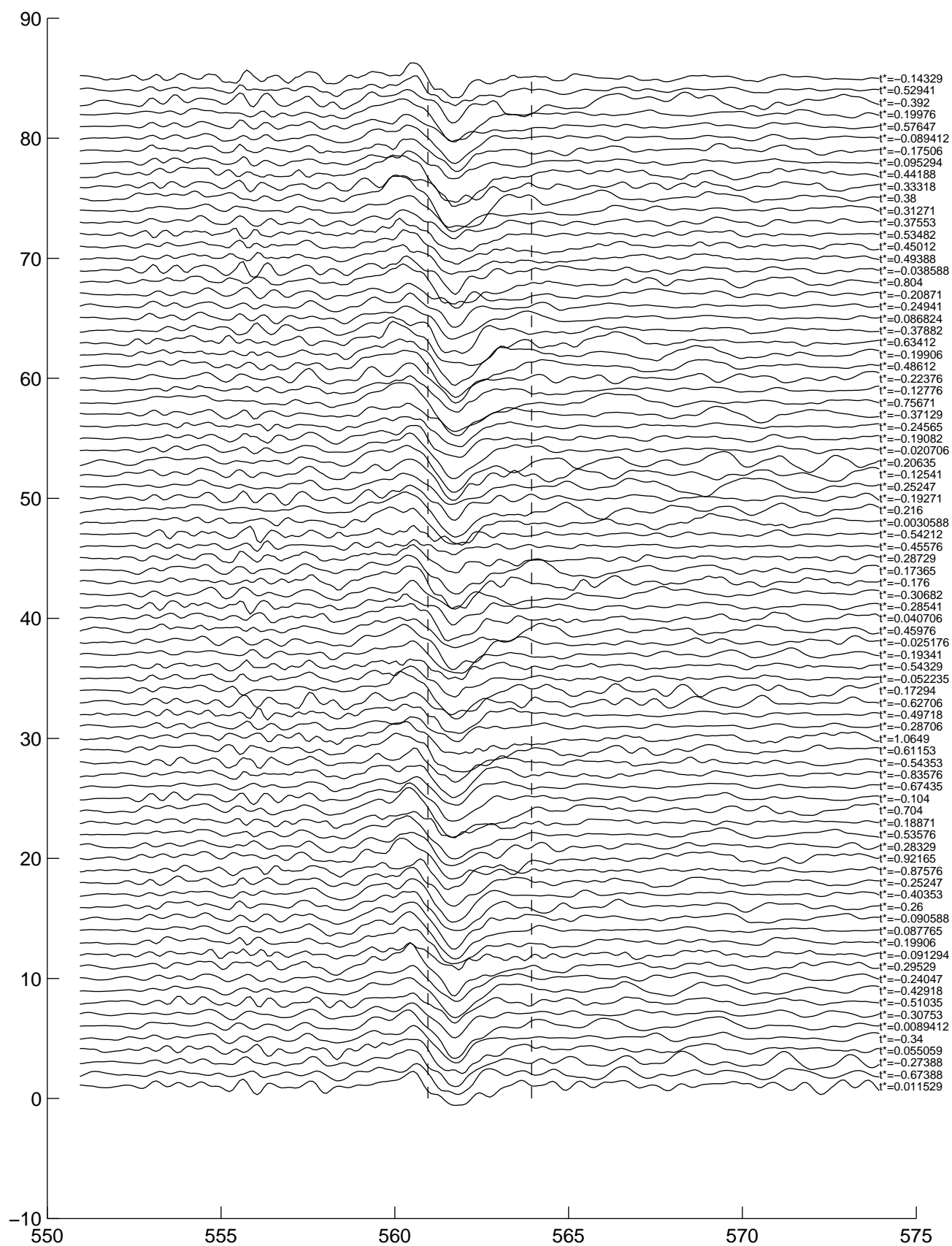
travel time residuals



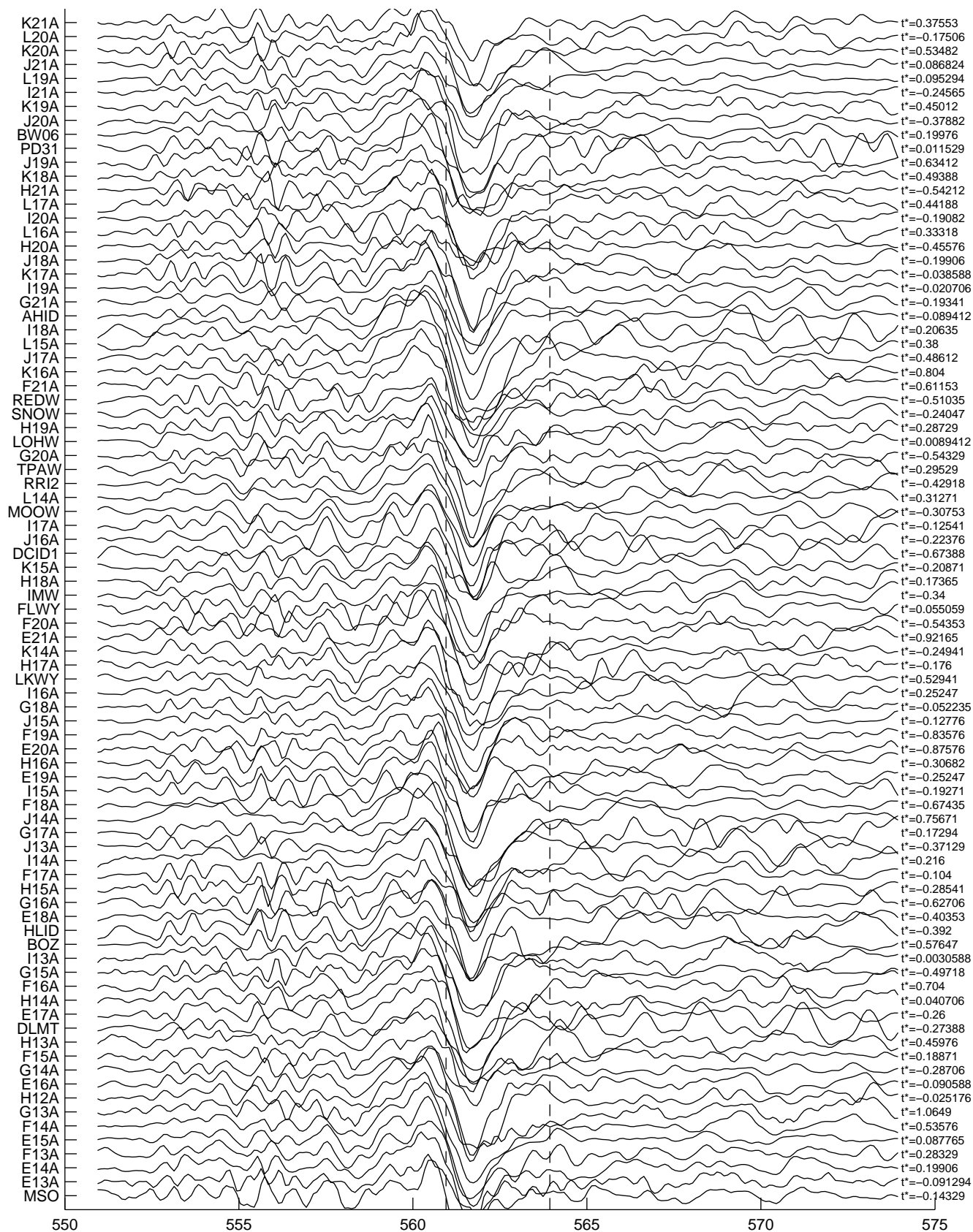
$t^*$  values



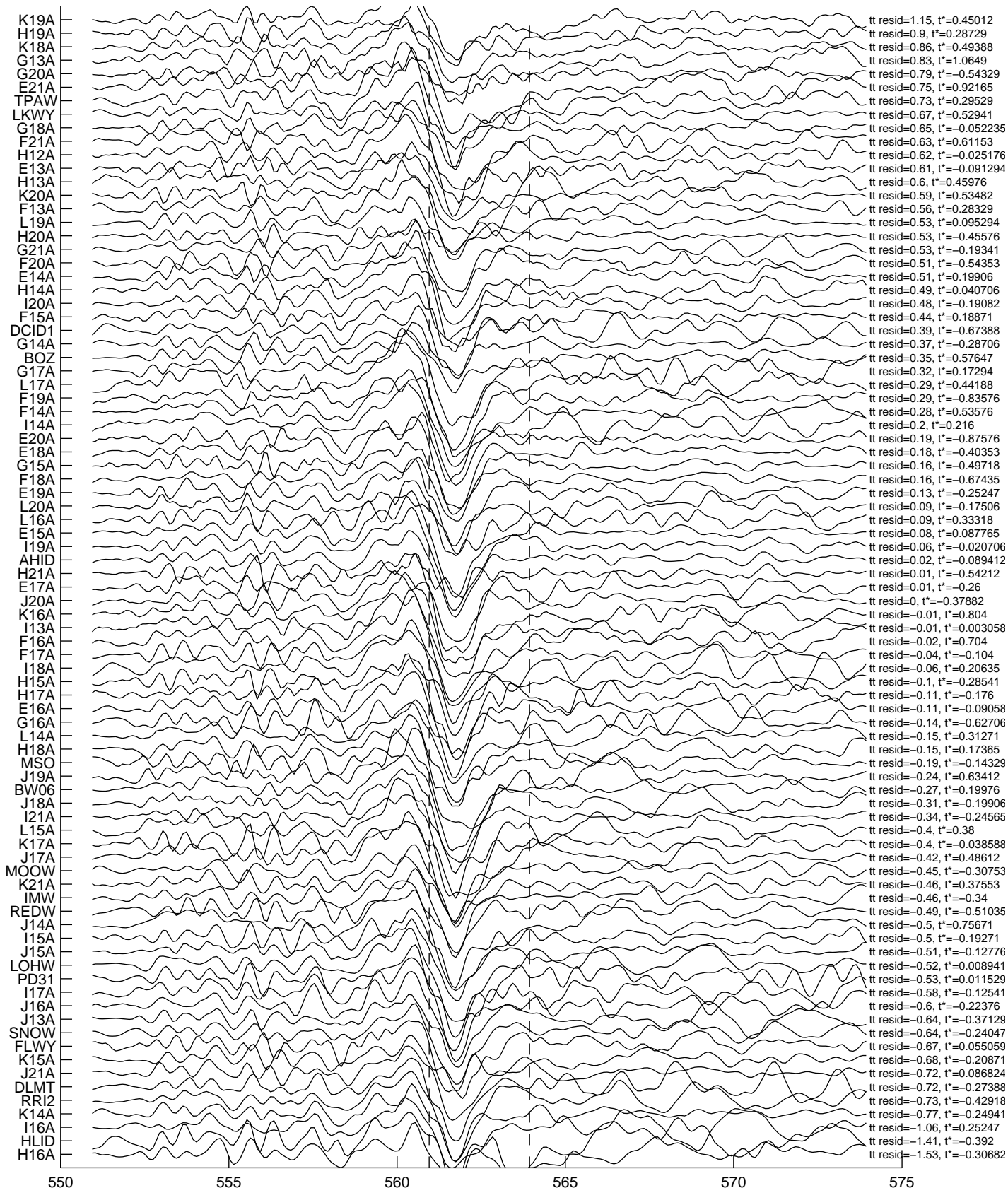
# Event\_2008\_329\_09\_02\_58



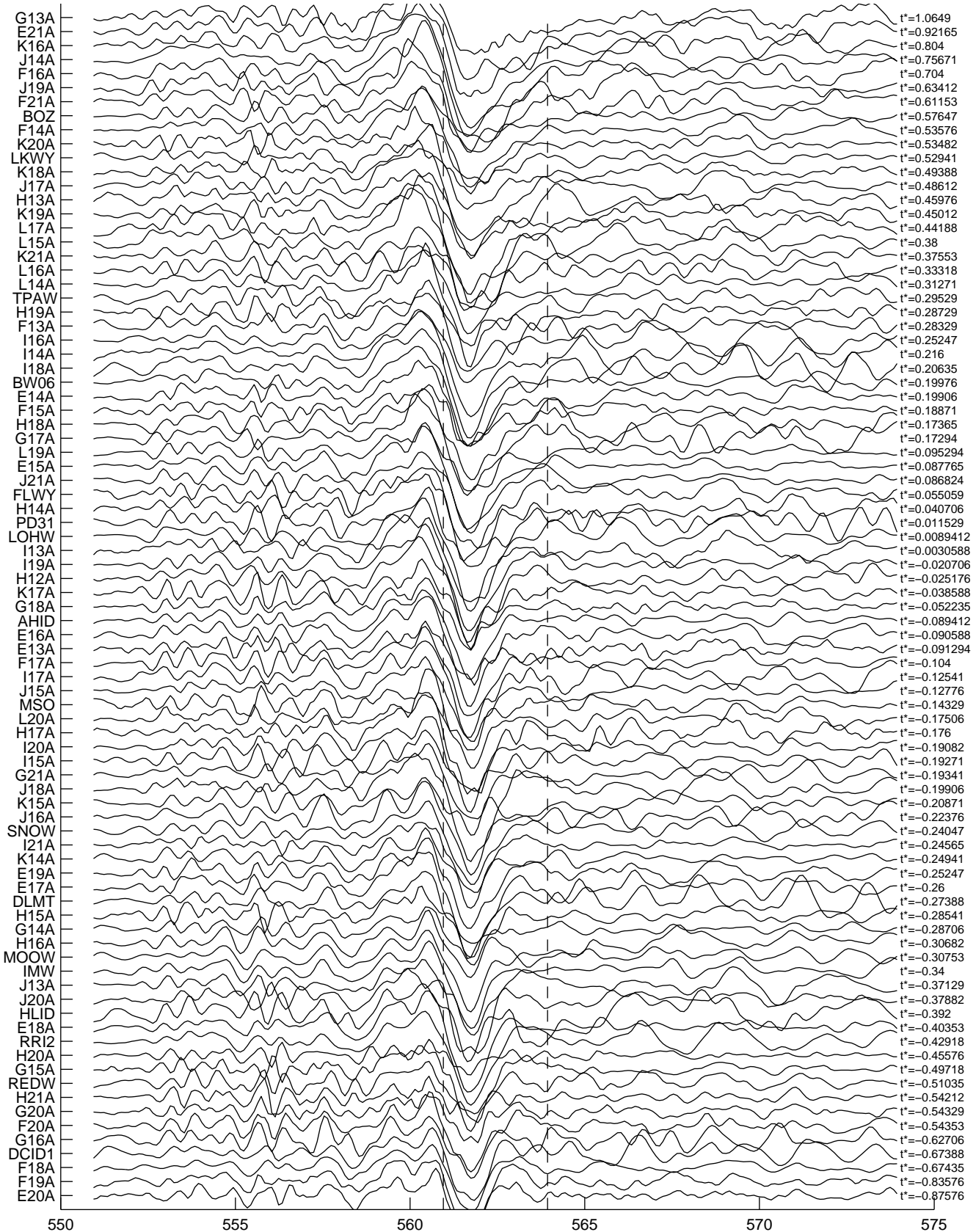
# Sorted by Delta:Event\_2008\_329\_09\_02\_58



# Sorted by travel time:Event\_2008\_329\_09\_02\_58

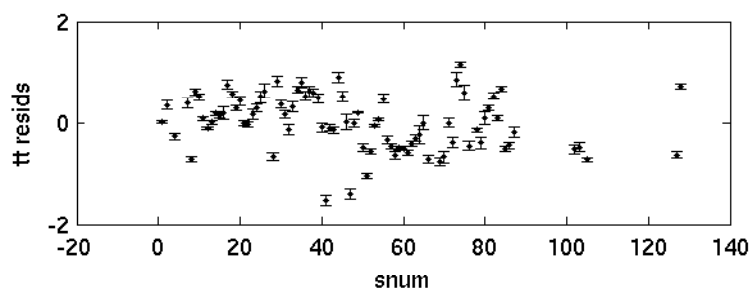
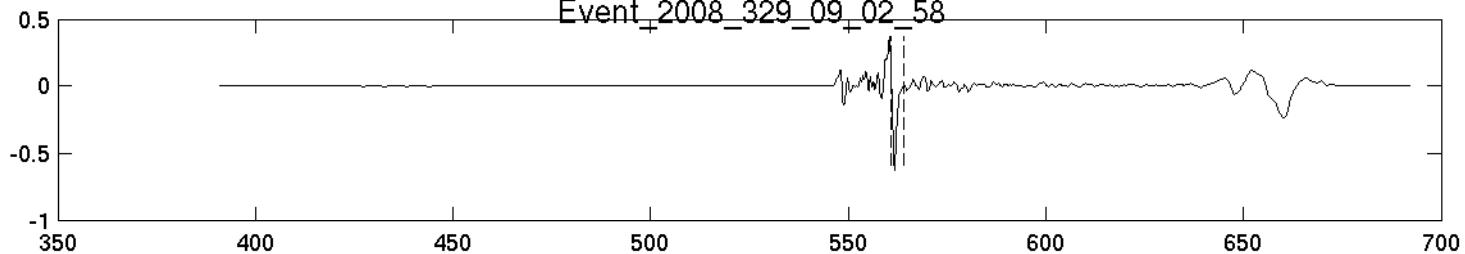


# Sorted by t\*:Event\_2008\_329\_09\_02\_58

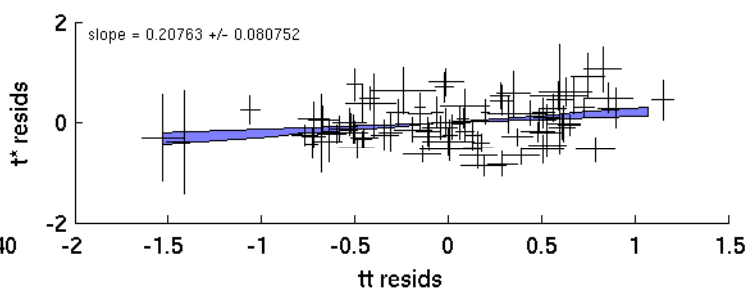
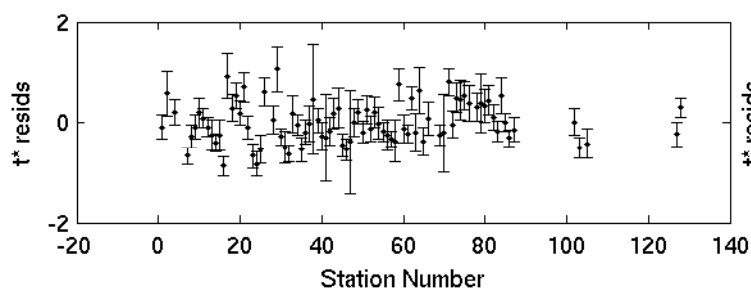




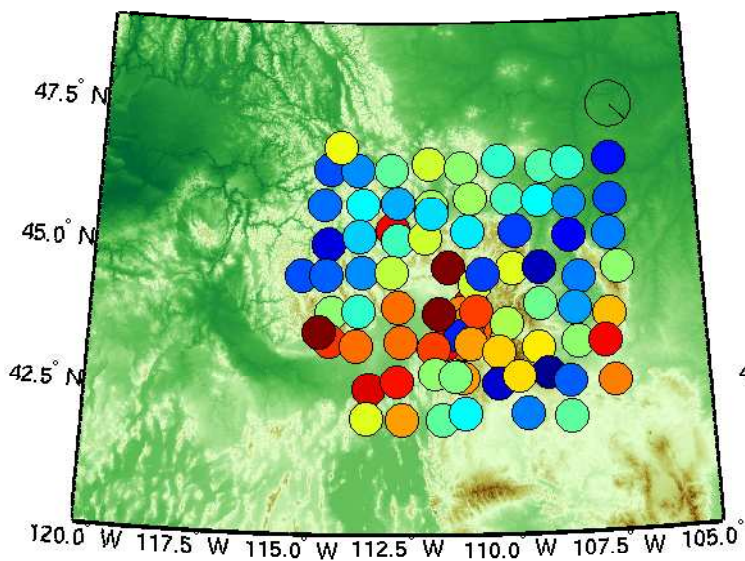
Stack  
Event\_2008\_329\_09\_02\_58



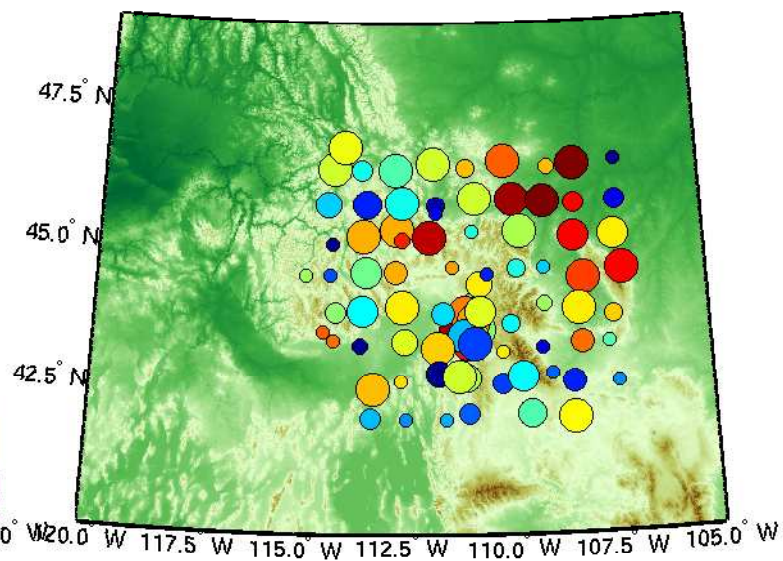
Baz = 316.5243  
Mean xcor value = 0.81541  
Range of  $t^*$  values is 1.9407  
Median  $t^*$  err is 0.27035  
Slope = 0.20763 +/- 0.080752



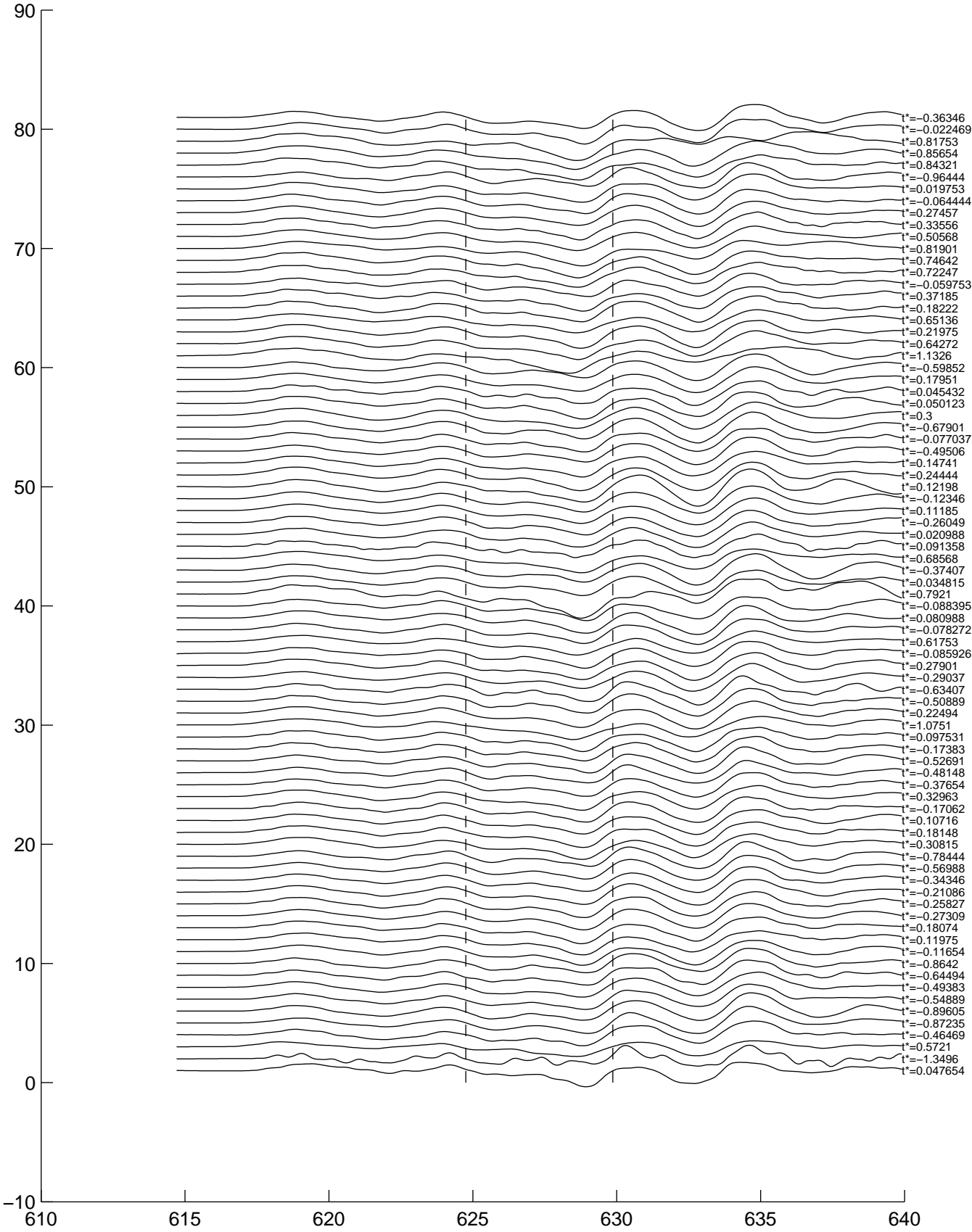
travel time residuals



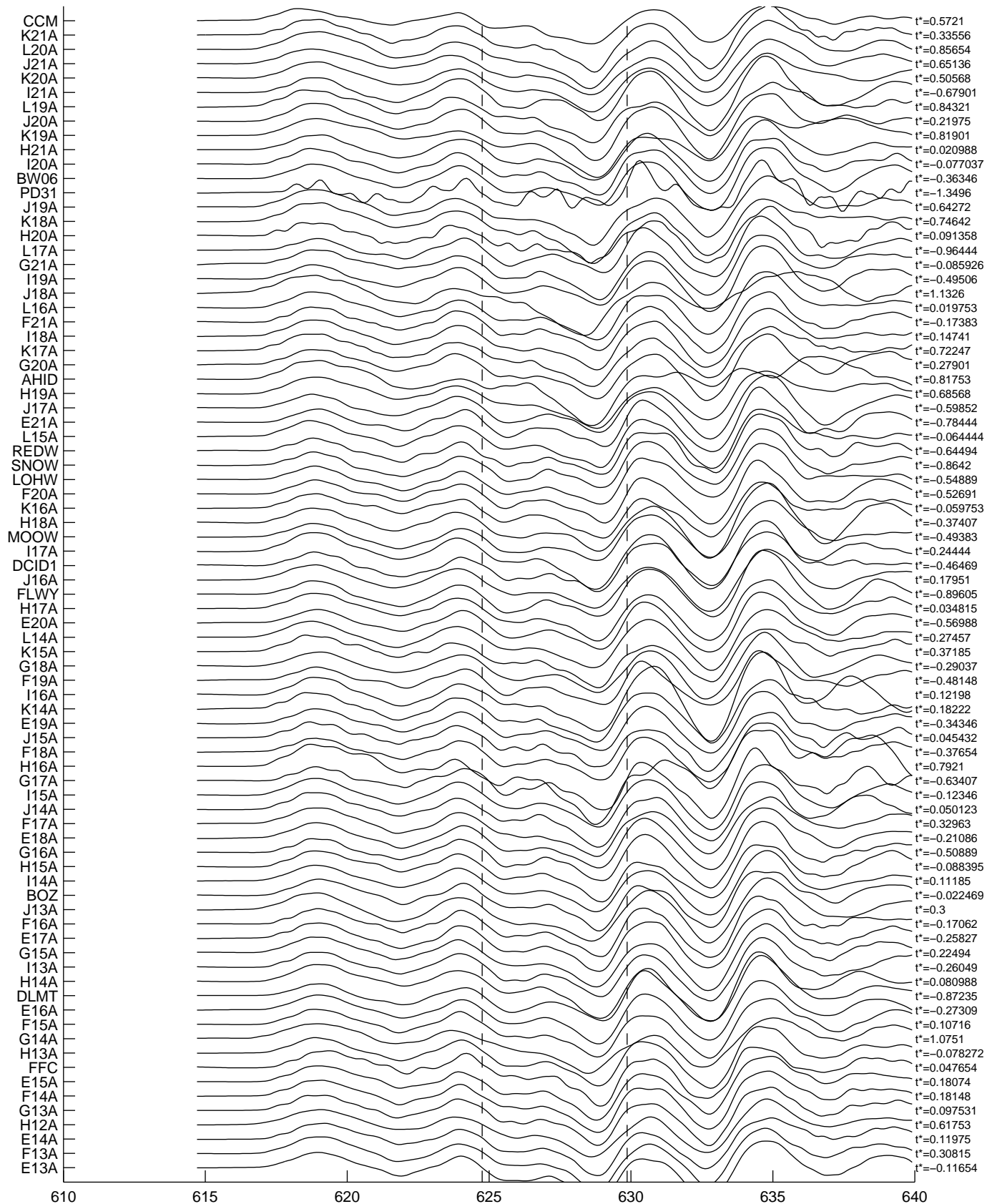
$t^*$  values



Event\_2009\_015\_17\_49\_39

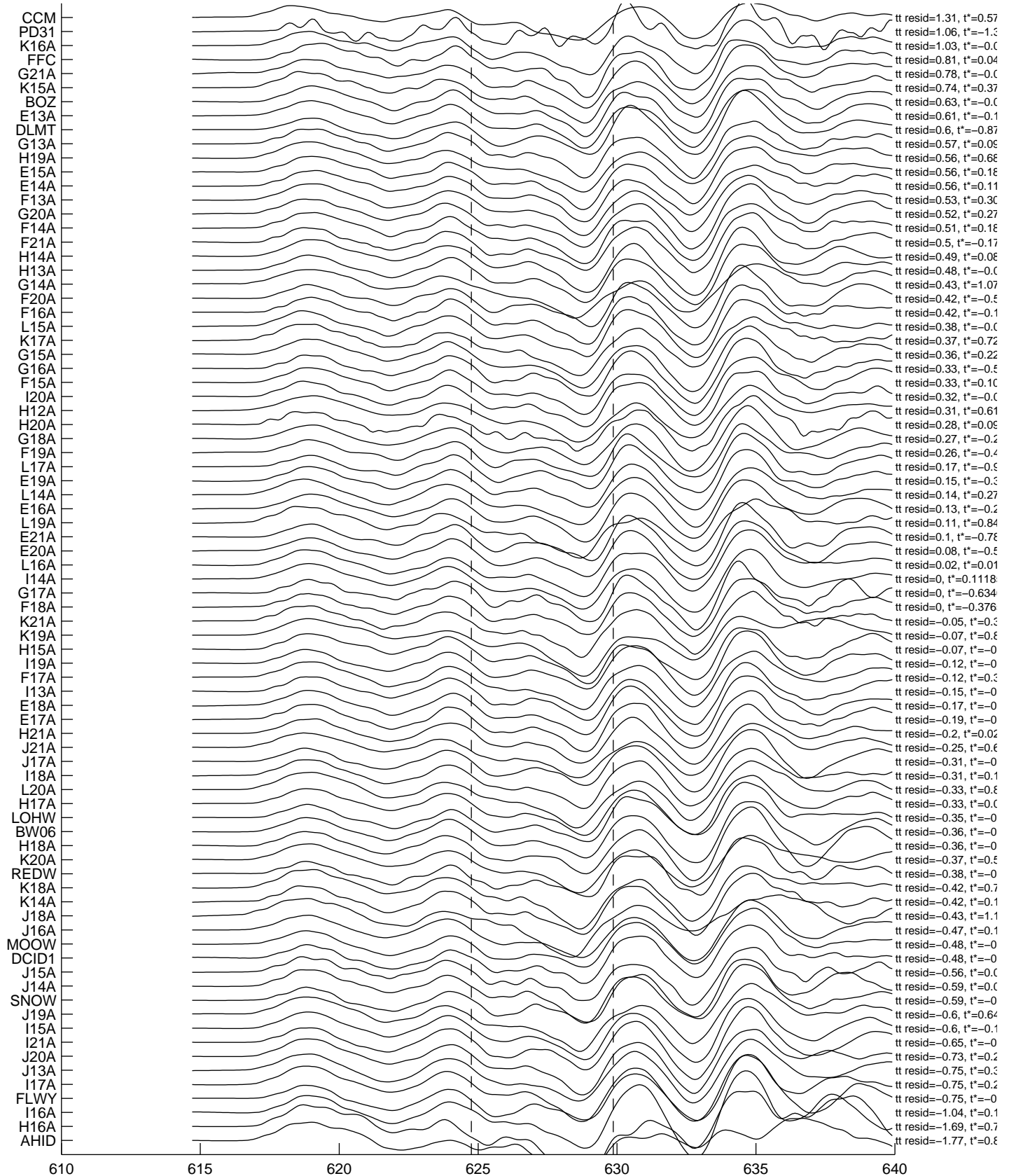


# Sorted by Delta:Event\_2009\_015\_17\_49\_39

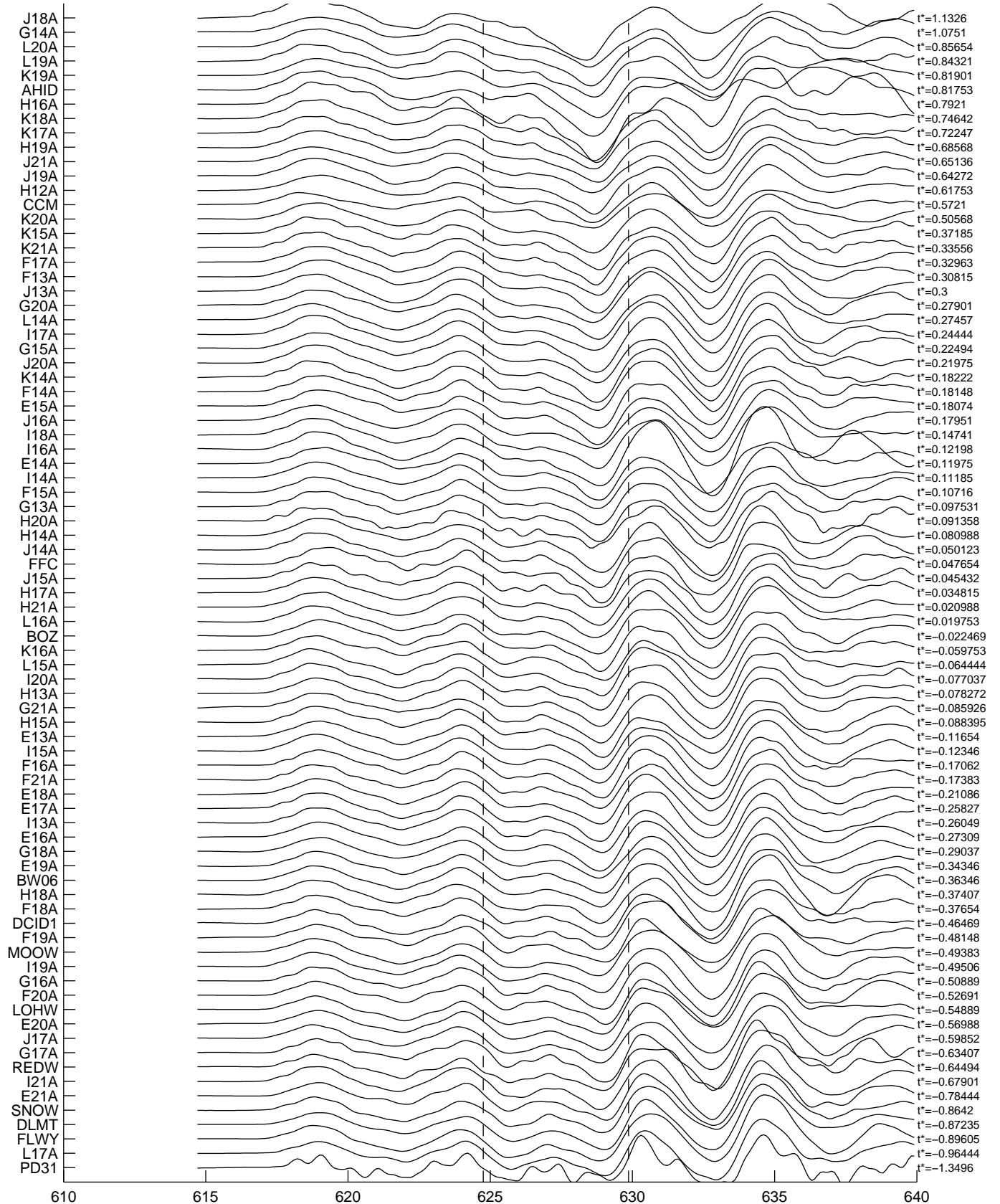




# Sorted by travel time:Event\_2009\_015\_17\_49\_39

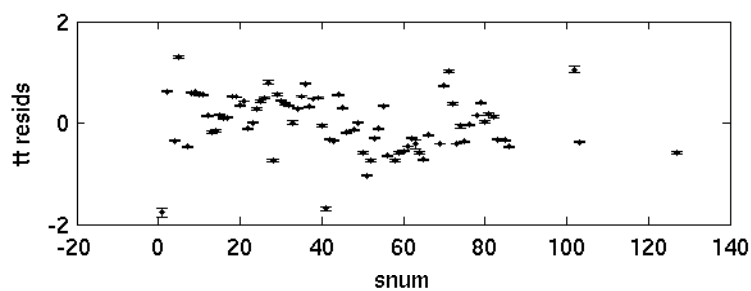
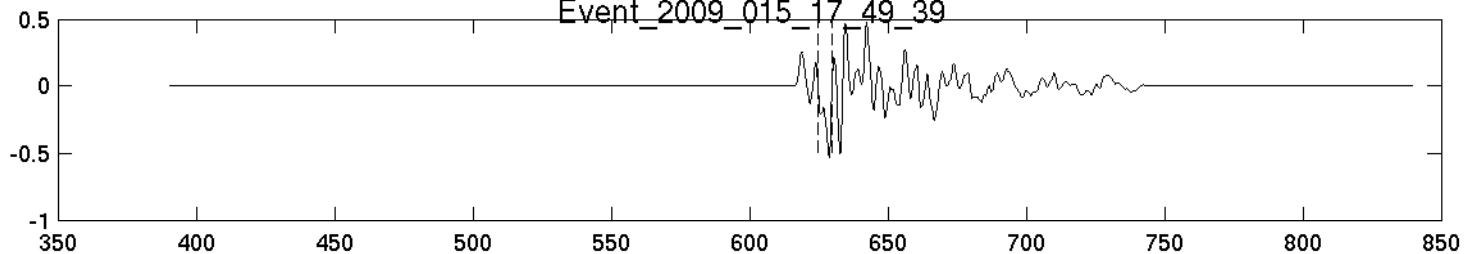


Sorted by  $t^*$ :Event\_2009\_015\_17\_49\_39

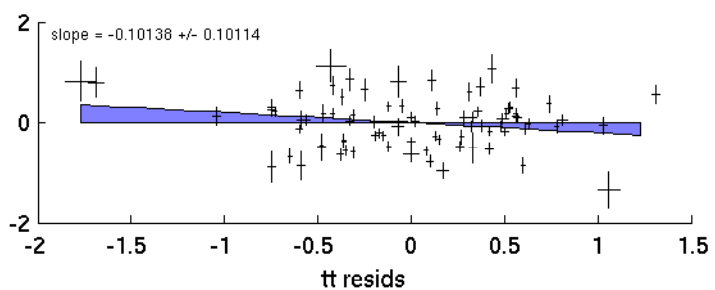
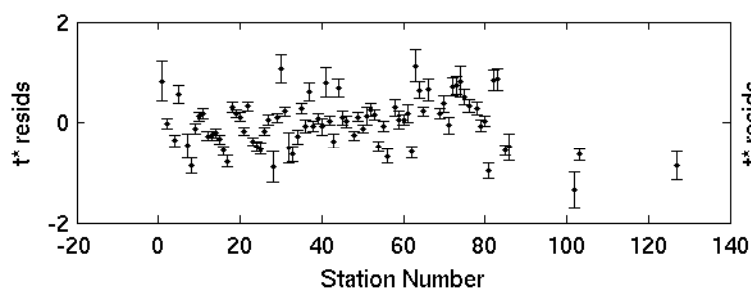


Event\_2009\_015\_17\_49\_39

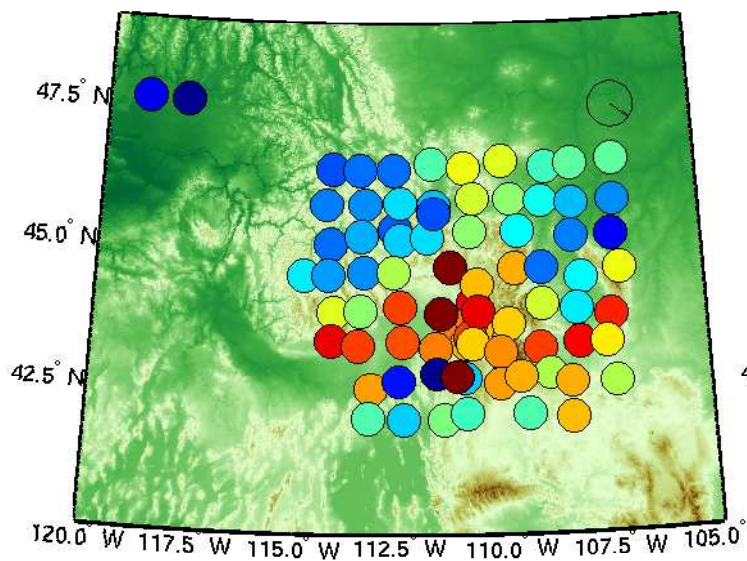
Stack



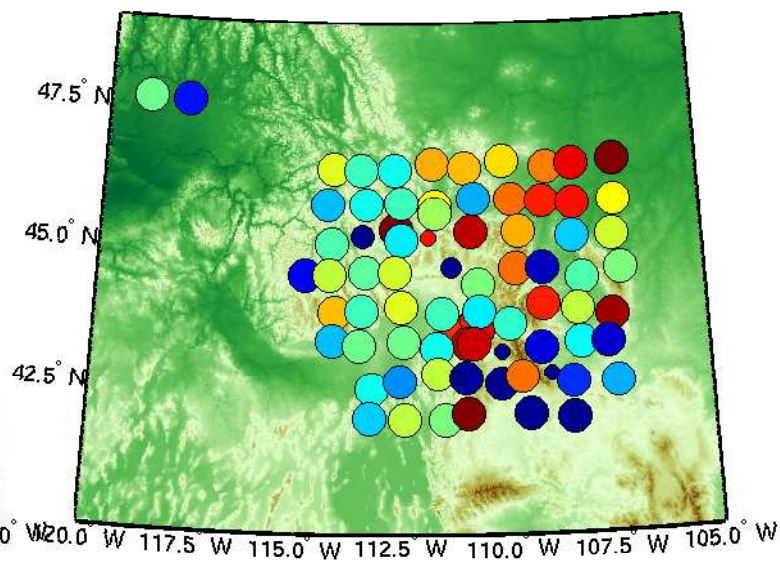
Baz = 309.2678  
Mean xcor value = 0.89753  
Range of t\* values is 2.4822  
Median t\* err is 0.11578  
Slope = -0.10138 +/- 0.10114



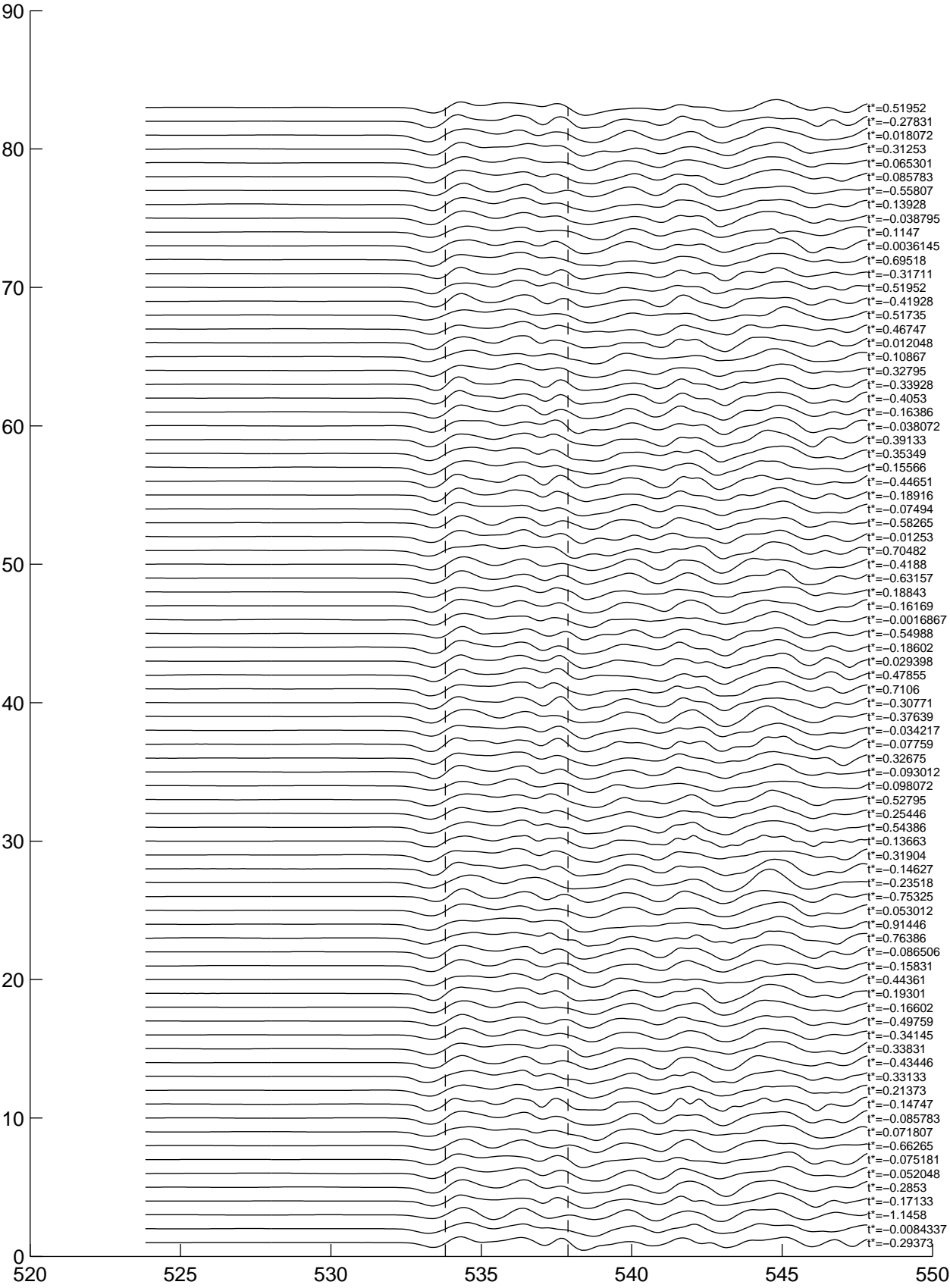
travel time residuals



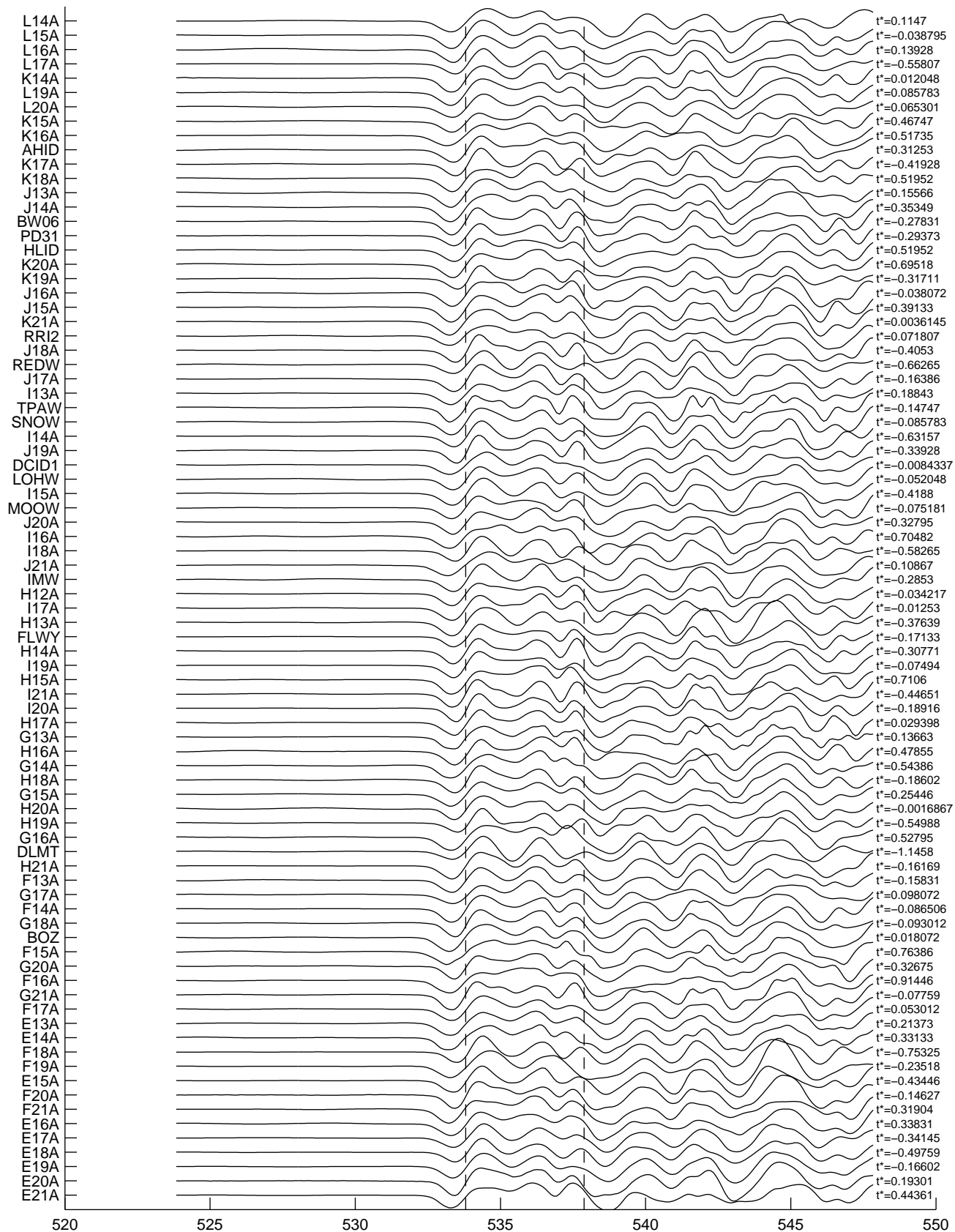
t\* values



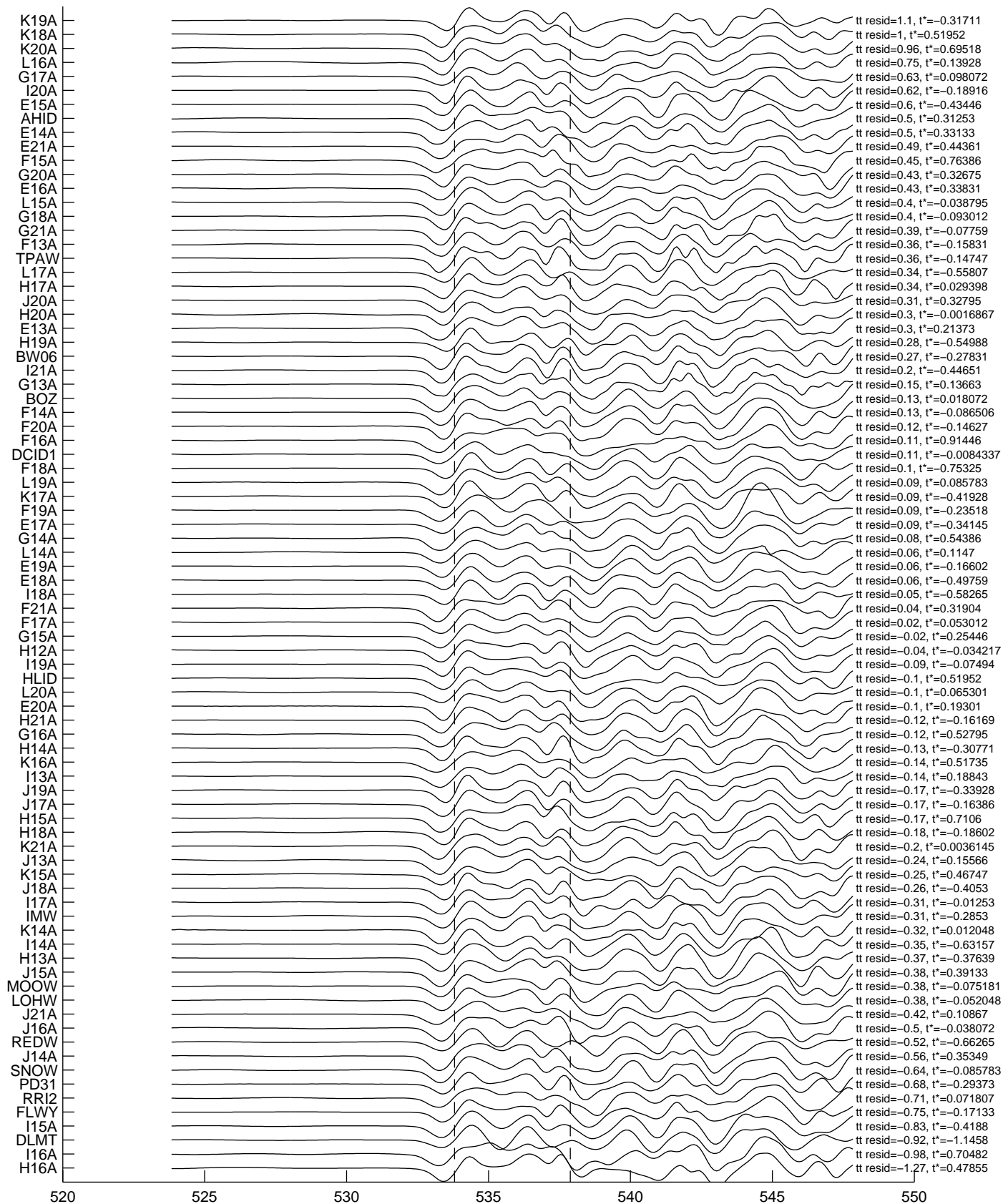
Event\_2009\_065\_10\_50\_29



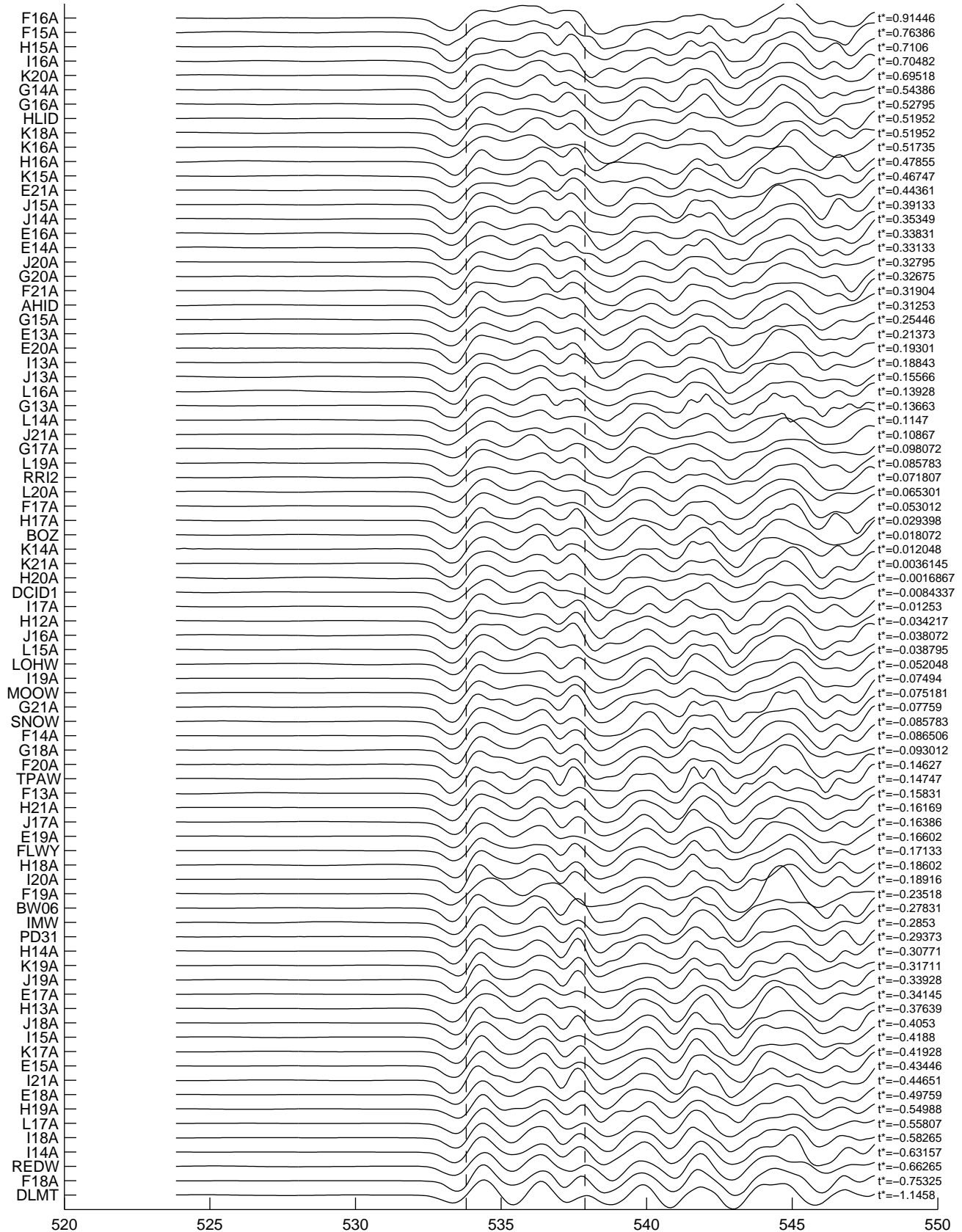
# Sorted by Delta:Event\_2009\_065\_10\_50\_29



# Sorted by travel time:Event\_2009\_065\_10\_50\_29



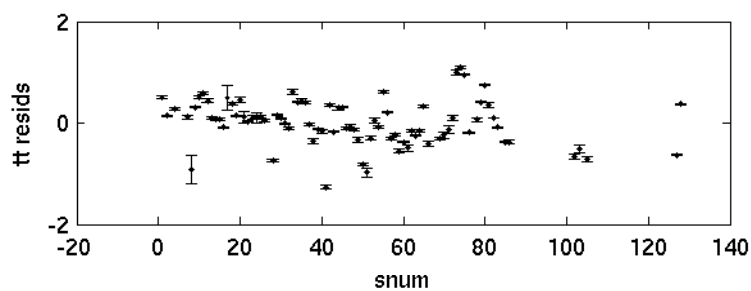
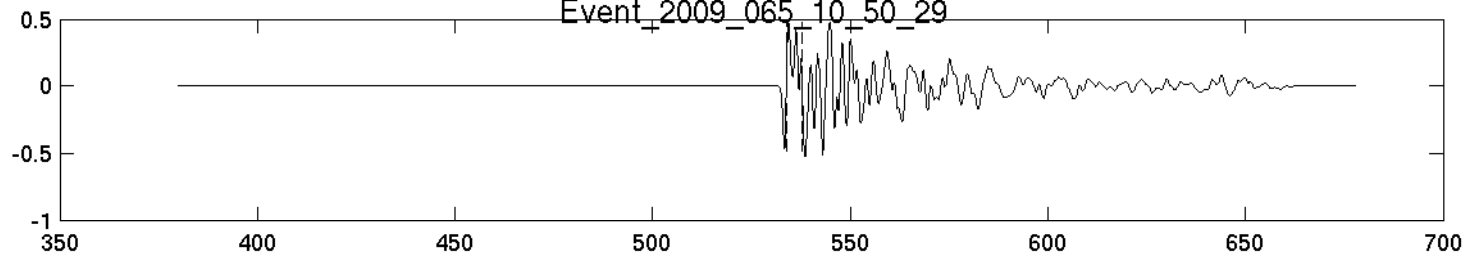
# Sorted by $t^*$ :Event\_2009\_065\_10\_50\_29



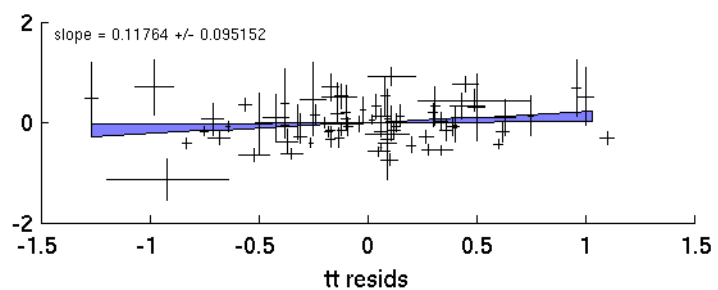
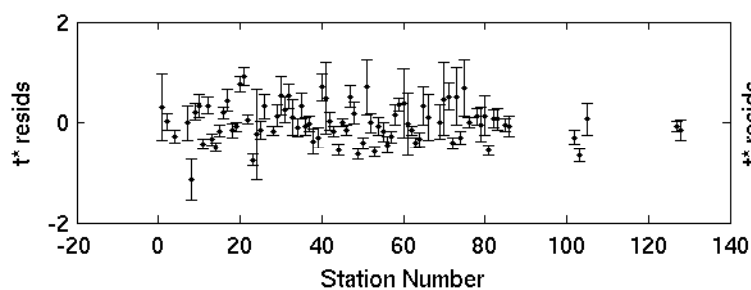


Event\_2009\_065 10 50 29

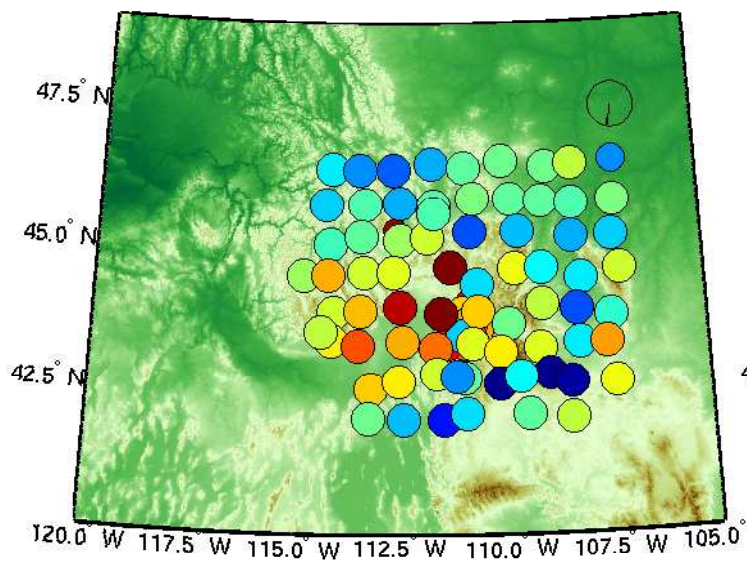
Stack



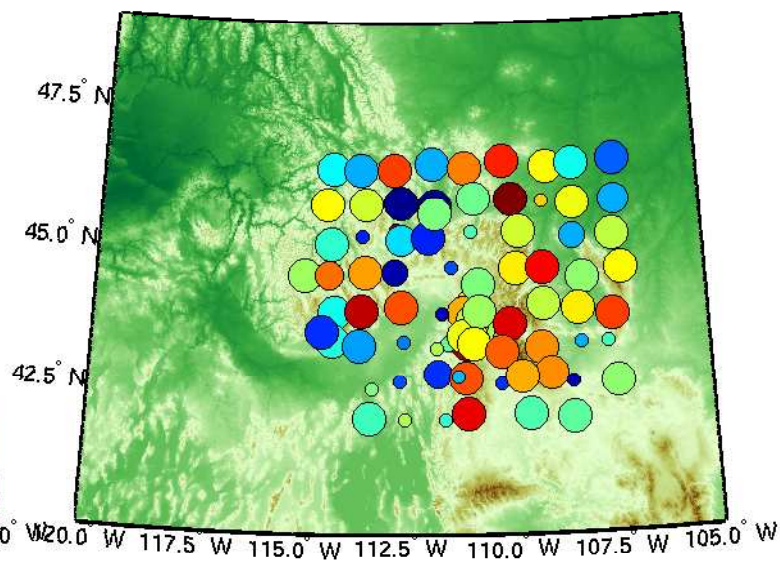
Baz = 12.0615  
Mean xcor value = 0.80663  
Range of  $t^*$  values is 2.0602  
Median  $t^*$  err is 0.1815  
Slope = 0.11764 +/- 0.095152



travel time residuals

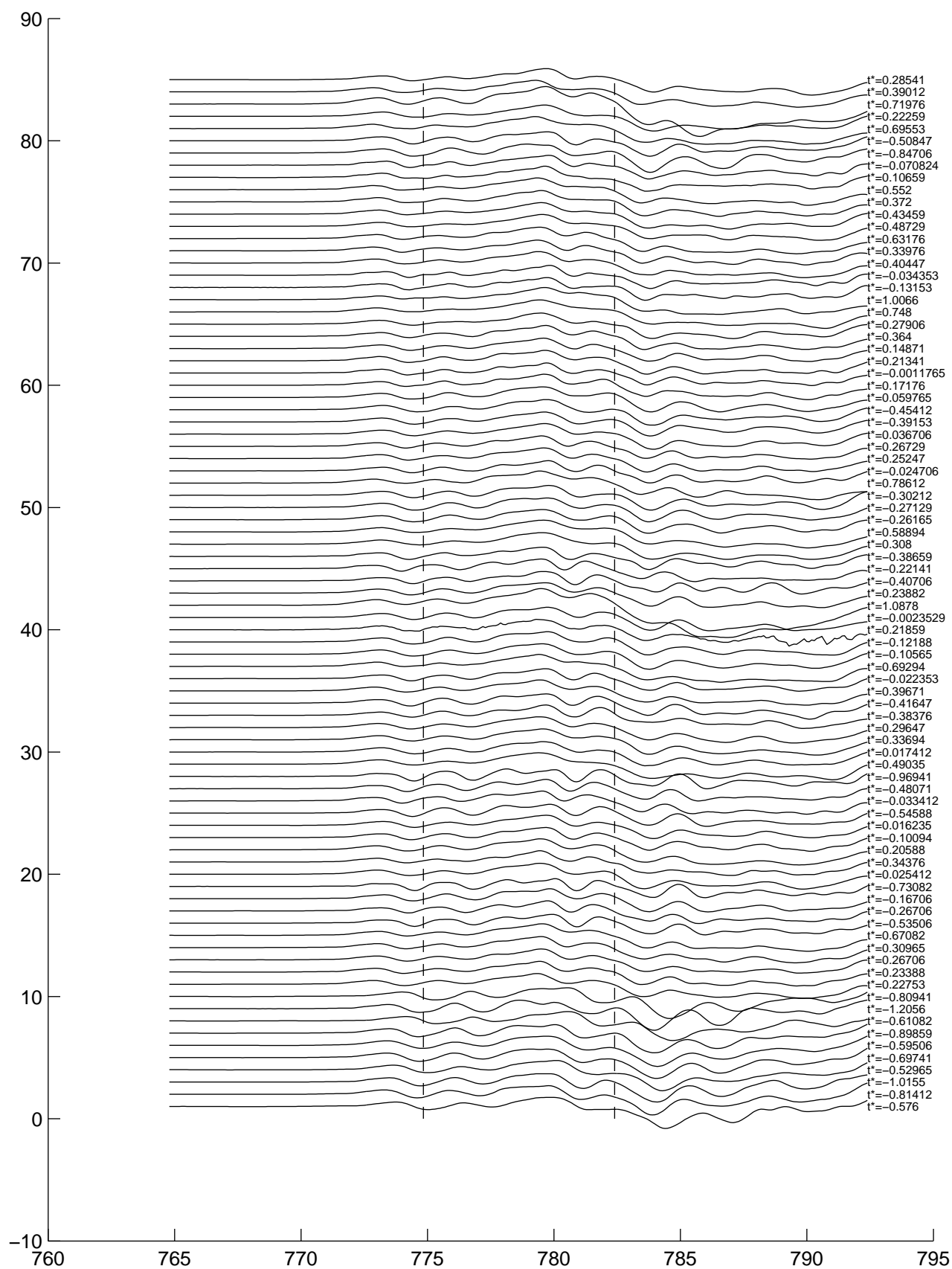


$t^*$  values

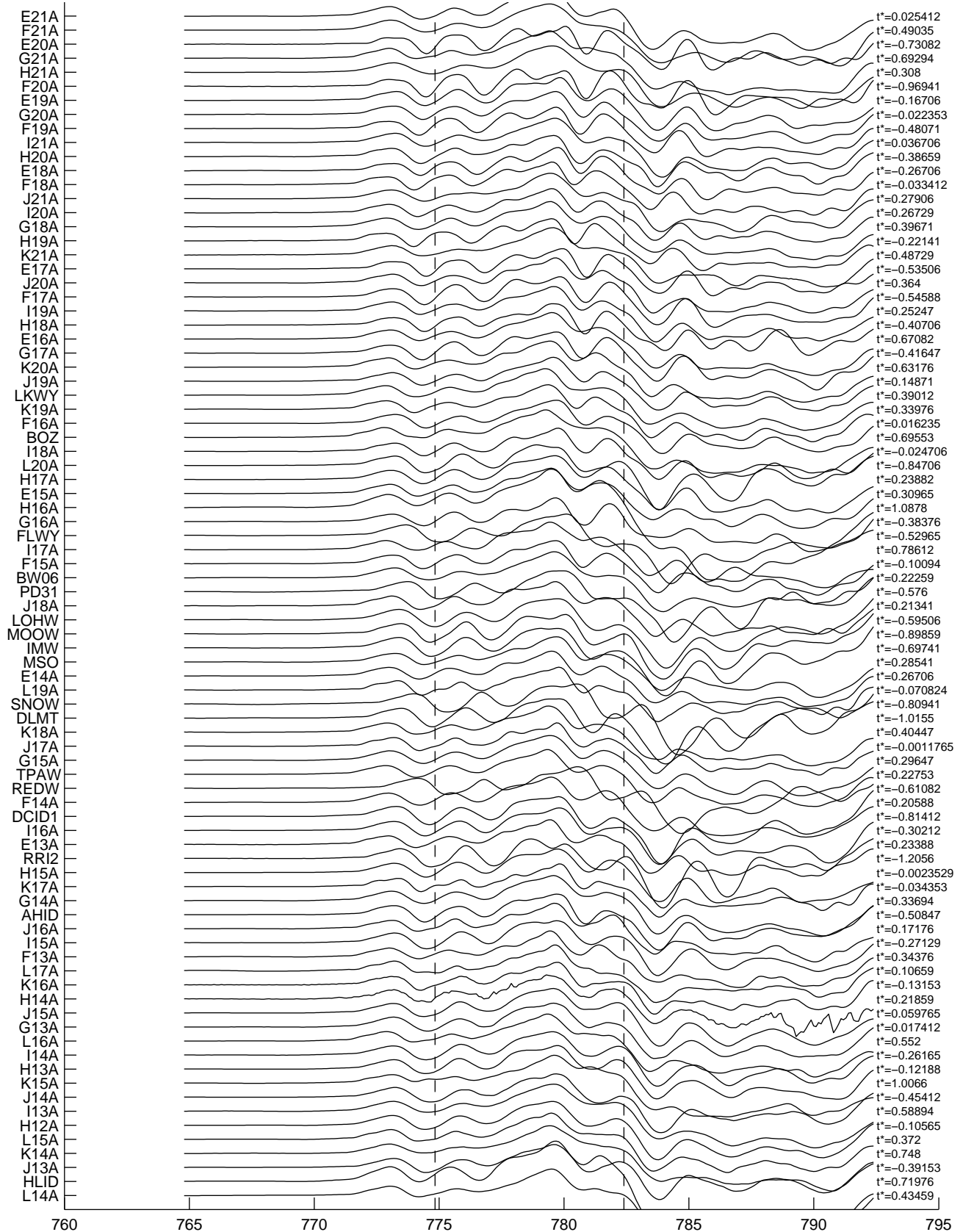




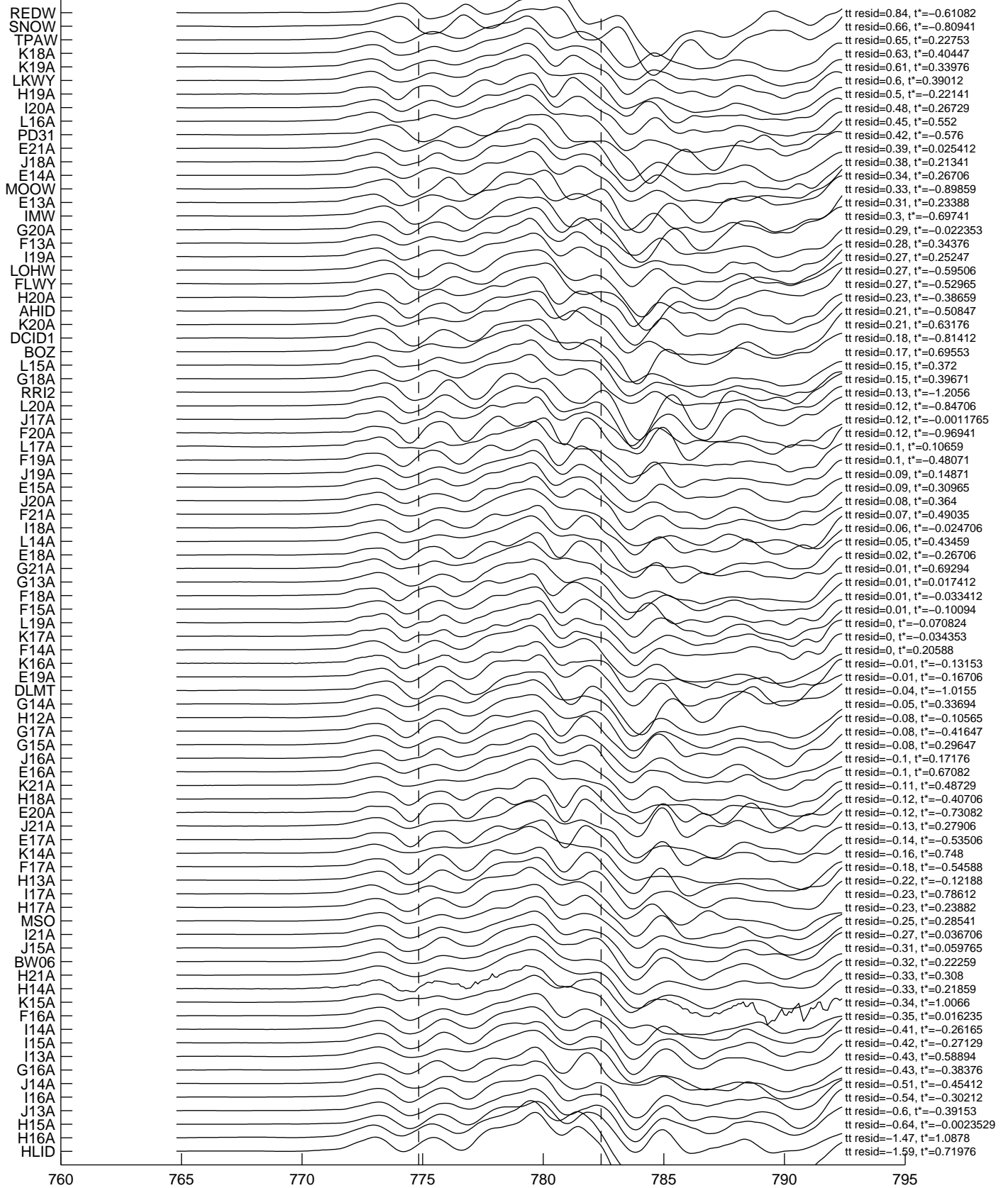
# Event\_2009\_078\_18\_17\_40



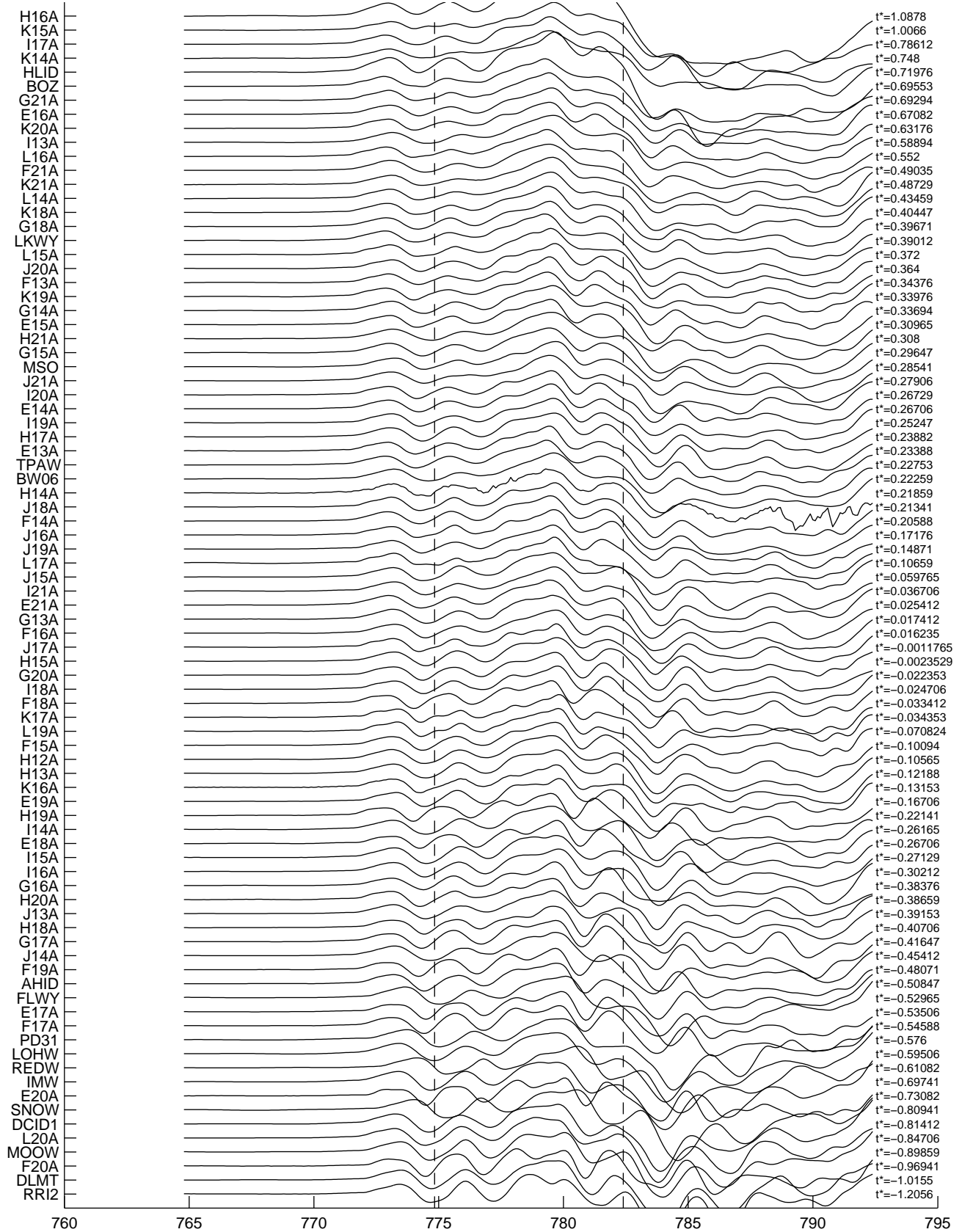
# Sorted by Delta:Event\_2009\_078\_18\_17\_40



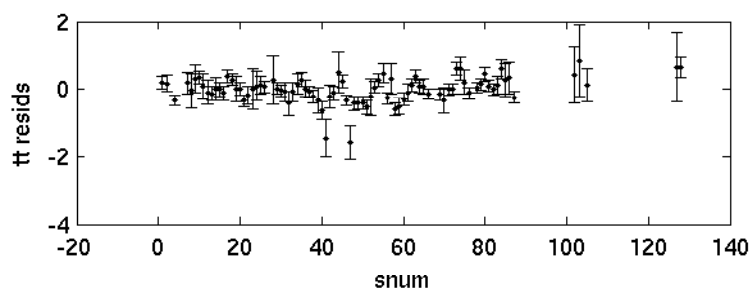
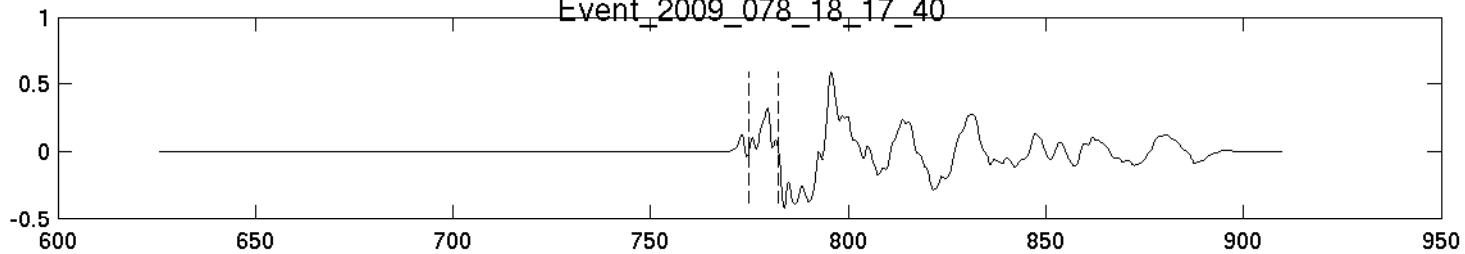
# Sorted by travel time:Event\_2009\_078\_18\_17\_40



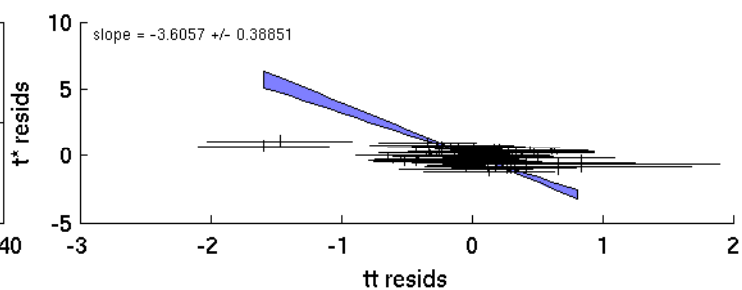
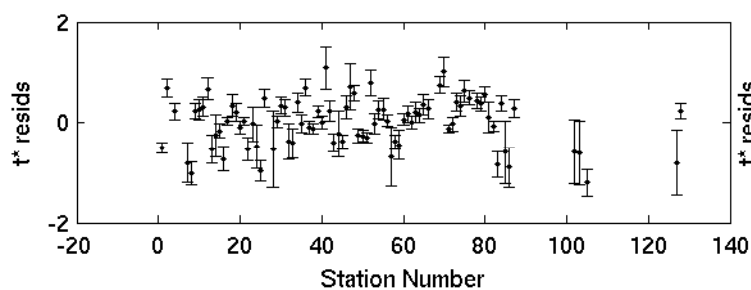
# Sorted by t\*:Event\_2009\_078\_18\_17\_40



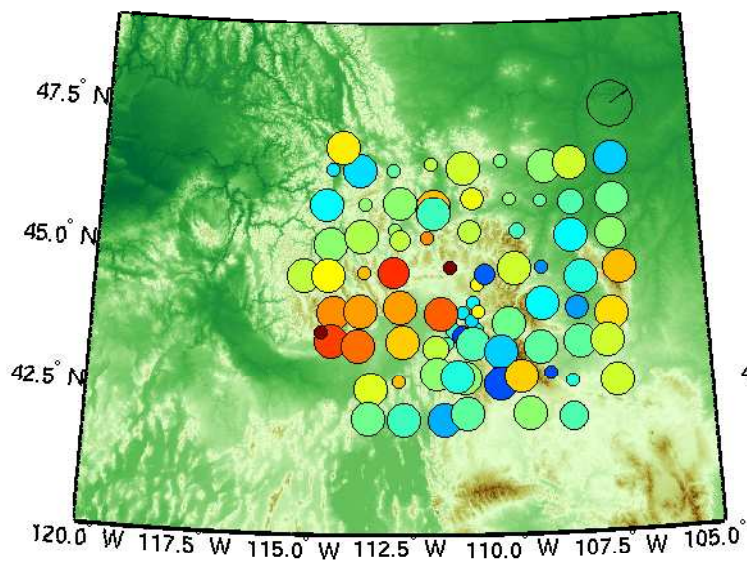
Stack  
Event\_2009\_078\_18\_17\_40



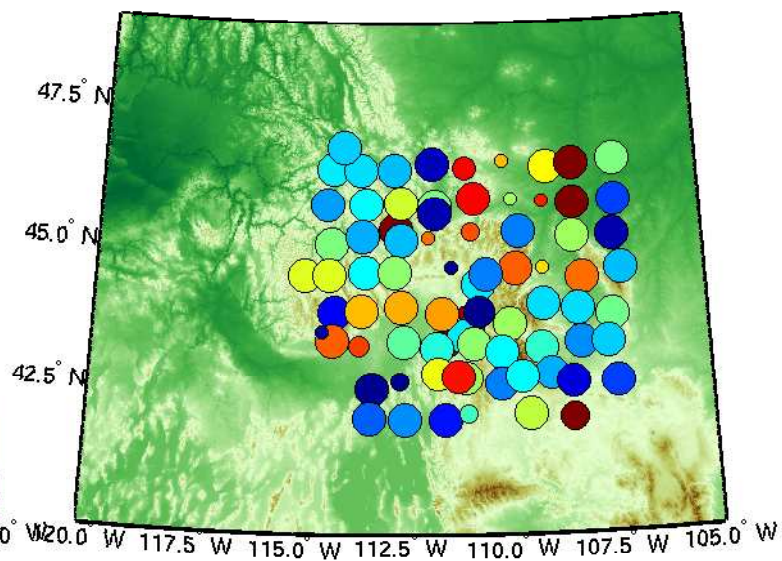
Baz = 235.6648  
Mean xcor value = 0.91024  
Range of  $t^*$  values is 2.2934  
Median  $t^*$  err is 0.18206  
Slope =  $-3.6057 \pm 0.38851$



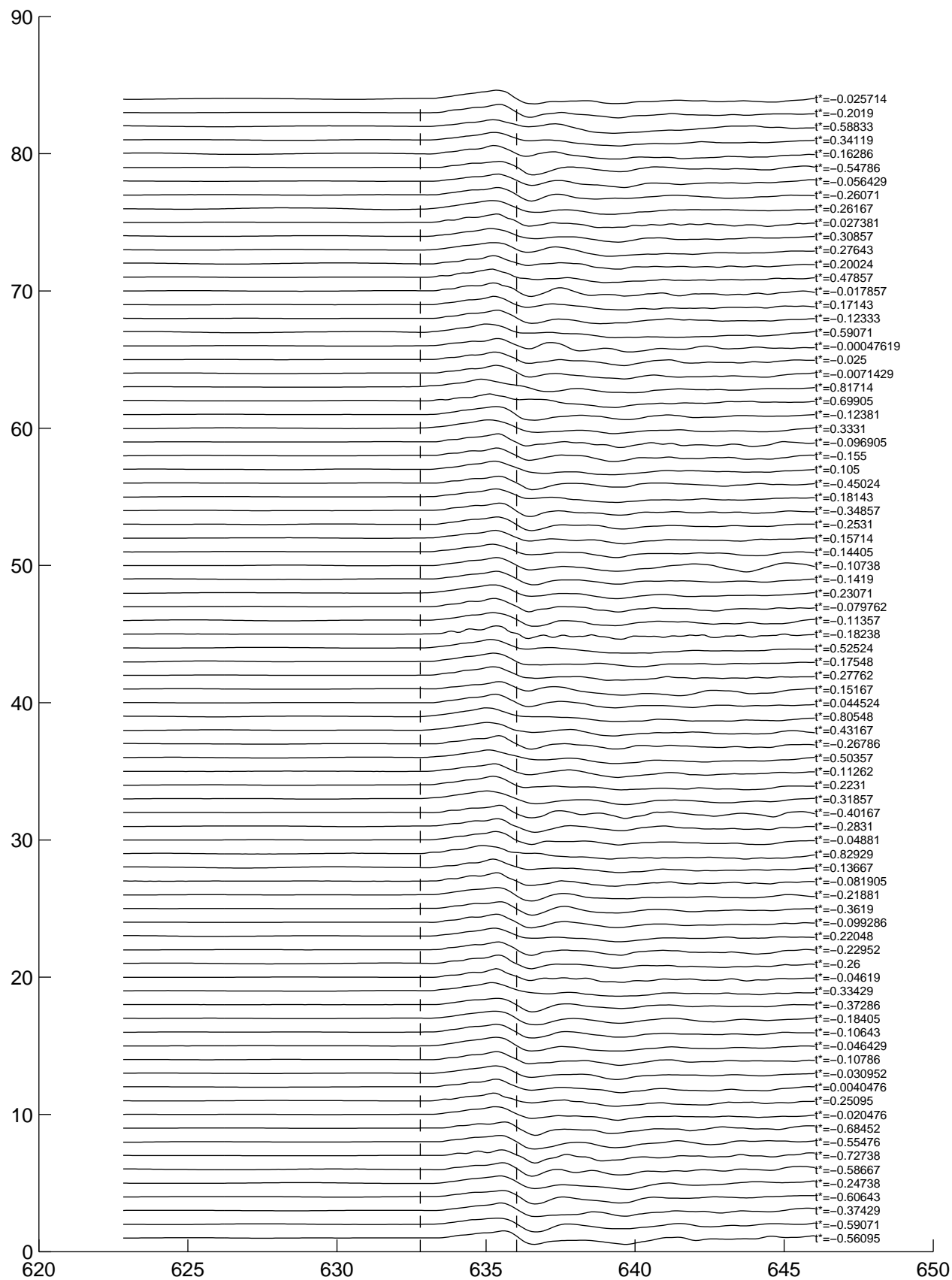
travel time residuals



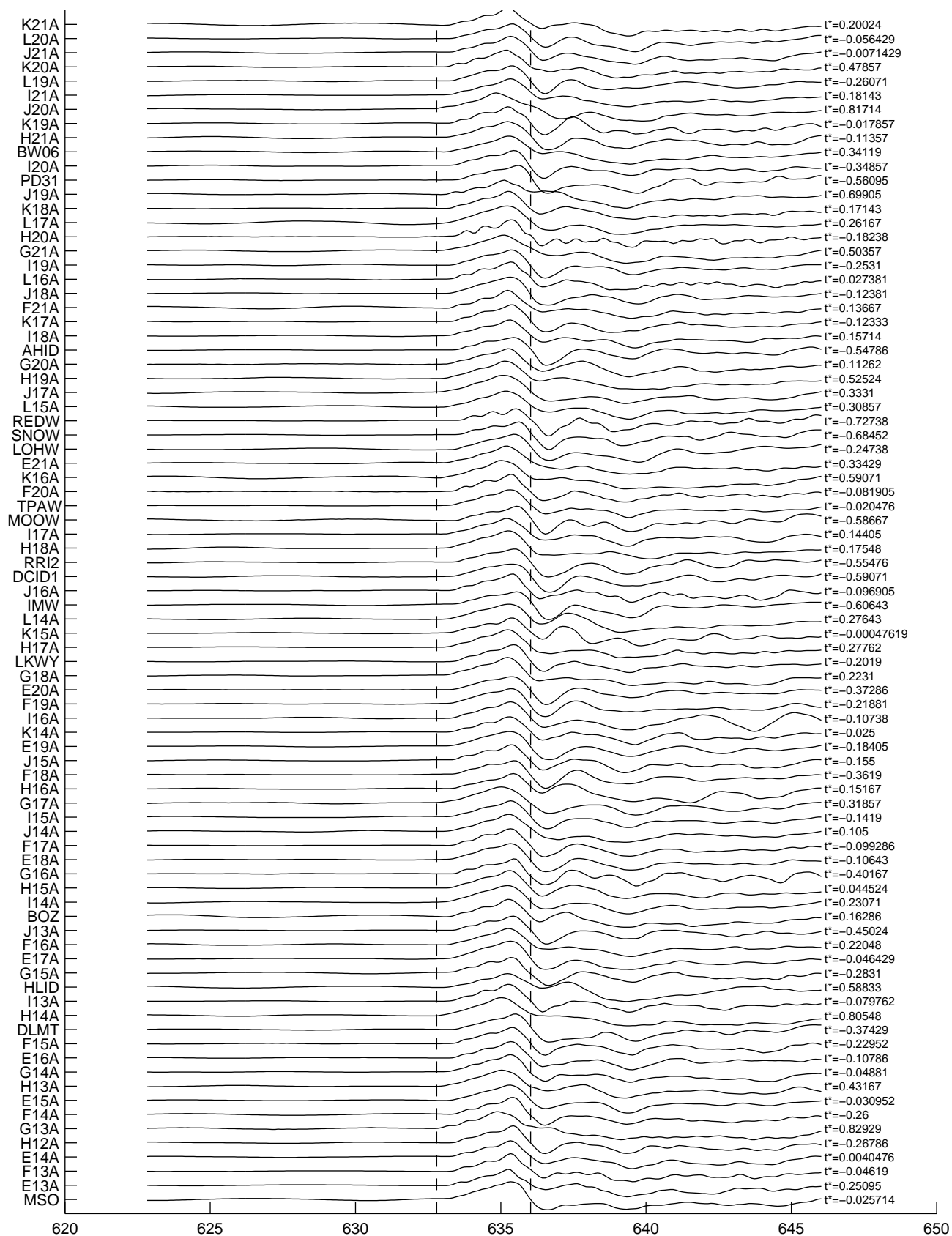
$t^*$  values



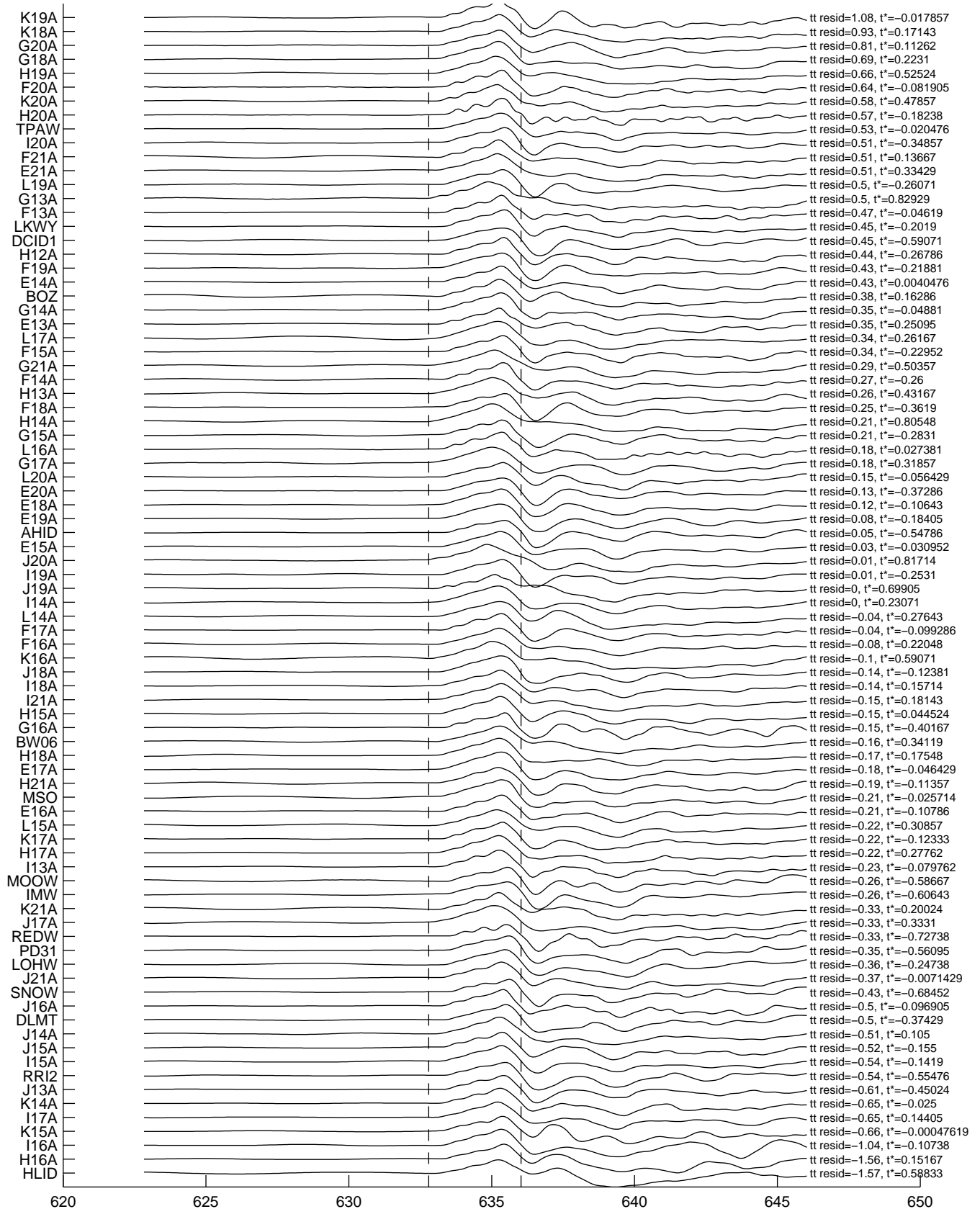
# Event\_2009\_097\_04\_23\_33



# Sorted by Delta:Event\_2009\_097\_04\_23\_33

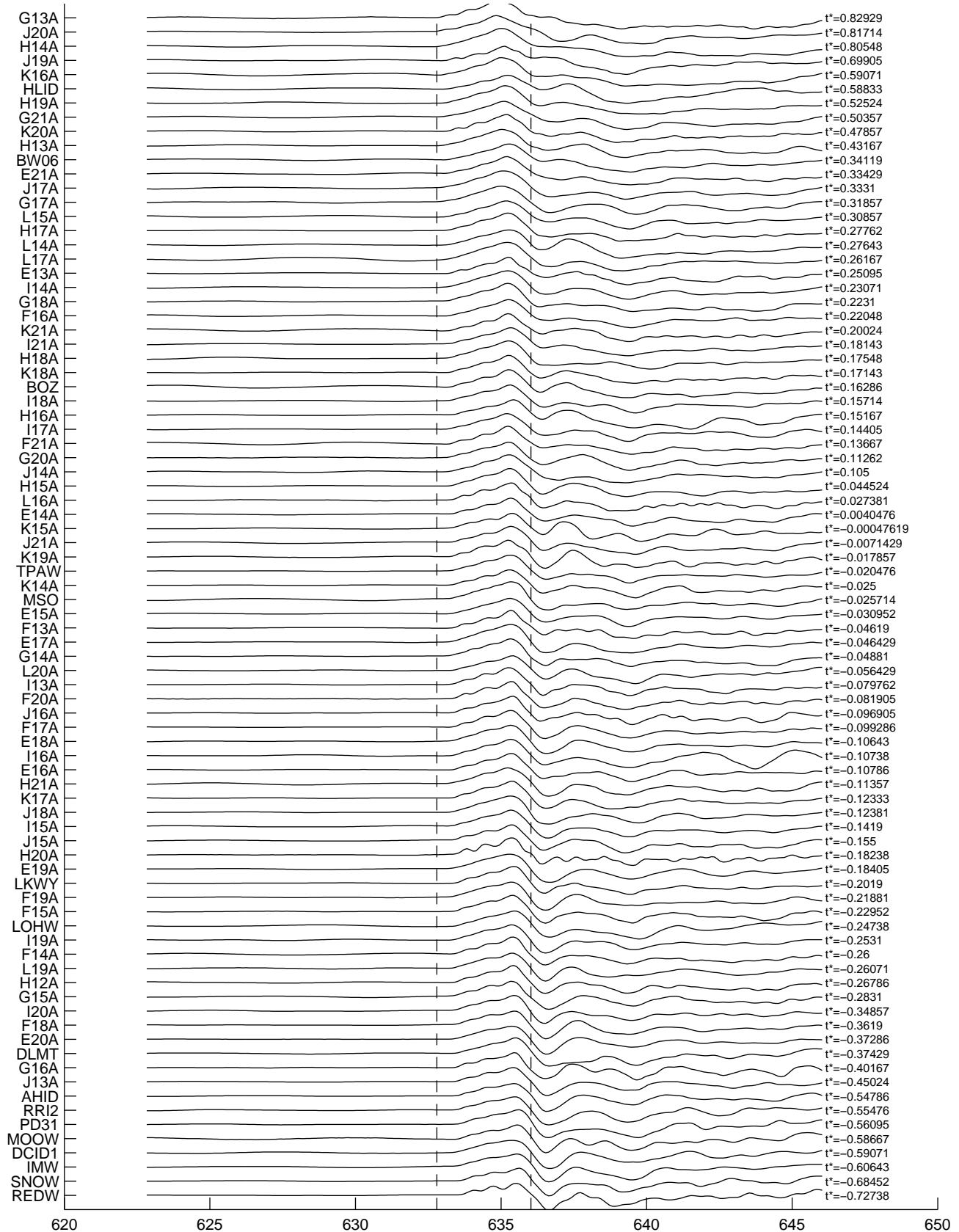


# Sorted by travel time:Event\_2009\_097\_04\_23\_33

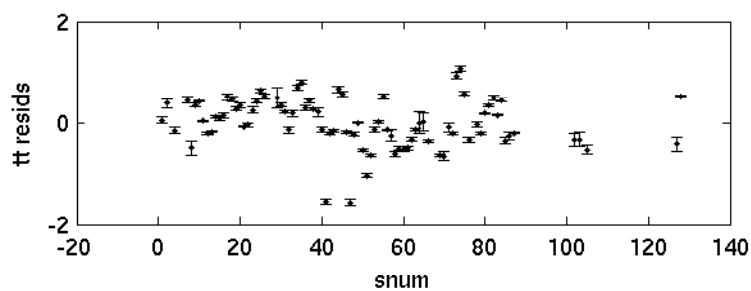
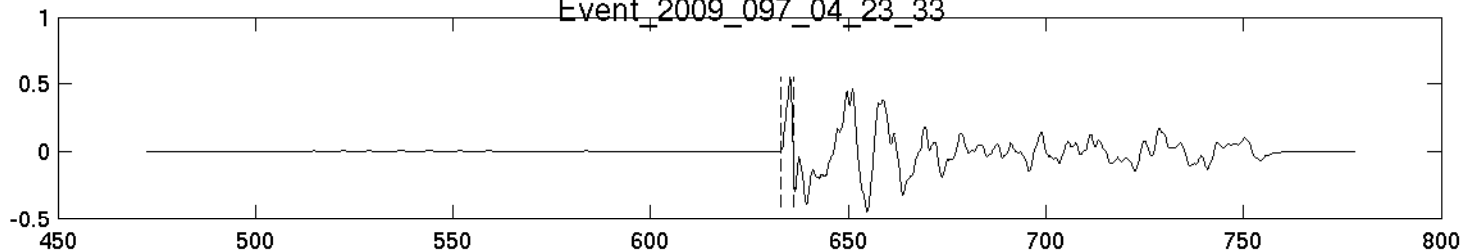




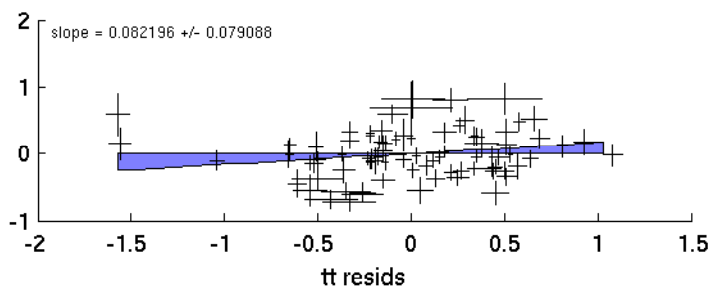
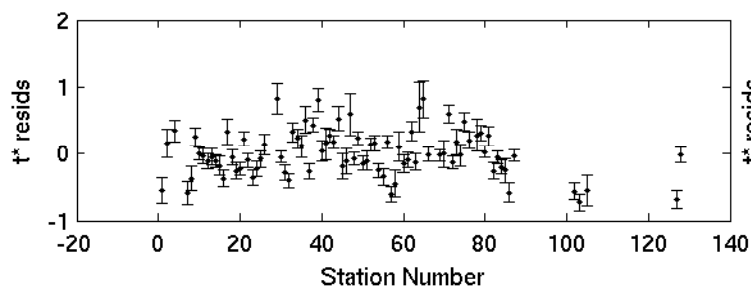
# Sorted by t\*:Event\_2009\_097\_04\_23\_33



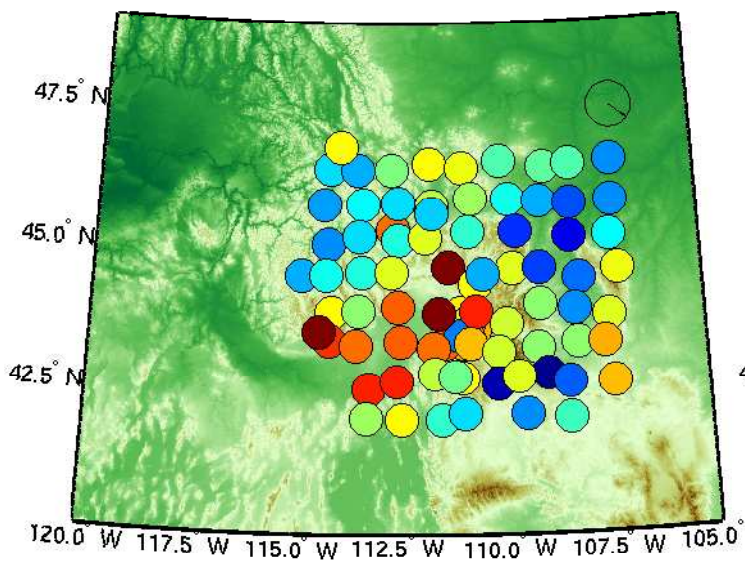
# Stack Event\_2009\_097\_04\_23\_33



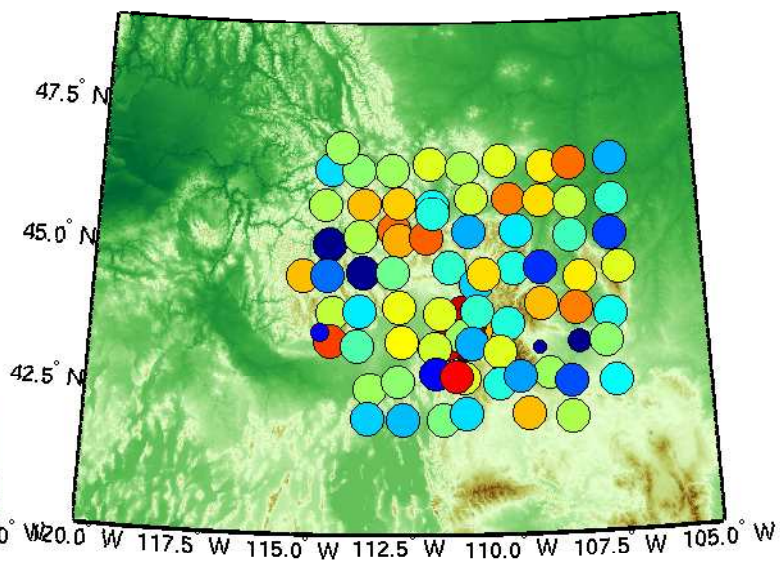
Baz = 310.0933  
Mean xcor value = 0.90381  
Range of  $t^*$  values is 1.5567  
Median  $t^*$  err is 0.12627  
Slope = 0.082196 +/- 0.079088



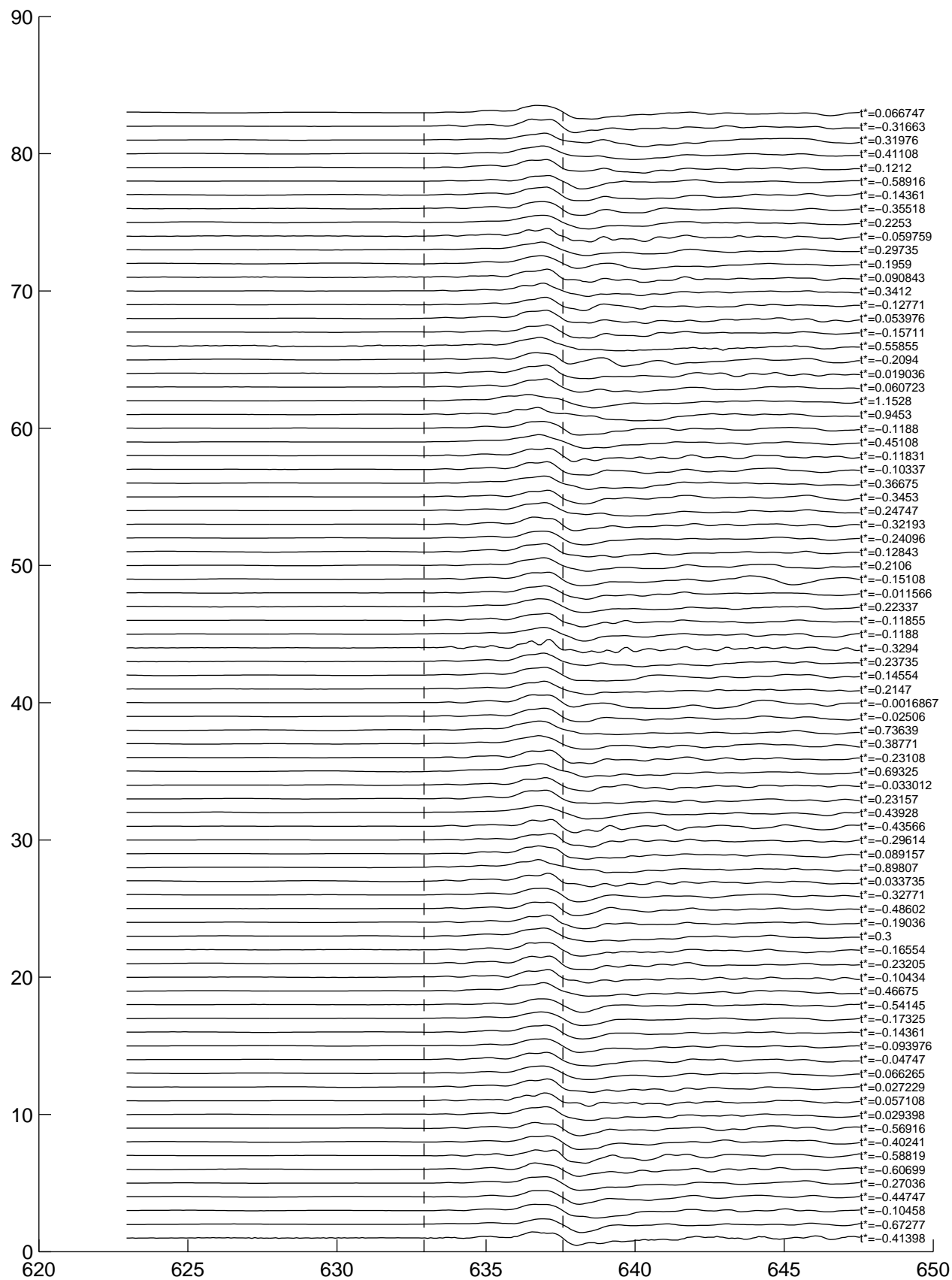
travel time residuals



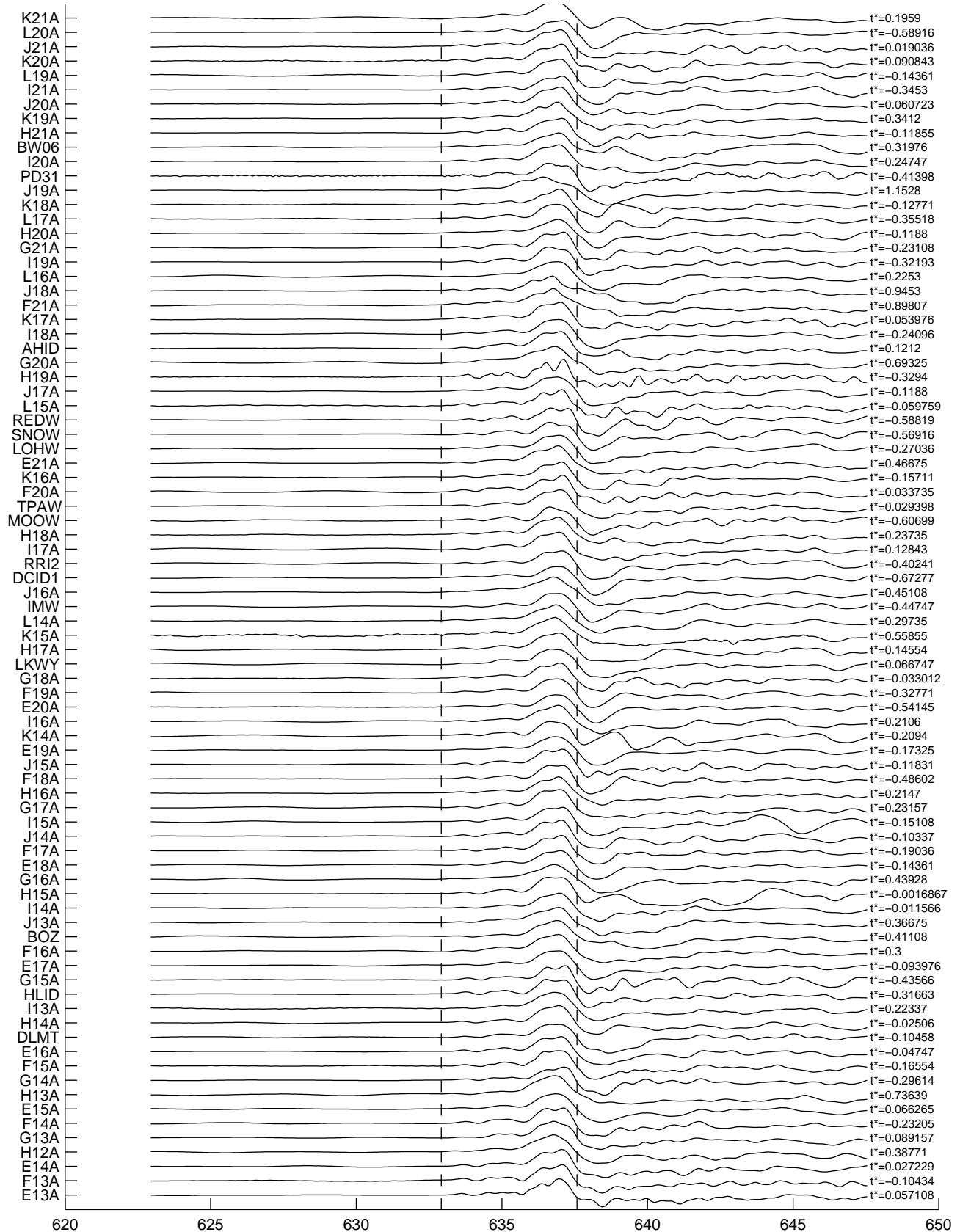
$t^*$  values



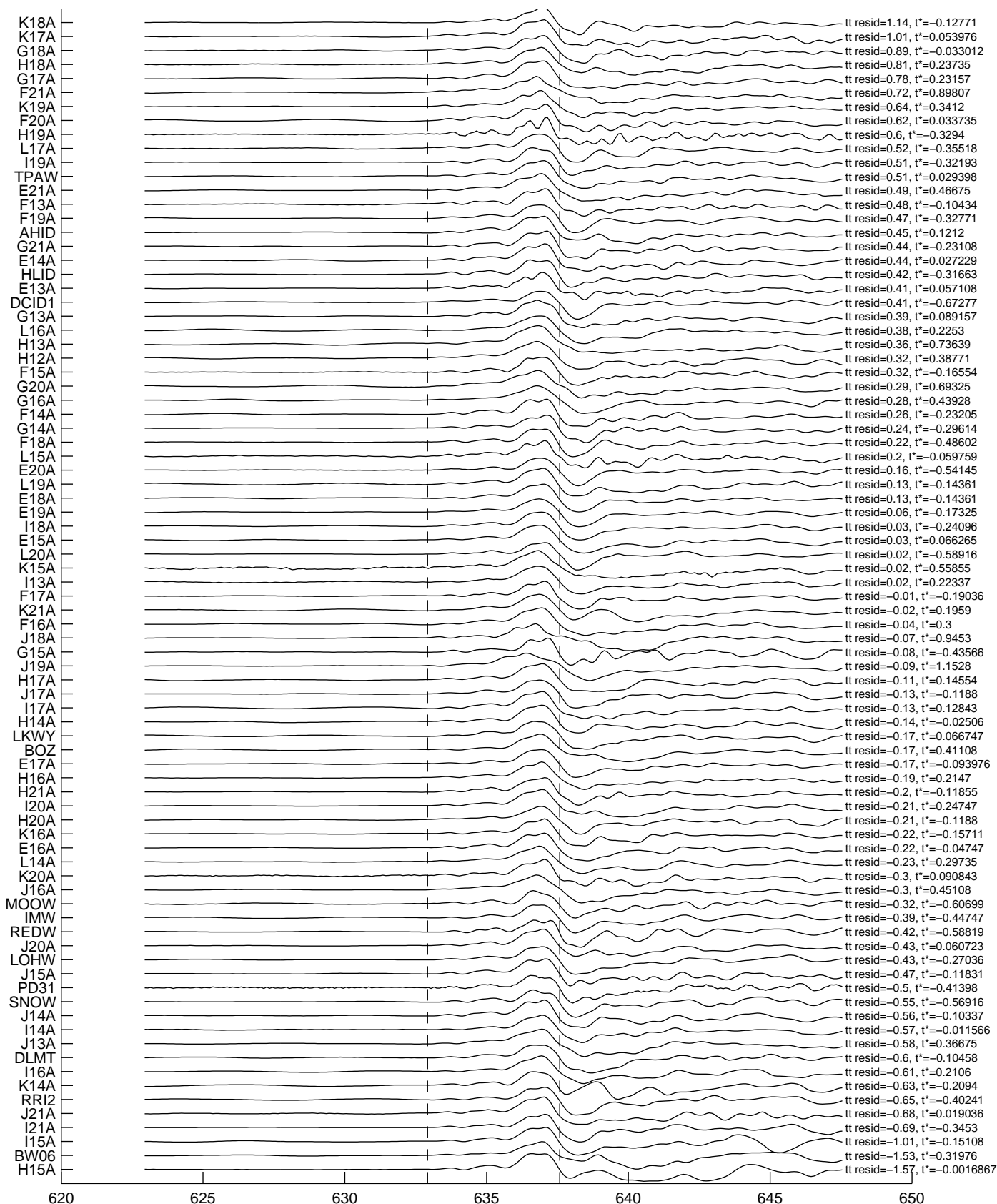
# Event\_2009\_108\_19\_17\_58



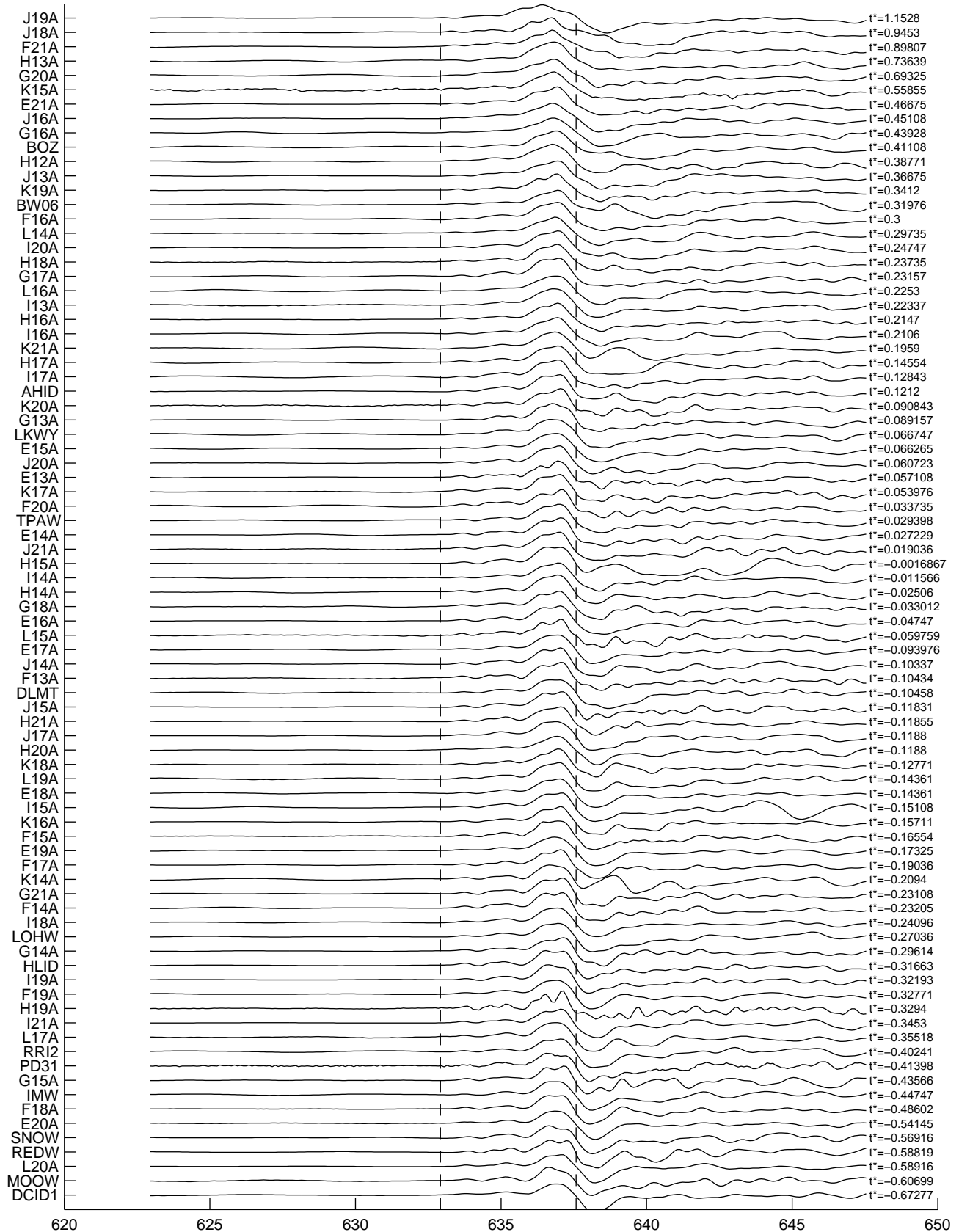
# Sorted by Delta:Event\_2009\_108\_19\_17\_58



# Sorted by travel time:Event\_2009\_108\_19\_17\_58

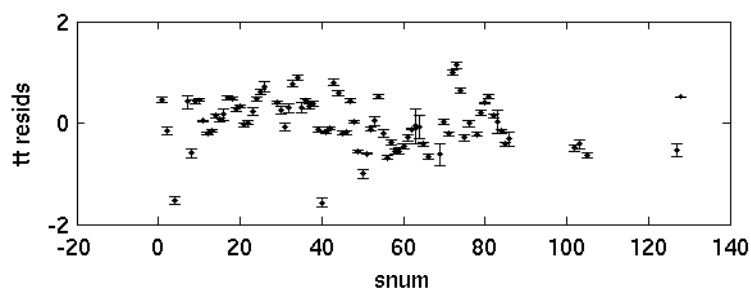
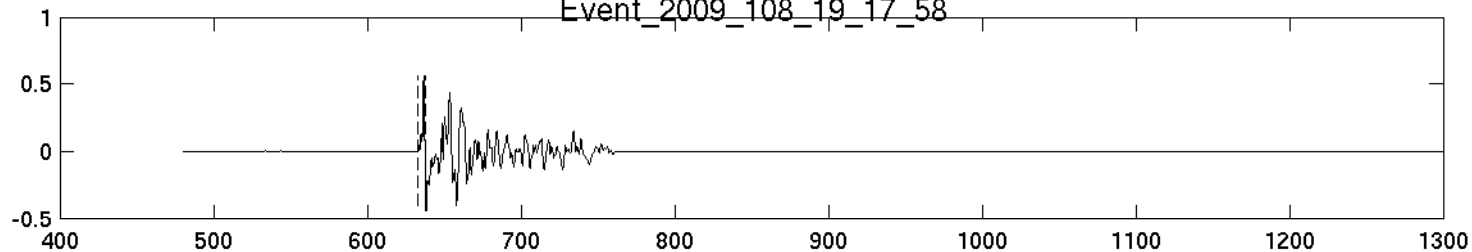


# Sorted by t\*:Event\_2009\_108\_19\_17\_58

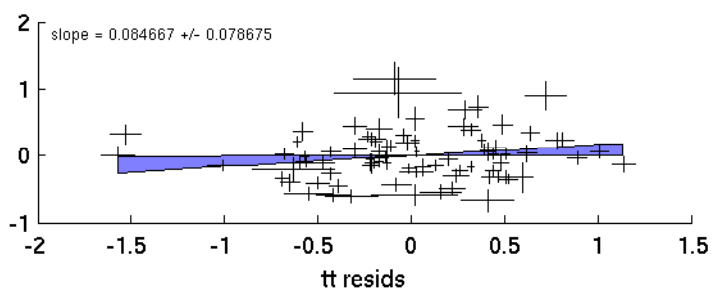
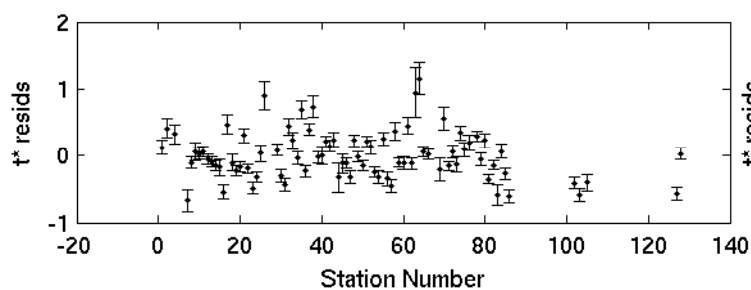


# Event\_2009\_108\_19\_17\_58

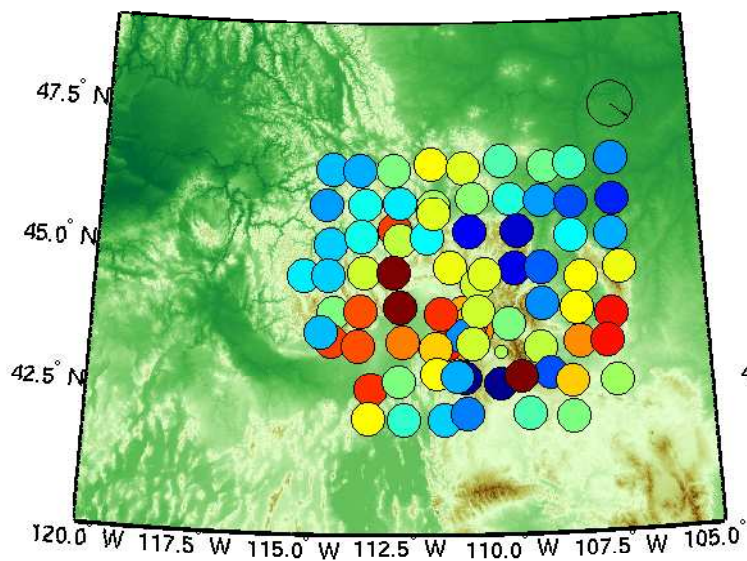
Stack



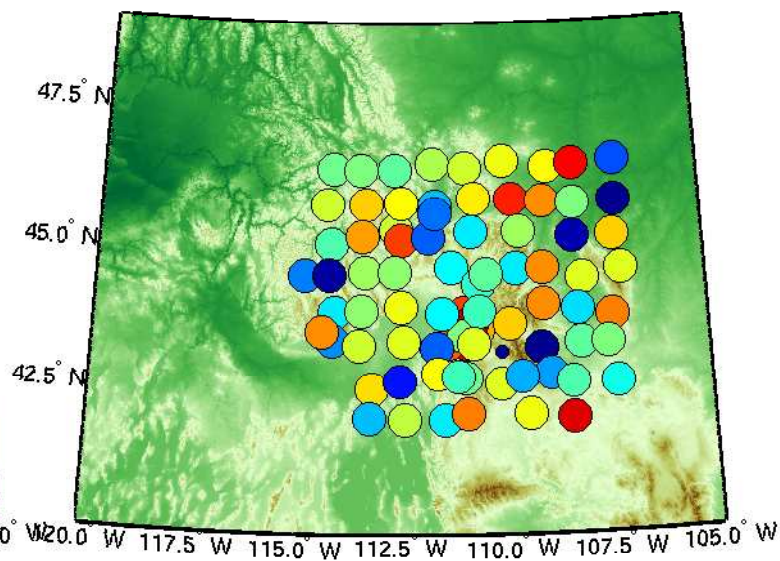
Baz = 310.121  
Mean xcor value = 0.82976  
Range of t\* values is 1.8255  
Median t\* err is 0.096634  
Slope = 0.084667 +/- 0.078675



travel time residuals

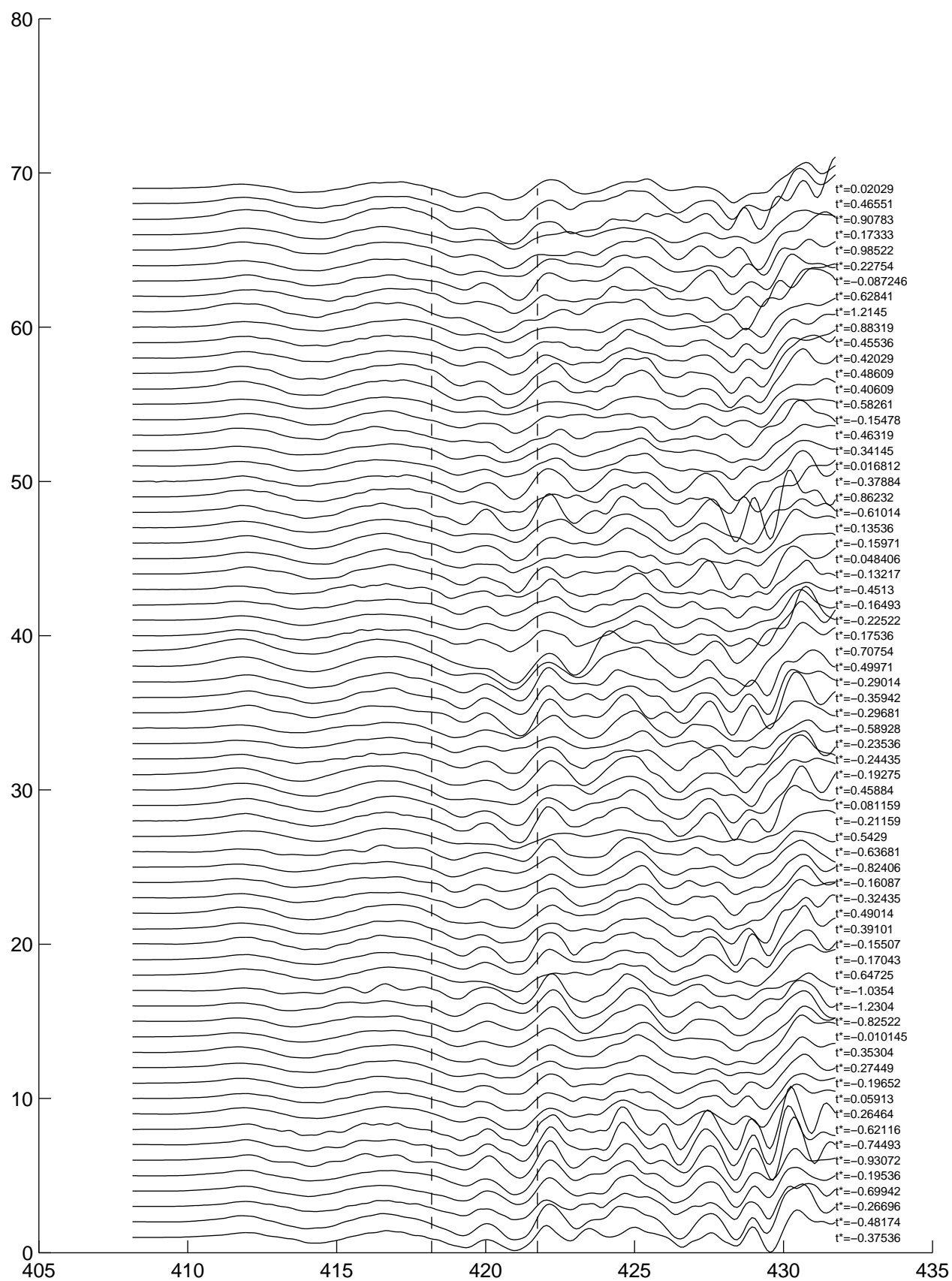


t\* values



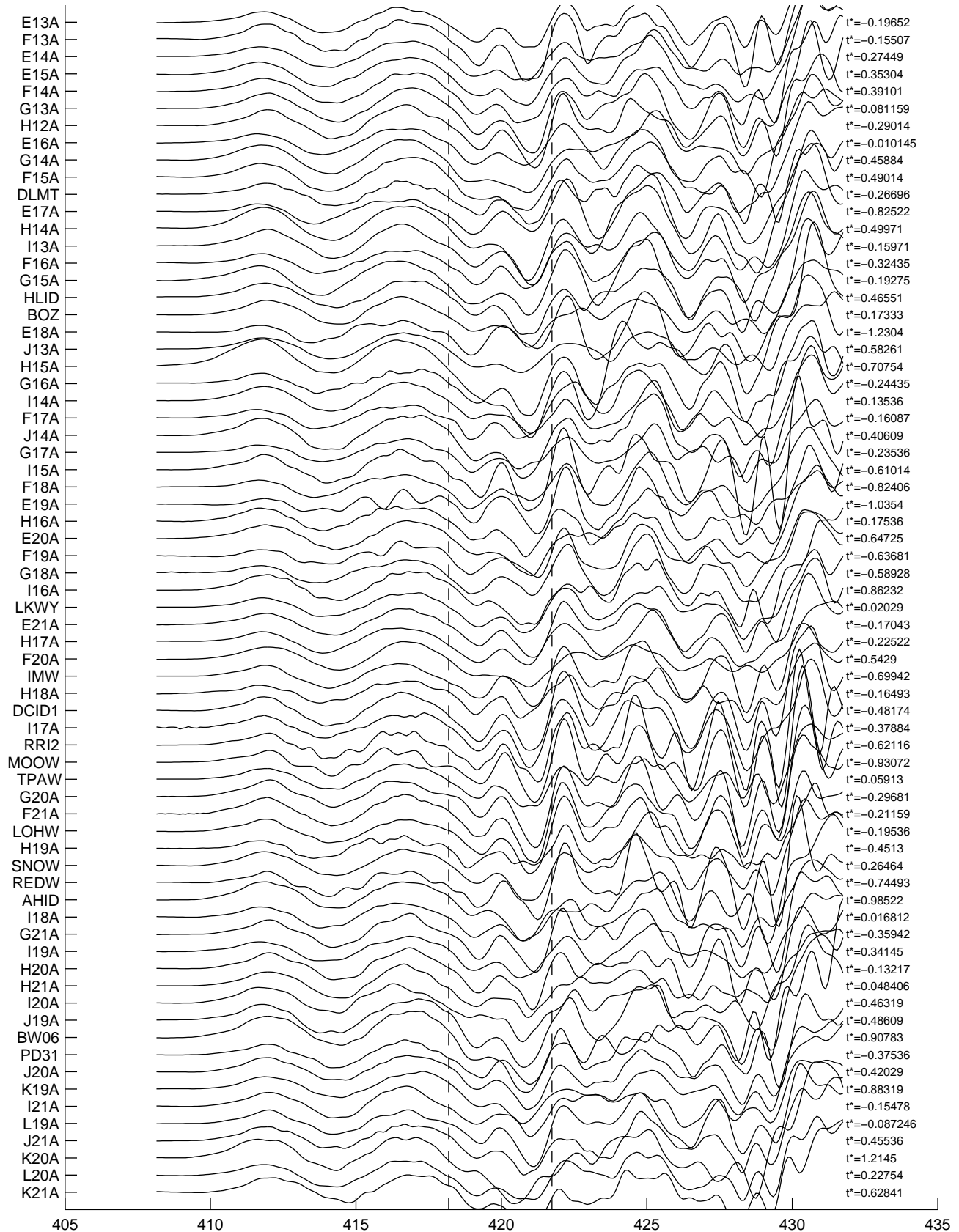


# Event\_2009\_148\_08\_24\_45

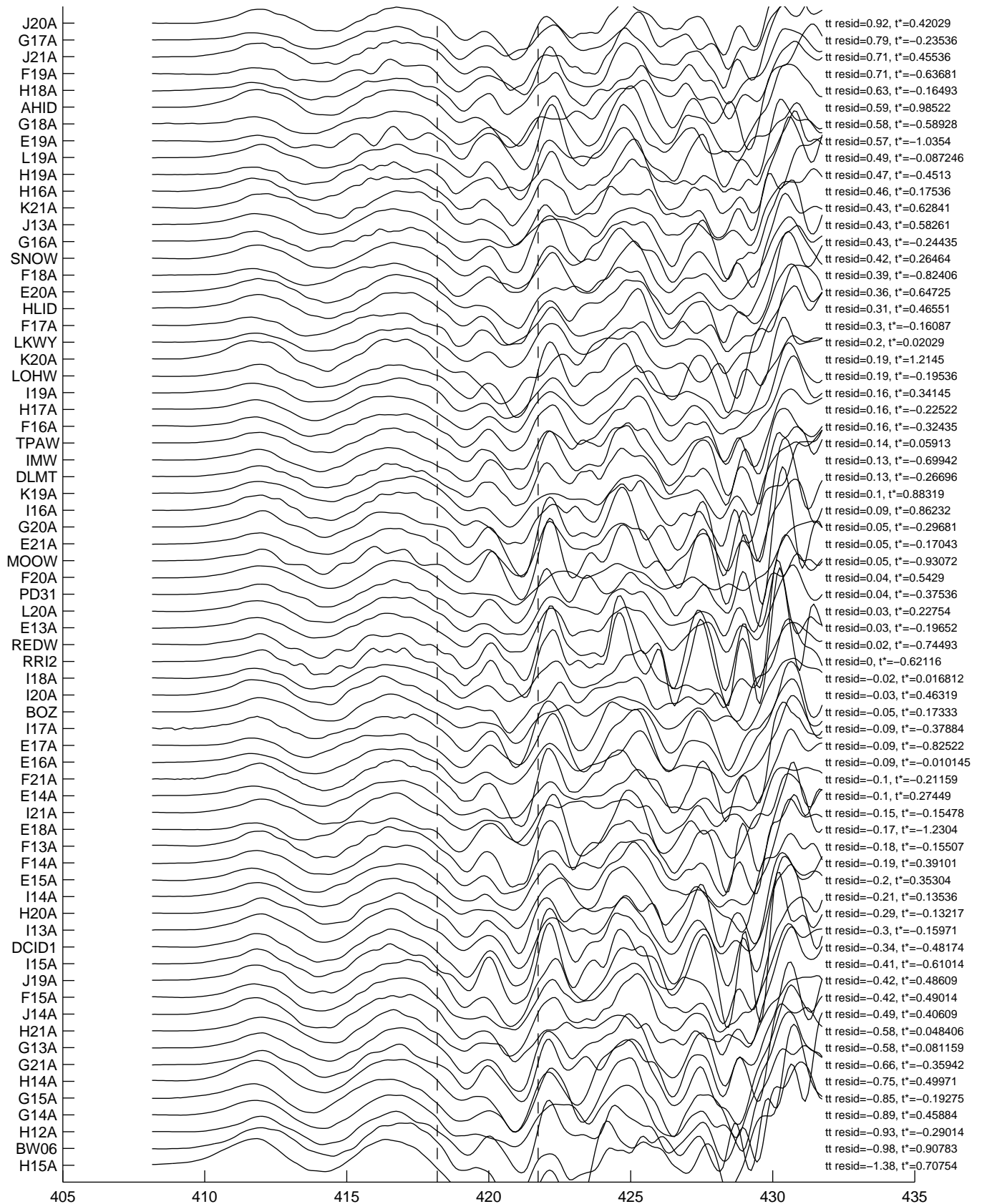




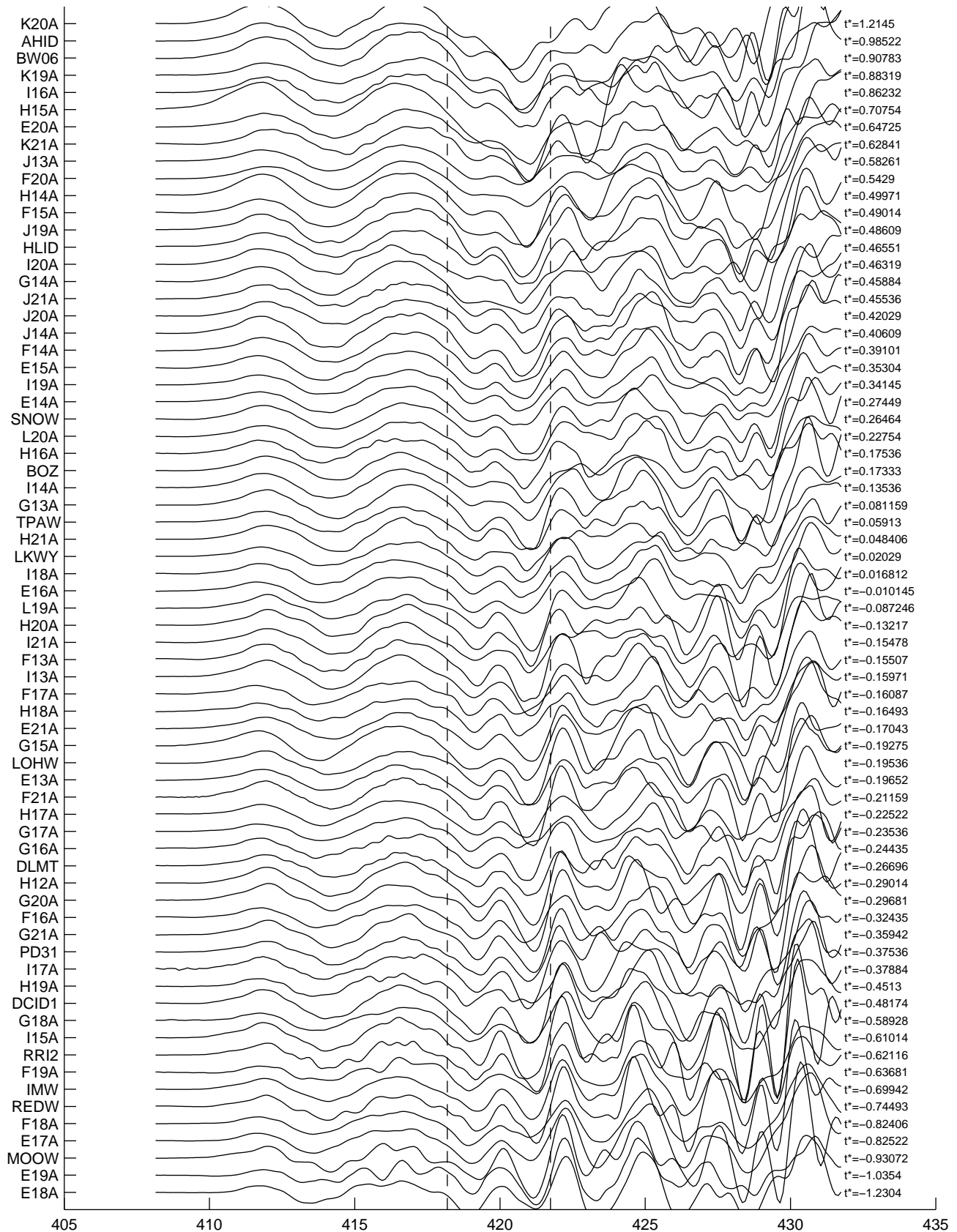
# Sorted by Delta:Event\_2009\_148\_08\_24\_45



# Sorted by travel time: Event\_2009\_148\_08\_24\_45

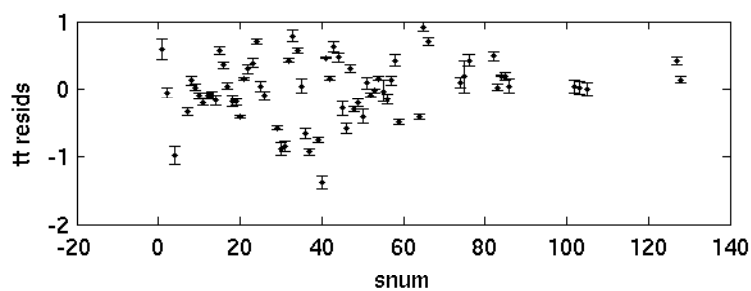
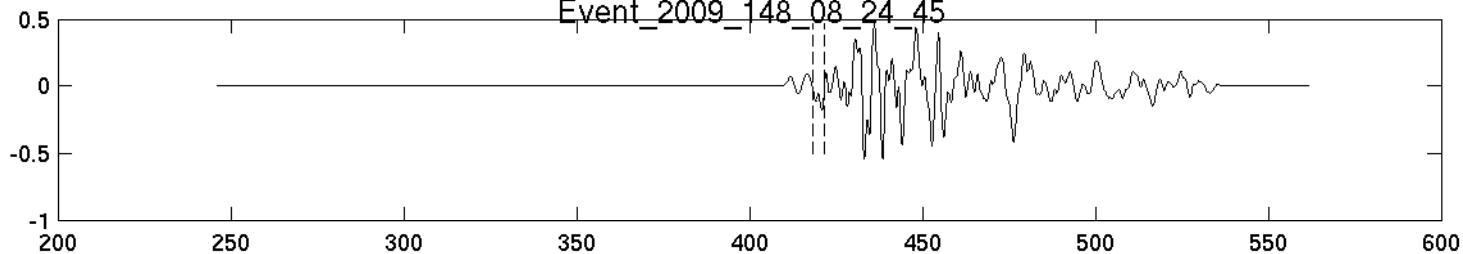


# Sorted by t\*:Event\_2009\_148\_08\_24\_45

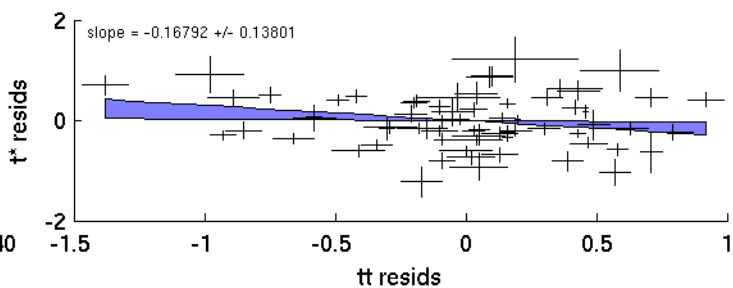
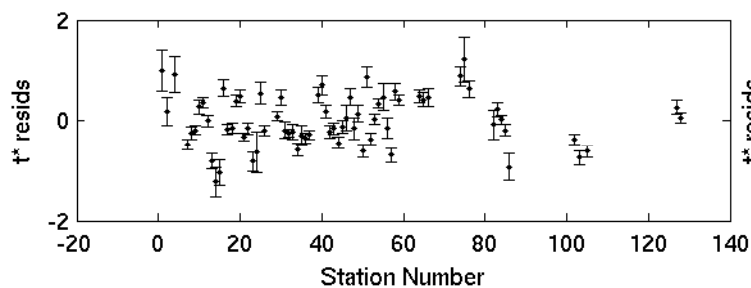


Event\_2009\_148\_08\_24\_45

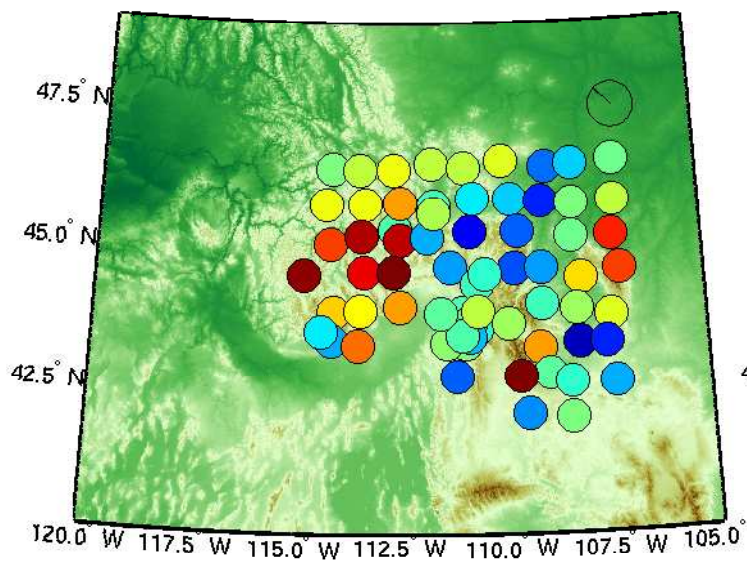
Stack



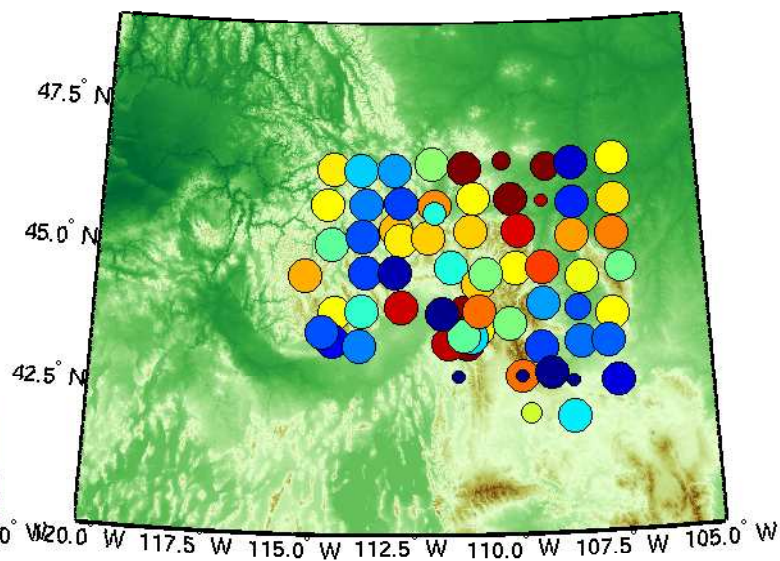
Baz = 135.8256  
Mean xcor value = 0.78913  
Range of  $t^*$  values is 2.4449  
Median  $t^*$  err is 0.13759  
Slope =  $-0.16792 \pm 0.13801$



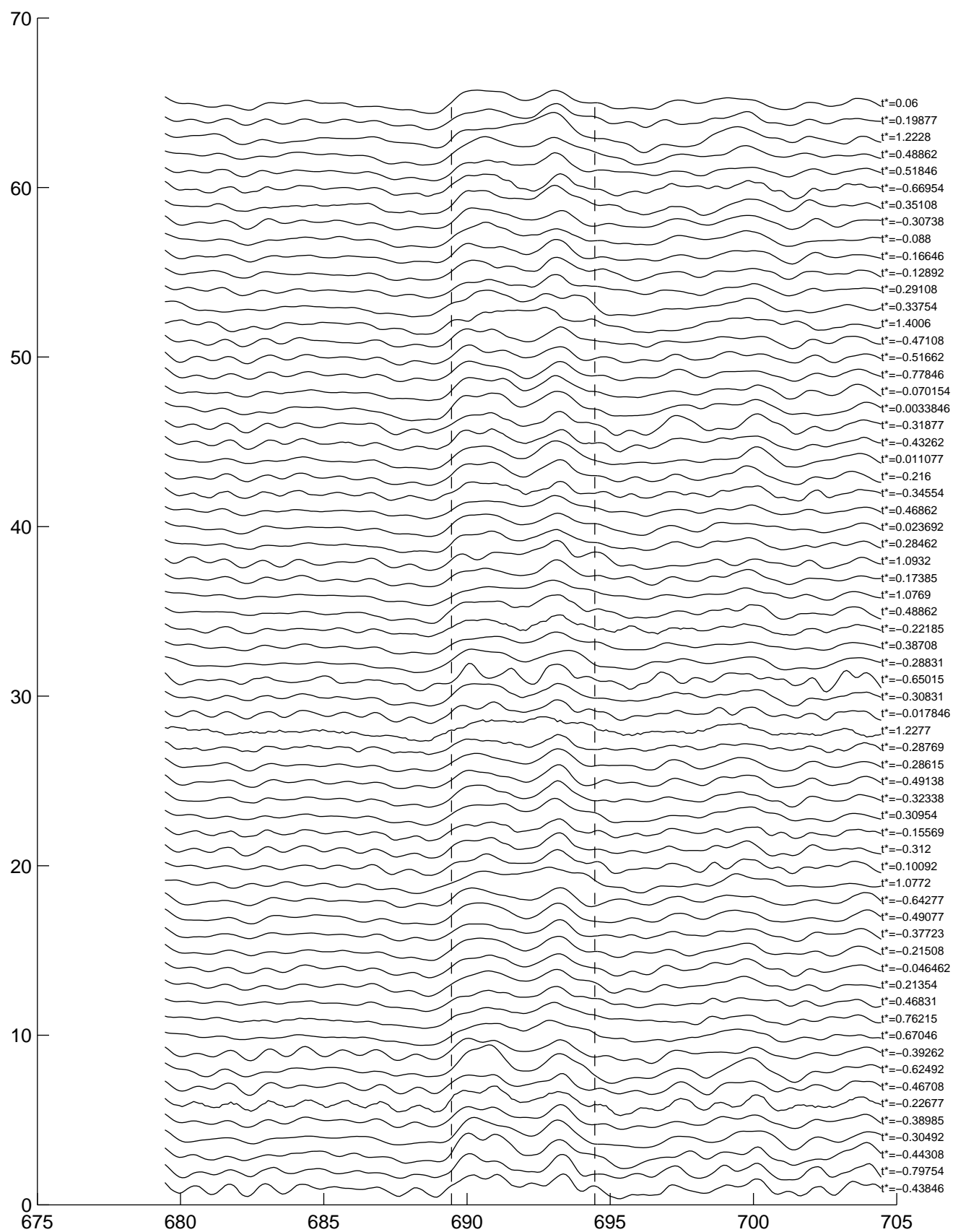
travel time residuals



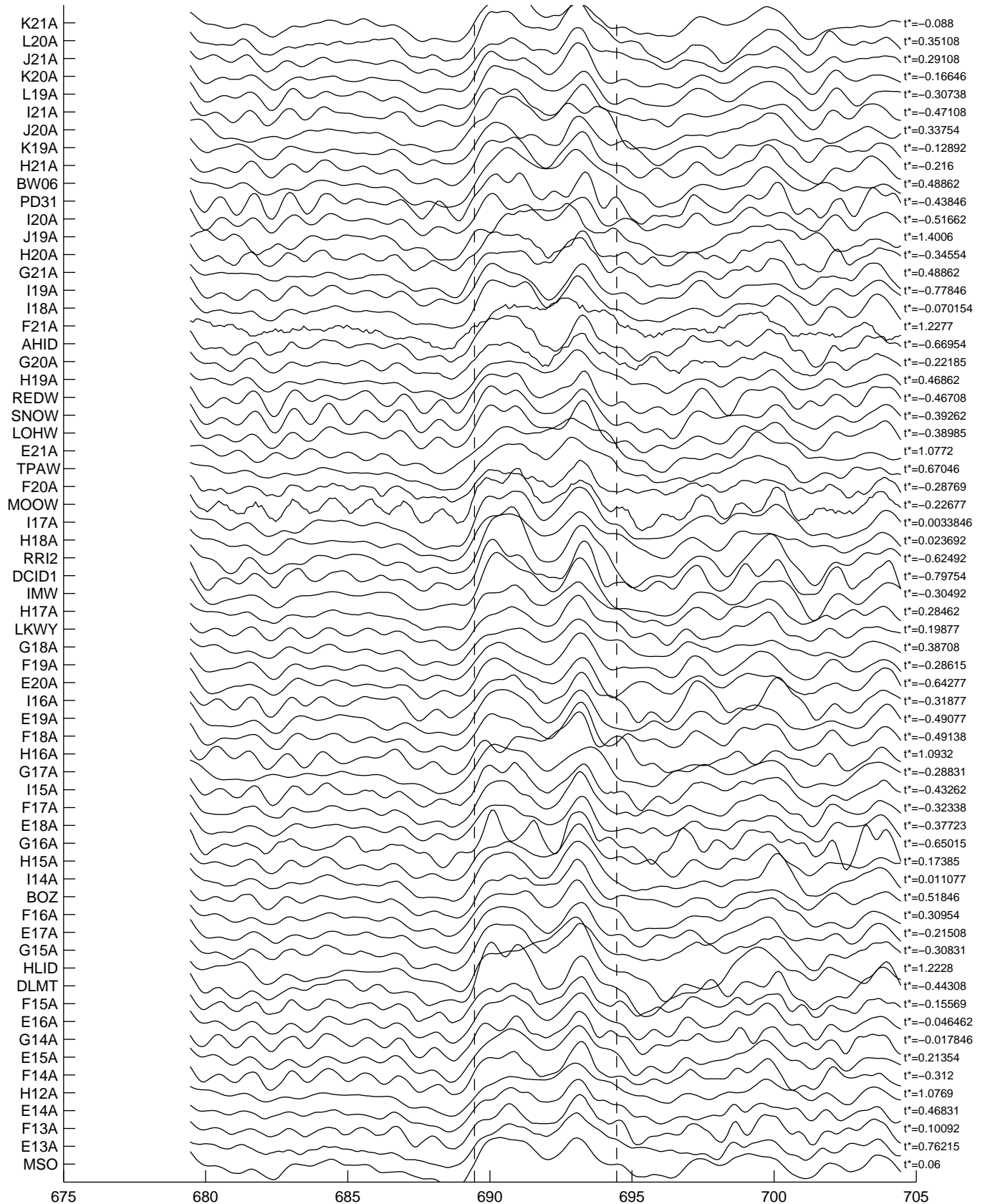
$t^*$  values



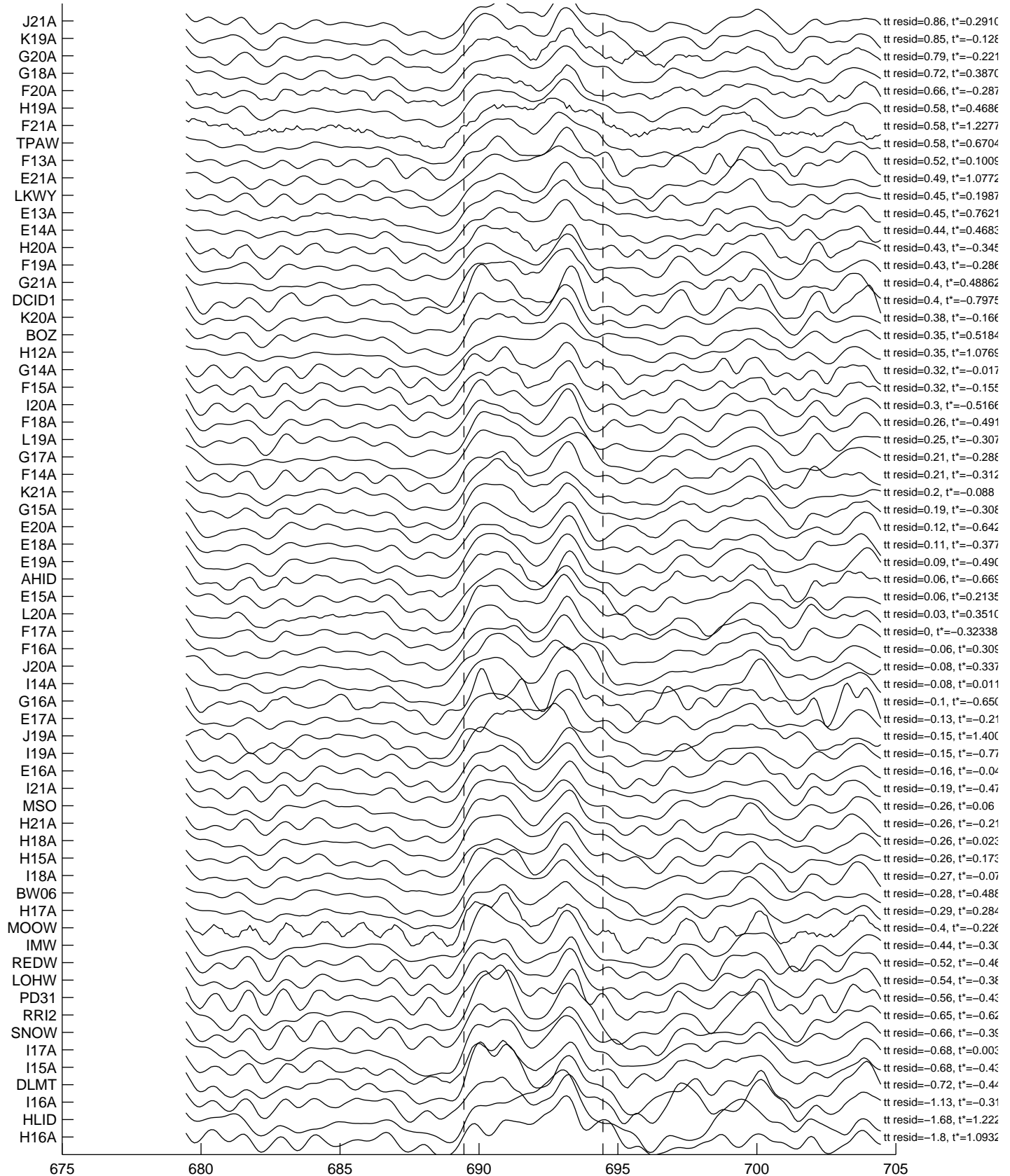
# Event\_2009\_156\_03\_30\_33



# Sorted by Delta:Event\_2009\_156\_03\_30\_33

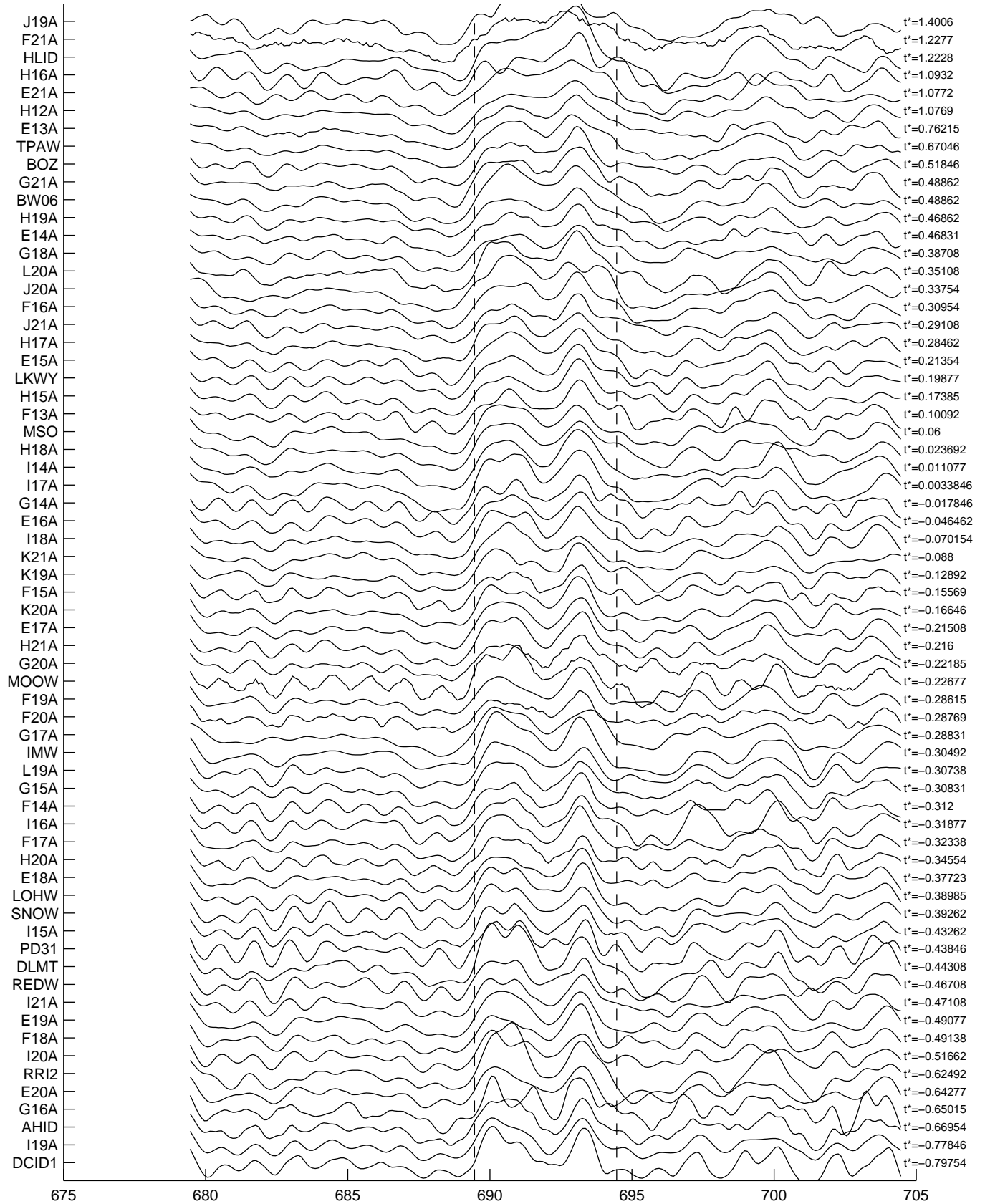


# Sorted by travel time:Event\_2009\_156\_03\_30\_33



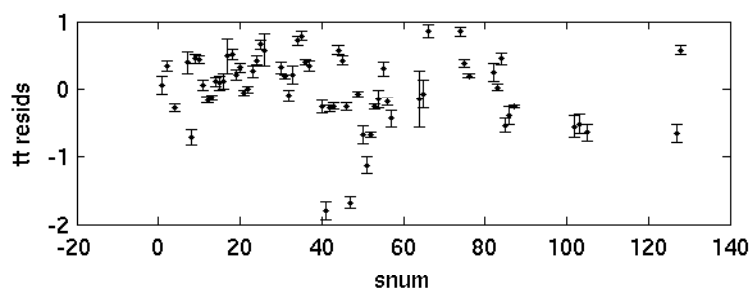
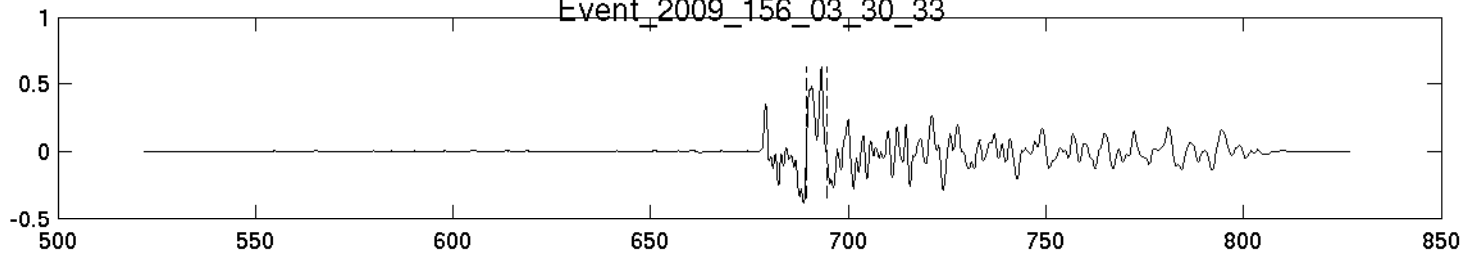


# Sorted by $t^*$ :Event\_2009\_156\_03\_30\_33

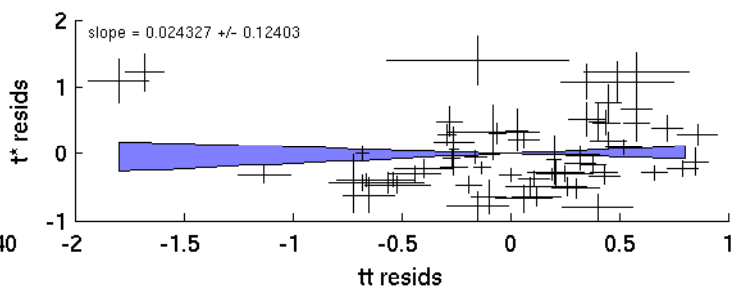
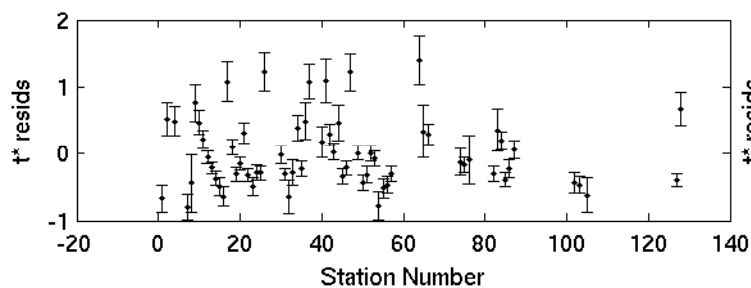




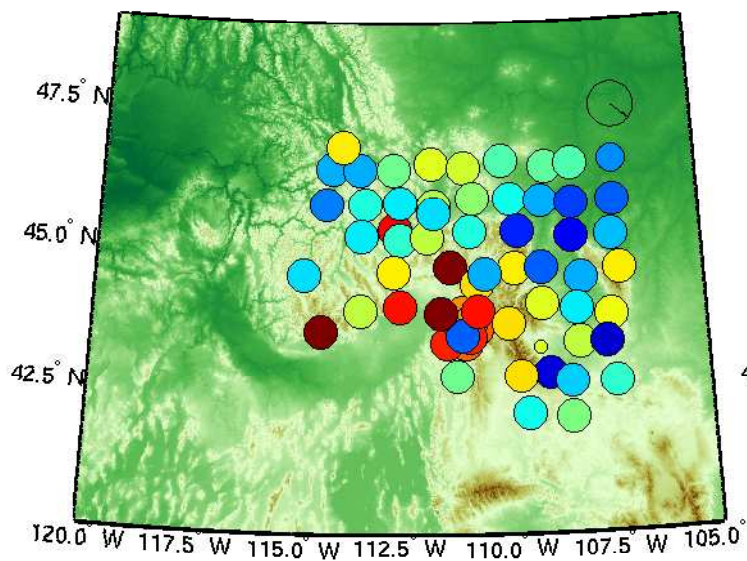
Stack  
Event\_2009\_156\_03\_30\_33



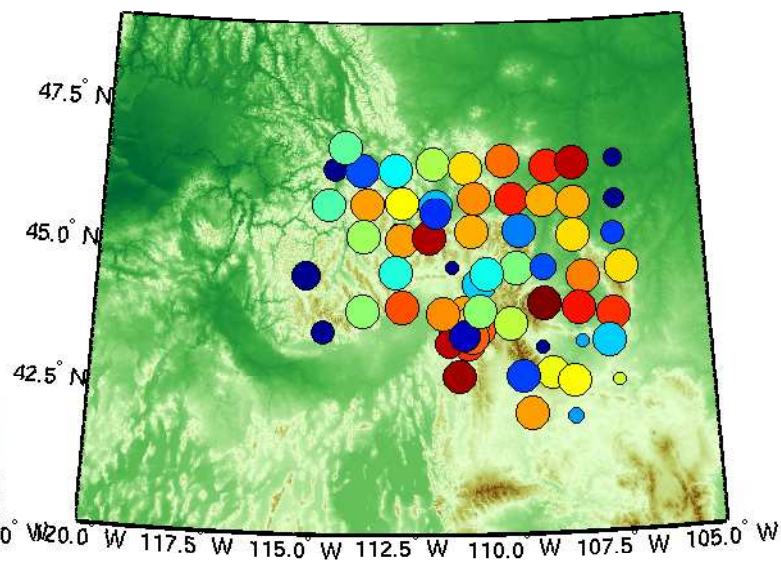
Baz = 310.8841  
Mean xcor value = 0.86385  
Range of  $t^*$  values is 2.1982  
Median  $t^*$  err is 0.14066  
Slope = 0.024327 +/- 0.12403

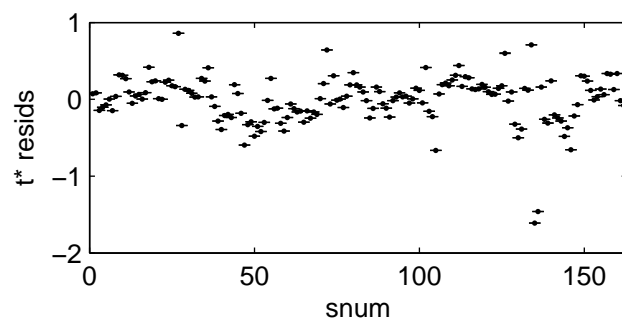
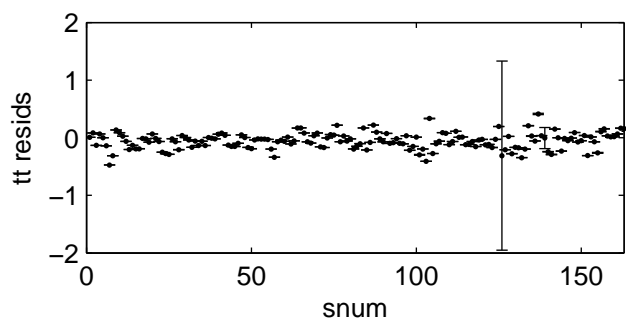
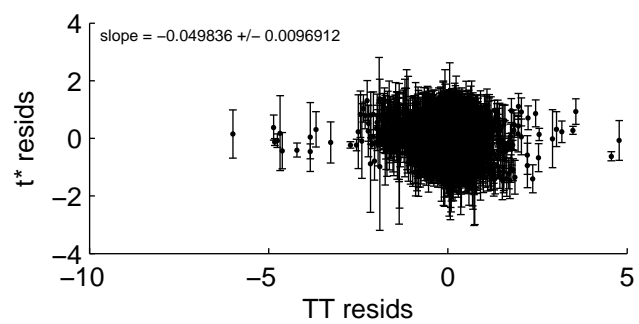
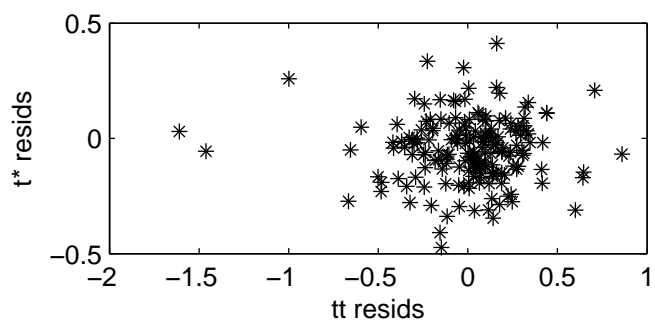


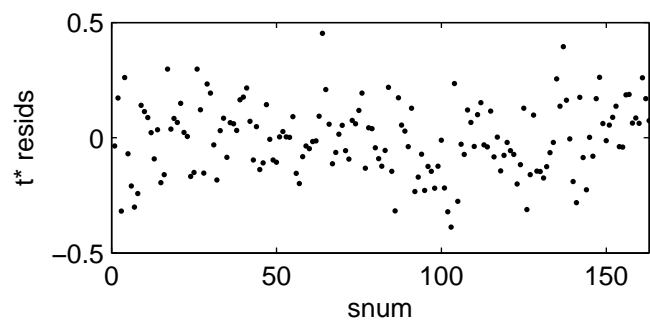
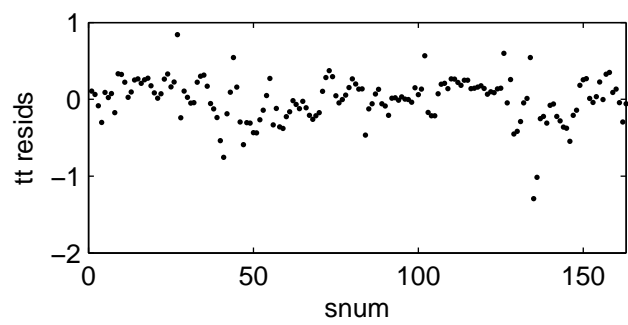
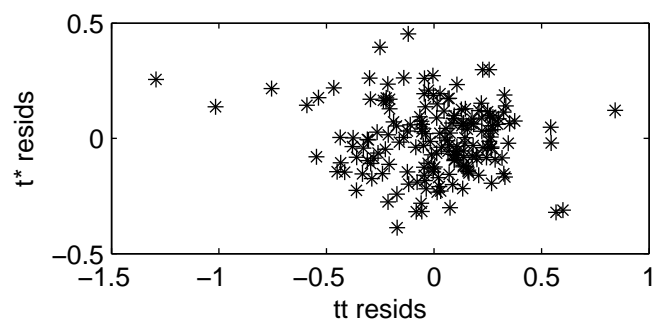
travel time residuals



$t^*$  values







ALL DATA

